NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT SECTION 7
BIOLOGICAL AND CONFERENCE OPINION

Title: Biological and Conference Opinion on Bureau of Ocean Energy Management and Bureau of Safety and Environmental Enforcement's Oil and Gas Program Activities in the Gulf of America

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List of Acronyms

ACP	Area Contingency Plan
AHTS	Anchor-Handling Towing Supply
APD	Application for Permit to Drill
AUD INJ	Auditory Injury
BA	Biological Assessment
BACT	Best Available Control Technology
BMP	Best Management Practice
BOEM	Bureau of Ocean Energy Management
BOEMRE	Bureau of Ocean Energy Management, Regulation, and Enforcement
BOP	Blowout Preventer
BSEE	Bureau of Environmental Safety and Enforcement
CAA	Clean Air Act
CCL	Curved Carapace Length
CER	Categorical Exclusion Review
C.F.R.	Code of Federal Regulations
CIE	Center for Independent Experts
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CSEM	Controlled Source Electromagnetic Survey
CPA	Central Planning Area
cSEL	Cumulative Sound Exposure Level
CWA	Clean Water Act
DOCD	Development Operations and Coordination Document
DOT	Department of Transportation
DPP	Development and Production Plan
DPS	Distinct Population Segment
DWH	Deepwater Horizon
DWOP	Deepwater Operations Plan
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EFGB	East Flower Garden Banks
EIS	Environmental Impact Statement
EP	Exploration Plan
EPA	Eastern Planning Area
EROS	Explosive Removal of Offshore Structures
ESA	Endangered Species Act
FAZ	Full Azimuth
FPSO	Floating Production and Storage and Off-loading Units

FGBNMS	Flower Garden Banks National Marine Sanctuary
G&G	Geological and Geophysical
GHG	Greenhouse Gas
GOA	Gulf of America
GoMMAPPS	Gulf of Mexico Marine Assessment Program for Protected Species
HRG	High-resolution Geophysical Survey
HPHT	High Pressure/High Temperature
ITS	Incidental Take Statement
LAA	Likely to Adversely Affect
LADC	Littoral Acoustic Demonstration Center
MARPOL	International Convention for the Prevention of Pollution from Ships
MAZ	Multi-Azimuth
mDNA	Mitochondrial DNA
MODU	Mobile Offshore Drilling Unit
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
NAAQS	National Ambient Air Quality Standards
nDNA	Nuclear DNA
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NLAA	Not Likely to Adversely Affect
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NSPS	New Source Performance Standards
NTL	Notice to Lessees and Operators
NUT	New or Unusual Technology
OBC	Ocean Bottom Cable
OBF	Oil-Based Fluid
OBN	Ocean Bottom Node
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OPA	Oil Pollution Act
OSRP	Oil Spill Response Plan
OSV	Offshore Supply Vehicle
PAH	Polycyclic Aromatic Hydrocarbon
PBF	Physical and Biological Features
PCB	Polychlorobiphenyl
PDARP	Programmatic Damage Assessment and Restoration Plan

PDC	Project Design Criteria
PEIS	Programmatic Environmental Impact Statement
PINC	Potential Incident of Non-Compliance
PM	Particulate Matter
PSD	Prevention of Significant Deterioration
PSO	Protected Species Observer
PTS	Permanent Threshold Shift
RDX	Royal Demolition Explosive or Cyclonitrite
RMS	Root Mean Square
ROV	Remotely Operated Vehicle
RPA	Reasonable and Prudent Alternative
RPM	Reasonable and Prudent Measure
RWA	Rice's Whale Area
SCL	Straight Carapace Length
SEL	Sound Exposure Level
SEMS	Safety and Environmental Management Systems
sSEL	Sound Exposure Level from a Single Pile-Driving Strike
TCW	Treatment Completion and Workover
TED	Turtle Excluder Device
TNT	Trinitrotoluene
TTS	Temporary Threshold Shift
USACE	U.S. Army Corps of Engineers
USDOC	U.S. Department of Commerce
USDOI	U.S. Department of Interior
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
UWC	Underwater Calculator
VSP	Vertical Seismic Profile
VOC	Volatile Organic Compound
WAZ	Wide Azimuth
WBF	Water-Based Fluid
WCD	Worst-Case Discharge
WFGB	West Flower Garden Banks
WPA	Western Planning Area
ZOI	Zone of Influence

1 INTRODUCTION

The Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. §1531 et seq.) establishes a national mandate for conserving and recovering threatened and endangered species of fish, wildlife, plants, and the habitats on which they depend. Section 7(a)(2) of the ESA requires Federal agencies to insure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitat. Federal agencies must do so in consultation with the National Marine Fisheries Service (NMFS) for threatened or endangered species (ESA-listed), or designated critical habitat under NMFS jurisdiction that may be affected by the action (50 C.F.R. §402.14(a)). If a Federal action agency determines that an action "may affect, but is not likely to adversely affect" endangered species, threatened species, or designated critical habitat and NMFS concurs with that determination for species under NMFS jurisdiction, consultation concludes informally (50 C.F.R. §402.14(b)).

Section 7(a)(4) of the ESA requires federal agencies to confer with the Secretary on any action that is likely to jeopardize the continued existence of proposed species or result in the destruction or adverse modification of proposed critical habitat. For actions that are not likely to jeopardize the continued existence of a proposed species or adversely modify critical habitat, a conference can be requested by the action agency, though it is not required. If requested by the federal action agency and deemed appropriate, the conference may be conducted in accordance with the procedures for formal consultation in 50 C.F.R. §402.14. An opinion issued at the conclusion of the conference may be adopted as the biological opinion when the species is listed or critical habitat is designated.

Section 7(b)(3) of the ESA requires that at the conclusion of consultation, NMFS provides an opinion stating whether the Federal agency's action is likely to jeopardize ESA-listed species or destroy or adversely modify designated critical habitat. If NMFS determines that the action is likely to jeopardize ESA-listed species or destroy or adversely modify critical habitat, NMFS provides a Reasonable and Prudent Alternative (RPA) that allows the action to proceed in compliance with section 7(a)(2) of the ESA. If incidental take is expected, section 7(b)(4) requires NMFS to provide an incidental take statement that specifies the impact of any incidental taking and includes reasonable and prudent measures to minimize such impacts and terms and conditions to implement the reasonable and prudent measures.

Updates to the regulations governing interagency consultation (50 C.F.R. part 402) were effective on May 6, 2024 (89 Fed. Reg. 24268). Because they are in effect, we are applying the updated regulations to this consultation. The 2024 regulatory changes, like those from 2019, were intended to improve and clarify the consultation process, and, with one exception from 2024 (offsetting reasonable and prudent measures), which was not applied here, were not intended to result in changes to the Services' existing practice in implementing section 7(a)(2) of the Act (89 Fed. Reg. 24268; 84 Fed. Reg. 45015). NMFS has considered the prior rules and affirm that the substantive analysis and conclusions articulated in this biological and conference

opinion and incidental take statement would not have been any different under the 2019 regulations or pre-2019 regulations.

The primary action agencies for this consultation are the United States (U.S.) Bureau of Ocean Energy Management (BOEM) and the U.S. Bureau of Safety and Environmental Enforcement (BSEE; jointly known as the "Bureaus"). The action for this consultation includes all activities regulated by the Bureaus and associated with the Outer Continental Shelf (OCS) Oil and Gas Program (hereafter referred to as "Oil and Gas Program" in this opinion) in the Gulf of America (formerly Gulf of Mexico[1]). The U.S. Environmental Protection Agency (USEPA) and NMFS' Office of Protected Resources, Permits and Conservation Division are also included as action agencies.

Oil and Gas Program activities include actions associated with all past leases operating in the Gulf of America at the time this opinion is issued, regardless of when the lease was awarded, and actions associated with new leases awarded in the Gulf of America in the first ten years following issuance of the 2020 biological opinion for oil and gas program activities (through approximately 2029). Each lease is projected to have a 40-year lifespan. Thus, the action is projected to cover 50 years (through approximately 2069). This opinion covers approximately 45 years of operations (i.e., five years of program implementation following the 2020 biological opinion). Oil and Gas Program activities include pre-lease activities related to geological and geophysical (G&G) surveys conducted under permits, prior to leasing, and activities associated with end-of-lease-life structure and equipment removal (decommissioning). This programmatic consultation considers all permitted actions and plans approved by BOEM and BSEE under the Outer Continental Shelf Lands Act (OCSLA), 43 U.S.C §1331 et seq. (2008). The Bureaus regulate air quality under the OCSLA for the OCS areas specifically west of 87.5° W longitude (43 U.S.C. §1334 (a)(8)), while the USEPA, under the Clean Air Act (CAA) is responsible for regulating air quality in areas outside of this longitude boundary (42 U.S.C. §7627 (1)(a)). Additionally, the USEPA has authority over all discharges to the waters of the OCS under the Clean Water Act (CWA).

This consultation also considers the promulgation of Federal regulations under the Marine Mammal Protection Act (MMPA) for the incidental take of marine mammals due to G&G surveys specific to the proposed Oil and Gas Program activities and subsequent issuance of letters of authorization (LOAs) by NMFS' Permits and Conservation Division.

This consultation, biological and conference opinion (hereafter, opinion), and incidental take statement (ITS), were completed by NMFS Office of Protected Resources' Endangered Species Act Interagency Cooperation Division (hereafter referred to as "NMFS" or "we") in accordance

[1] Pursuant to Executive Order 14172, "Restoring Names That Honor American Greatness," and Department of the Interior Secretarial Order 3423, "The Gulf of America," the body of water formerly known as the Gulf of Mexico is now called the Gulf of America. Accordingly, this opinion hereafter refers to the Gulf of America.

with section 7(a)(2) and 7(b) of the statute (16 USC §1536 (a)(2)), associated implementing regulations (50 C.F.R. §402), and agency policy and guidance.

On August 19, 2024, the United States District Court for the District of Maryland ruled against NMFS in *Sierra Club v. NMFS* (Case No. 8:20-cv-03060-DLB), in which plaintiffs challenged various elements of NMFS' 2020 Biological Opinion on the Oil and Gas program (D. Md. Aug. 19, 2024). The court ordered that the 2020 opinion be vacated on December 20, 2024. NMFS and intervenor-defendants moved to alter or amend the judgement in regards to the date of vacatur, and, on October 21, 2024, the court granted the motion, setting May 21, 2025 as the date on which the 2020 opinion is vacated.

This reinitiated biological opinion replaces the 2020 opinion in its entirety. This opinion incorporates updates to the best available science since 2020, including that provided by the action agencies' 2023 amended Biological Assessment, and makes changes fully addressing each of the court's findings of error in the 2020 opinion.

This document represents NMFS' opinion on the effects of the above actions on Rice's whales (*Balaenoptera ricei*; previously Gulf of Mexico Bryde's whale; *Balaenoptera edeni*), sperm whales (*Physeter macrocephalus*), Kemp's ridley sea turtles (*Lepidochelys kempii*), loggerhead sea turtles (Northwest Atlantic Distinct Population Segment [DPS], *Caretta caretta*), green sea turtles (North Atlantic DPS, *Chelonia mydas*), hawksbill sea turtles (*Eretmochelys imbricata*), leatherback sea turtles (*Dermochelys coriacea*), Gulf sturgeon (*Acipenser oxyrinchus desotoi*), oceanic whitetip shark (*Carcharhinus longimanus*), giant manta ray (*Manta birostris*), proposed critical habitat for Rice's whale, and designated critical habitat for Gulf sturgeon and green North Atlantic DPS and loggerhead Northwest Atlantic DPS sea turtles. We also considered the following species in this consultation: fin whale (*Balaenoptera physalus*), blue whale (*Balaenoptera musculus*), sei whale (*Balaenoptera borealis*), North Atlantic right whale (*Eubalaena glacialis*), queen conch (*Aliger gigas*), smalltooth sawfish (U.S. population, *Pristis pectinata*), Nassau grouper (*Epinephelus striatus*), boulder star coral (*Orbicella franksi*), elkhorn coral (*Acropora palmata*), lobed star coral (*Orbicella annularis*), mountainous star coral (*Orbicella faveolta*), and designated critical habitat for boulder star coral, lobed star coral, and mountainous star coral.

Note that, as of August 23, 2021, the common and scientific name of the Gulf of Mexico Bryde's whale (*Balaenoptera edeni*) was revised via rulemaking to Rice's whale (*Balaenoptera ricei)* to reflect the scientifically accepted taxonomy and nomenclature of the whale (86 FR 47022). We revise all references to the species in this opinion to Rice's whale accordingly.

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA; section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). A complete record of this consultation is on file electronically with

the NMFS OPR in Silver Spring, Maryland, and available in the NOAA Library Institutional Repository https://repository.library.noaa.gov/welcome.

1.1 Consultation History

Below is a brief timeline of pertinent activities as they relate to this consultation.

- February 24, 2020, and then revised and resent on March 12, 2020: BOEM sent NMFS a revised proposed action that removed a large portion of the Eastern Planning Area and a small portion of the Central Planning Area that are both under a leasing moratorium. In the letter accompanying this submission, BOEM/BSEE removed previously proposed mitigation protocols jointly developed during consultation and included as appendices to the draft opinion measures for preventing vessel strike and marine debris, as well as seismic survey measures, while leaving in effect the 2015 and 2016 Notices to Lessees and Operators (NTLs) already being implemented. Portions of these appendices were adopted by NMFS in the 2020 opinion in the RPA and ITS. BOEM removed vessel speed and nighttime vessel travel restrictions they had proposed for a portion of the Rice's whale area (RWA) from the action. NMFS incorporated such restrictions in the RPA for the RWA in the 2020 opinion.
- March 12, 2020: NMFS issued the 2020 "Biological Opinion on the Federally Managed Oil and Gas Program in the Gulf of Mexico" (NMFS 2020).
- October 21, 2020: Sierra Club, Center for Biological Diversity, Friends of the Earth, and Turtle Island Restoration Network (Plaintiffs) sued NMFS (Defendants) based on the Plaintiffs' claim that the 2020 opinion was arbitrary and capricious, and in violation of the ESA.
- April 21, 2021: NMFS amended the incidental take statement for the 2020 opinion to include additional mitigations and incorporate take exemption for marine mammals as authorized under the MMPA.
- January-March 2022: The Bureaus and NMFS participated in several meetings to complete the first programmatic annual activity review.
- October 25, 2022: The Bureaus sent a letter to NMFS formally requesting reinitiation of consultation on federally regulated offshore oil and gas activities in the Gulf of America with the intent to update the oil spill risk analysis and reexamine additional concerns raised by the litigation. The letter requesting reinitiation triggered a technical assistance period during which NMFS provided guidance to the Bureaus for the preparation of a focused biological assessment (BA).
- November 9, 2022: NMFS requested the 2020 opinion be voluntarily remanded without vacatur.

- December 2022-February 2023: Through several meetings, the Bureaus and NMFS completed the second programmatic annual activity review.
- December 5, 2022: Plaintiffs opposed NMFS' request for voluntary remand without vacatur.
- January 27, 2023: Plaintiffs, NMFS and industry intervenors began mediation as directed by the court.
- January-June 2023: NMFS held a series of calls with the Bureaus to discuss multiple topics relating to the content of the Bureaus' BA.
- August 29, 2023: The Bureaus submitted a BA to NMFS.
- September 29, 2023: NMFS responded to the initiation package with a letter to the Bureaus, noting the package was incomplete and further clarification was needed to initiate consultation.
- December 22, 2023: The Bureaus provided a final BA to NMFS.
- January 29, 2024: NMFS informed the Bureaus we had determined we had sufficient information to initiate consultation.
- May 14, 2024: BOEM provided revisions to their Focused BA regarding the final blowout rule revisions to NMFS.
- August 2, 2024: The Bureaus provided amended effects determinations for the Focused BA to NMFS.
- August 19, 2024: The Court in *Sierra Club v. NMFS* issued its opinion finding error in certain aspects of the 2020 opinion.
- September 16, 2024: NMFS filed a motion to alter the judgement to extend the date of vacatur.
- October 21, 2024: The Court granted NMFS' motion to alter and amend judgement to extend the date of vacatur of the 2020 opinion to May 21, 2025.
- December 31, 2024: The Bureaus provided the Revision to Focused BA Protocol A.6 to NMFS (BOEM and BSEE 2024).
- January 3, 2025: NMFS updated the incidental take table in the 2021 ITS amendment to reflect corrected MMPA rule.
- January 7, 2025: The Bureaus provided an Addendum to the High Pressure High Temperature (HPHT) portion of the Focused BA to NMFS.
- March 10, 2025: BOEM and BSEE granted applicant status to Chevron and several oil and gas industry associations.

- March 31, 2025: NMFS provided a copy of the Draft Biological and Conference Opinion to the Bureaus, who shared it with the applicants.
- April 2, 2025: NMFS met with the Bureaus and applicants to discuss initial questions on the draft opinion.
- April 7, 2025: NMFS received comments on the draft opinion from DOI and applicants.
- April 16, 2025: NMFS met with the Bureaus and applicants to discuss comments on the draft opinion.
- May 7, 2025: NMFS met with the Bureaus and applicants to discuss changes to the opinion's RPA since the draft opinion was initially provided.

1.2 Background

Collectively, BOEM and BSEE were part of a single agency known as the Minerals Management Service (MMS), which was renamed the Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE) on June 18, 2010. BOEMRE was reorganized, effective October 1, 2011, into the separate agencies of BOEM and BSEE. BOEM and BSEE (through their predecessor agencies) have historically consulted with NMFS under section 7 of the ESA on lease sales and five-year schedules of lease sales (now referred to as the National OCS Oil and Gas Leasing Program or National OCS Program) in the Gulf of America. Many of the leases associated with those lease sales continue to be active. The most recent programmatic consultation with NMFS resulted in a biological opinion issued in March 2020, and, prior to that, a biological opinion on the five-year schedule of Gulf of America lease sales issued in June 2007 (NMFS 2007). NMFS also issued a separate opinion for decommissioning activities in 2006, and amended that opinion's ITS to include take of sperm whales in 2008 following issuance of the MMPA take authorization (**Error! Reference source not found.**).

On April 20, 2010, the Deepwater Horizon (DWH) mobile offshore drilling unit, a dynamically positioned semisubmersible exploratory drilling rig owned by Transocean Ltd. and leased to BP Public Liability Company, exploded at approximately 9:48 p.m. CDT and began to burn uncontrollably. The explosion occurred within BP's exploration prospect, Macondo, located on a lease in the Mississippi Canyon Block 252, about 53 miles (mi; 85 kilometers [km]) southeast of the nearest land at the end of the Mississippi River's Bird's Foot Delta. The rig burned for 36 hours and, after a final explosion, sank on April 22, 2010, at 10:22 a.m. CDT in 4,992 feet (ft; 1,521 meters [m]) of water with approximately 700,000 gallons of diesel fuel on board. Eleven crew members were killed in the explosion. According to the *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan (PDARP),* 3.19 million barrels (MMbbl) of oil were released into the ocean (Trustees 2016). The DWH event resulted in litigation and, ultimately, the reinitiation of the 2007 consultation. Instead of reissuing multiple new opinions, NMFS, BOEM and BSEE agreed to evaluate all ongoing oil and gas activities, regardless of the year of the lease, in a Gulf-wide programmatic opinion.

Table 1. Completed biological opinions this consultation and biological opinion supersede

BOEM/BSEE Action	Date
Lease Sale 58	1979
Lease Sale 90	July 5, 1984
Lease Sales 110, 112	November 21, 1986
Lease sales 113, 115, 116	November 2, 1987: NMFS again confirmed concurrence on LS 116 on January 9, 2002.
Lease Sales 118, 122	August 8, 1988
Lease Sales 131, 135, 137	April 9, 1990
Lease Sale 139	February 8, 1991
Lease Sales 142, 143	August 17, 1992
Lease Sales 147, 150	July 30, 1993
Lease Sale 152, 155	October 13, 1994
Reinitiation on Lease sales from 1998-2001	December 10, 1997
Lease Sales 169, 171, 172, 174, 175, 177, 178, 180, 182	January 6, 1998 (replaced the November 2, 1987 opinion) LS 179 added to multi-year plan, NMFS concurred January 15, 1982 NMFS again reviewed LS 174 on March 29, 1996; LS 172 on November 6, 1998; LS 177 on March 30, 2000; and LS 180 on June 14, 2001.
Lease Sale 175	October 27, 1999
Destin Dome	April 13, 2000
Lease Sale 178	November 2, 2000
FPSOS (Floating, Production, Storage, and Off-loading Systems) EIS for the OCS.	November 30, 2000
Lease Sale 181	June 15, 2001
Lease Sale 184	July 11, 2002
Lease Sales 185, 190, 194, 198, 201, 187, 192, 196, 200	November 29, 2002
Lease Sales 189 and 197	August 30, 2003
Programmatic Decommissioning Activities.	August 28, 2006 (replaced all previous decommissioning and abandonment opinions) ITS amended June 20, 2008
Lease Sales 204, 205, 206, 207, 208, 210, 213, 215, 216, 218, 222	June 29, 2007 BOEM added Lease Sale 224 to the 5-year plan and NMFS reviewed on October 9, 2007.

BOEM/BSEE Action	Date
Programmatic Oil and Gas Activities over 50 years	March 13, 2020 replaced all prior consultations for a comprehensive approach; ITS amended April 24, 2021

On June 30, 2010, the Natural Resources Defense Council (NRDC) and other environmental non-governmental organizations (NGOs; the plaintiffs) filed suit [*NRDC v. Salazar*, No. 2:10-cv-01882 (E.D. La.)] against the U.S. Department of the Interior (DOI) alleging BOEM (then BOEMRE) violated the National Environmental Policy Act (NEPA) by issuing authorizations for seismic surveys in the Gulf of America without a sufficient NEPA analysis. A settlement agreement was entered on June 25, 2013. The agreement stayed the litigation and required that BOEM make its best effort to facilitate completion of Final Action on its MMPA application during the stay. If such final action was issuance of an MMPA take authorization, it would be accompanied by:

- Completion of an Environmental Impact Statement (EIS)/Record of Decision or Environmental Assessment (EA)/Finding of "No Significant Impact" for G&G activities in the Gulf in support of MMPA application (i.e., Programmatic EIS or PEIS).
- Conclusion of ESA consultation pursuant to section 7 through either the issuance of an ESA biological opinion or a "not likely to adversely affect" concurrence letter from NMFS.

The duration of the stipulated stay was extended by joint agreement of the parties and approval by the court several times. On September 27, 2017, the court approved the parties' motion for approval of the second stipulated amendment of the settlement agreement. This amendment continued the stay of litigation until November 1, 2018, and allowed plaintiffs to amend their lawsuit to include NMFS as a defendant based on a claim of undue delay in making a determination on BOEM's MMPA permit application. In addition to the continuing obligations on BOEM listed above, the subsequent amendment required that, by March 13, 2020, NMFS complete any of the following final actions on BOEM's permit application: (1) a final decision by NMFS denying BOEM's MMPA Application; (2) BOEM's withdrawal of the Pending Application or any revision thereof, unless a revised application that is substantively the same in scope as the Pending Application is submitted to NMFS within 14 days after the Pending Application or any revision thereof is withdrawn; or (3) NMFS's submission of a final MMPA rule or regulation to the Federal Register in response to BOEM's MMPA Application, preceded or accompanied by (a) a biological opinion or "not likely to adversely affect" concurrence letter from NMFS concluding consultation pursuant to Section 7(a)(2) of the ESA and (b) an Environmental Impact Statement ("EIS")/Record of Decision ("ROD") or Environmental Assessment ("EA")/Finding of No Significant Impact ("FONSI") prepared pursuant to NEPA.

The 2020 biological opinion represented NMFS' final action component (3)(a) of the settlement agreement. The DWH oil spill changed the environmental baseline in the Gulf of America and

exceeded the effects to ESA-listed species evaluated in the 2007 opinion to an extent that required BOEM and BSEE to reinitiate consultation on oil and gas activities in the Gulf of America. The changes to the baseline also affected the analyses in biological opinions on five-year lease sale programs issued prior to 2007. Instead of reissuing multiple new opinions, NMFS, BOEM and BSEE agreed to evaluate all ongoing oil and gas activities, regardless of the year of the lease, in a Gulf-wide programmatic opinion. The 2020 programmatic opinion superseded all prior opinions issued to BOEM, BSEE, or their predecessor agencies for oil and gas activities in the Gulf of America, as does this opinion. Therefore, this opinion, which is a reinitiation of the analysis conducted in 2020, necessary to comply with the court's ruling in *Sierra Club v. NMFS*, analyzes the effects of all on-going and future oil and gas activities related to leases awarded through 2029 on ESA-listed listed species and designated and proposed critical habitat in the entire Gulf of America. During consultation, we considered the effects of all stages of the leasing program, including G&G survey activities that may be permitted by the action agencies, regardless of whether they occur pre- or post-lease, development, and decommissioning. Given the generally expected 40-year lifetime of each individual lease (through decommissioning), this opinion analyzes effects over approximately the next 45 years.

The USEPA administers the CWA in the Gulf of America for federal waters seaward of the Gulf states' territorial seas as defined in the CWA Section 502 (8), 33 USC 1362(8), and the CAA east of 87.5°W longitude for oil and gas-related activities on the OCS. The USEPA issues CWA National Pollutant Discharge Elimination System (NPDES) general permits for discharges to these Gulf of America waters from offshore oil and gas-related activities. Less commonly, the USEPA may also issue an individual NPDES permit. An OCS lessee or operator, as an individual applicant, submits a notice of intent (NOI) to USEPA if they intend to make any discharges covered under the NPDES general permits. The USEPA also issues air quality permits to individual applicants within Gulf of America OCS areas under the CAA (i.e., east of 87.5°W longitude), while BOEM regulates air quality west of 87.5°W longitude under the OCSLA. As for previous ESA section 7 consultations with BOEM and BSEE, this consultation considers the effects of air emissions and discharges to OCS waters resulting from oil and gas activities permitted by the USEPA as an action resulting from BOEM-approved leases on the OCS in the Gulf of America.

On January 19, 2021, the NMFS Permits and Conservation Division issued a final rule for "Taking Marine Mammals Incidental to Geophysical Surveys Related to Oil and Gas Activities in the Gulf of Mexico" ("MMPA seismic rule") that was subsequently updated in 2024. The update resulted from the discovery of errors in the estimates of incidental take of marine mammals anticipated from the activities analyzed for the 2021 regulations, but was still within the scope of what was analyzed in the 2020 programmatic opinion. The NMFS Permits and Conservation Division's action was considered in the 2020 opinion and the ITS revised in 2021 when the MMPA seismic rule was promulgated, and again in 2025 to reflect updates in take estimates from the 2024 revisions to the MMPA seismic rule. The MMPA seismic rule covers a five-year period.

2 THE ASSESSMENT FRAMEWORK

Section 7(a)(2) of the ESA requires Federal agencies, in consultation with NMFS, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species; or destroy or adversely modify their designated critical habitat.

"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 an ESA-listed species in the wild by reducing the reproduction, numbers, or distribution of that species." (50 C.F.R. §402.02).

"Destruction or adverse modification" means a direct or indirect alteration that appreciably diminishes the value of designated critical habitat as a whole for the conservation of a listed species (50 C.F.R. §402.02).

The final designations of critical habitat for green (North Atlantic DPS only but new critical habitat is proposed for this and other DPSs), leatherback, and loggerhead sea turtles and Gulf sturgeon used the term primary constituent element (PCEs) or essential features. The new critical habitat regulations [81 FR 7414 (Feb. 11, 2016)] replace this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a destruction or adverse modification analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this opinion, we use the term PBFs to mean PCEs or essential features, as appropriate for the specific critical habitat.

Our ESA section 7 assessment involves the following steps:

Programmatic Consultation Requirements and Procedures (Section 2.1) and *Description of the Action* (Section 3): We identify programmatic consultation requirements and procedures and describe the action, and identify PDCs. In this programmatic consultation, a supplemental description of the action includes a description of the activities that occur during oil and gas exploration, development and production, and decommissioning. We discuss the potential stressors we expect to result from the Bureaus' regulated activities, including describing unplanned, but reasonably foreseeable incidences of oil spills, and associated regulatory requirements to prevent spills. This section also includes the PDCs for avoidance and minimization of impacts to ESA-listed species and designated critical habitat, and information regarding the procedures for submitting information for consistency or project-specific review and tiered consultation requests, and for submitting reports as part of regular reviews under the programmatic consultation, including any changes to these procedures since the 2020 opinion.

Action Area (Section 4): We describe the full spatial extent of the action area based on those aspects (or stressors) of the action that may have effects on the physical, chemical and biotic environment, which includes coastal areas and into Mexican waters. This section also incorporates maps and any area restrictions proposed by the action agencies.

Stressors Created by the Activities (Section 5): We crosswalk the activities of the action with the stressors those activities create. This organizes the stressors for our later evaluation of potential effects to ESA-listed species and designated critical habitat. For example, the stressor of sound may result from numerous activities in different phases of the program. However, the effects of sound on ESA-listed animals are independent of the activity. Hence, in our *Effects of the Action* (Section 8) we summarize the effects based on the stressor rather than on the activity that created it.

Species and Designated Critical Habitat Evaluated (Section 6): We identify the ESA-listed species and designated or proposed critical habitat that are likely to co-occur with identified stressors in space and time and evaluate the status of those species and habitats. In Section 6.1, we identify ESA-listed species and designated critical habitat not likely to be adversely affected. In Section 6.2, we identify and describe ESA-listed species and designated or proposed critical habitat that are likely to be adversely affected, and provide relevant information on their status, biology, ecology, and life history.

Environmental Baseline (Section 7): We describe the environmental baseline as the condition of the listed species or its designated or proposed critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the components of the action that are the focus of this opinion. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to 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 C.F.R. §402.02).

Effects of the Action (Section 8 and 9): Effects of the action are all consequences to listed species or designated critical habitat that are caused by the components of the action considered in this consultation, including the consequences of other activities that are caused by the action. A consequence is caused by the action if it would not occur but for the 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 C.F.R. §402.02). Based on the stressors identified for the components of the action subject to this consultation, and the ESA-listed species and critical habitat that are likely to be affected by those stressors, we describe the effects of the stressors on those species in Section 8 and on critical habitat in Section 9. Our analysis is inclusive of any existing or proposed measures that will be taken to mitigate or minimize exposure of ESA resources to the stressors. We conduct an exposure analysis to identify the ESA-listed species and critical habitat that are likely to co-occur with the actions' effects on the environment in space and time, and identify the nature of that co-occurrence. The exposure analysis also identifies, as possible, the number, age or life stage, and gender of the

individuals likely to be exposed to the actions' effects and the population(s) or subpopulation(s) those individuals represent, and the PBFs of critical habitat units. We evaluate the available evidence to determine how individuals of ESA-listed species and PBFs of designated or proposed critical habitat are likely to respond given their probable exposure. This is our response analysis.

Cumulative Effects (Section 10): Cumulative effects are the effects to ESA-listed species and proposed or designated critical habitat of future state or private activities that are reasonably certain to occur within the action area (50 C.F.R. §402.02). Effects from future Federal actions that are unrelated to the action are not considered because they require separate ESA section 7 compliance.

Integration and Synthesis (Section 11): In these sections, we add the effects of the action and cumulative effects to the environmental baseline, and, in light of the status of the species and critical habitat, analyze whether the action is likely to jeopardize the continued existence of listed species or destroy or adversely modify critical habitat.

Conclusion (Section 12): We summarize the results of the integration and synthesis as to whether the action could reasonably be expected to:

- Reduce appreciably the likelihood of survival and recovery of proposed or ESA-listed species in the wild by reducing its numbers, reproduction, or distribution, and state our conclusion as to whether the action is likely to jeopardize the continued existence of such species; or
- Appreciably diminish the value of designated critical habitat for the conservation of an ESA-listed species, and state our conclusion as to whether the action is likely to destroy or adversely modify designated critical habitat.

Reasonable and Prudent Alternative (Section 13): If, in completing the last step in the analysis, we determine that the action under consultation is likely to jeopardize the continued existence of ESA-listed or proposed to be listed species or destroy or adversely modify designated critical habitat, then we must identify a RPA(s) to the action, if any, that would allow the action to proceed without jeopardizing listed species and/or destroying or adversely modifying critical habitat, or indicate that to the best of our knowledge there are no RPAs. See 50 C.F.R. §402.14.

Incidental Take Statement (Section 14): For a programmatic consultation, an ITS is included for those actions for which we can determine take of ESA-listed species is reasonably certain to occur. The ITS specifies the impact of the take, reasonable and prudent measures necessary and appropriate to minimize the impact of the take, and terms and conditions to implement the reasonable and prudent measures, procedures for handling injured or dead species, and requirements for monitoring and reporting take (ESA section 7 (b)(4); 50 C.F.R. §402.14 (i)) for actions that do not violate section 7(a)(2) of the ESA or for an alternative action that does not violate section 7(a)(2) of the ESA. We also provide discretionary *Conservation Recommendations* (Section 15) that may be implemented by the action agency. 50 C.F.R.

§402.14 (j). Finally, we identify the circumstances in which reinitiation of consultation is required (Section 16) 50 C.F.R. §402.16.

References (Section 17): To comply with our obligation to use the best scientific and commercial data available, we collected information through searches of *Google Scholar*, *Web of Science*, literature cited sections of peer reviewed articles, species listing documentation, and reports published by government and private entities. This opinion is based on our review and analysis of various information sources, including:

- Information submitted by the Bureaus, including required programmatic reporting as part of implementation of the 2020 opinion;
- Government reports (including NMFS biological opinions and stock assessment reports);
- National Oceanic and Atmospheric Administration (NOAA) technical memoranda;
- Peer-reviewed scientific literature; and
- External agency or entity data, as available, to assist in the consideration of secondary effects, such as those associated with vessel traffic.

These resources were used to identify information relevant to the potential stressors and responses of ESA-listed species and designated critical habitat under NMFS' jurisdiction that may be affected by the action to draw conclusions on risks the action may pose to the continued existence of these species and the value of designated critical habitat for the conservation of ESA-listed species.

2.1 Programmatic Consultation Requirements and Procedures

Programmatic consultations typically include:

- Non-discretionary PDCs that describe aspects of the action required for all projects implemented under the program, to avoid or minimize adverse effects on listed species and designated critical habitat (Section 3).
- Procedures for streamlined project-specific review and, when necessary, consultation (Section 3).
- Periodic comprehensive review of the program (Section 3).
- Description of the manner in which projects to be implemented under the programmatic consultation may affect listed species and critical habitat, and evaluation of expected level of effects from covered projects (Section 8 Effects of the Action on ESA-Listed Species).
- Process for evaluation of the aggregate or net additive effects of all projects expected to be implemented under the programmatic consultation, including any RPA (Sections 8 through 13). The programmatic consultation document must demonstrate that, when the PDCs, RPA, Reasonable and Prudent Measures and Terms and Conditions are applied to each project, the aggregate effect of all projects is not likely to jeopardize listed species or destroy or adversely modify their critical habitat, as applicable.
- Procedures for tracking and monitoring projects and validating effects predictions, are also in the ITS, including its Reasonable or Prudent Measures (RPMs) and associated Terms and Conditions (Section 14).

Actions outside the scope of this opinion will be appropriately evaluated when proposed. If a federal action (as defined in 50 C.F.R. 402.02) may affect listed species or critical habitat and is outside the scope of this Opinion, the action agency would need to request a separate ESA section 7 consultation. Such actions are not addressed by this opinion.

2.2 Definition of Take

Section 3 of the ESA defines take as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. We categorize two forms of take, lethal and sublethal take. Lethal take is expected to result in immediate, imminent, or delayed but likely mortality. Sublethal take is when effects of the action are below the level expected to cause death, but are still expected to cause injury, harm, or harassment.

On October 21, 2016, NMFS issued interim guidance in a policy directive on the term “harass,” defining it as to “create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering.” NMFS issued a revised policy directive in 2023, affirming this definition of harass, concluding “In practice, this may result in different outcomes under the MMPA and

ESA analyses of an action, depending on the record in the particular matter." For this consultation, we rely on this definition of harass when assessing effects to all ESA-listed species except marine mammals.

To assess harassment under the ESA, we use the following criteria:

1) Whether an animal is likely to be exposed to a stressor or disturbance (i.e., an annoyance);

2) The nature of that exposure in terms of magnitude, frequency, duration, etc. Included in this may be type and scale, as well as considerations of the geographic area of exposure (e.g., is the annoyance within a biologically important location for the species, such as a foraging area, spawning/breeding area, or nursery area?);

3) The expected response of the exposed animal to a stressor or disturbance (e.g., startle, flight, alteration [including abandonment] of important behaviors); and;

4) Whether the nature and duration or intensity of that response is a significant disruption of those behavior patterns which include, but are not limited to, breeding, feeding, or sheltering, resting or migrating, as described above in this memorandum).

For this consultation, as for the 2020 opinion, we do not rely on the NMFS ESA definition of harass when assessing effects to marine mammals. This is because the 2020 opinion was the result of a consultation initiated soon after the 2010 DWH event. As such, data collection, modeling, and environmental document preparation on marine mammal take was completed, including as part of the supplemental information provided with BOEM's biological assessment, prior to issuance of the interim and final NMFS ESA harass guidance. The 2020 opinion, and this consultation, considered MMPA Level B harassment estimates as a reasonable approximation given the overlap in the MMPA and ESA definitions to determine the extent of ESA take resulting from harassment.

Under the MMPA, harassment is defined as any act of pursuit, torment, or annoyance which:

- has the potential to injure a marine mammal or marine mammal stock in the wild (Level A Harassment); or
- has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B Harassment). Under NMFS regulation, Level B harassment does not include an act that has the potential to injure a marine mammal or marine mammal stock in the wild.

NMFS' guidance notes that ESA harassment does not specifically equate to MMPA Level A or Level B harassment, but shares some similarities with both levels in the use of the terms 'injury/injure' and a focus on a disruption of behavior patterns. In this opinion, and the 2020 programmatic, available data and models that provide estimates of MMPA Level B harassment were used to determine how many of the estimates correspond to ESA harassment of ESA-listed

marine mammals, whereas available data and models that provide estimates of MMPA Level A harassment are considered to be instances of harm and/or injury under the ESA, depending on the nature of the effects.

After the 2020 opinion was issued, an error was discovered in how BOEM's reduction in exposures for the removal of the "Gulf of Mexico Energy Security Act" (GOMESA) area (now the Presidential withdrawal[2] area) was calculated, and BOEM subsequently provided updated corrected numbers to NMFS on September 3, 2021.

The acoustic exposure modeling described in the 2020 opinion was redone in support of the 2024 final corrective revised seismic rule using the BOEM-provided activity levels from the 2021 letter noting an error in BOEM's calculation of the reduction in exposures for the removal of the GOMESA area, now the Presidential withdrawal area[3] (JASCO 2022). The MMPA seismic rule was revised to reflect the recalculated exposure amounts for marine mammals. The effects analysis in this opinion considered the revised MMPA Level B estimates to determine the extent of ESA take resulting from harassment, which is also reflected in the ITS.

The updated acoustic model determines exposures based on the revised, BOEM-provided activity levels for a specified geophysical survey type. The acoustic model considers behavioral characteristics of marine mammals and a smaller array size (5,110 cubic inch [in^3]) to account for the typical array size used in the Gulf of America. This smaller array size allows for a more realistic account of the potential nature of exposure in terms of magnitude, frequency, and duration, and provides a metric for the expected response to geophysical survey noise.

3 DESCRIPTION OF THE ACTION

Action means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies in the United States or on the high seas. Examples include, but are not limited to: 1) actions intended to conserve listed species or their habitat; 2) the promulgation of regulations; 3) the granting of licenses, contracts, leases, easements, rights-of-way, permits, or grants in aid; or 4) actions directly or indirectly causing modifications to the land, water, or air (50 C.F.R. §402.02).

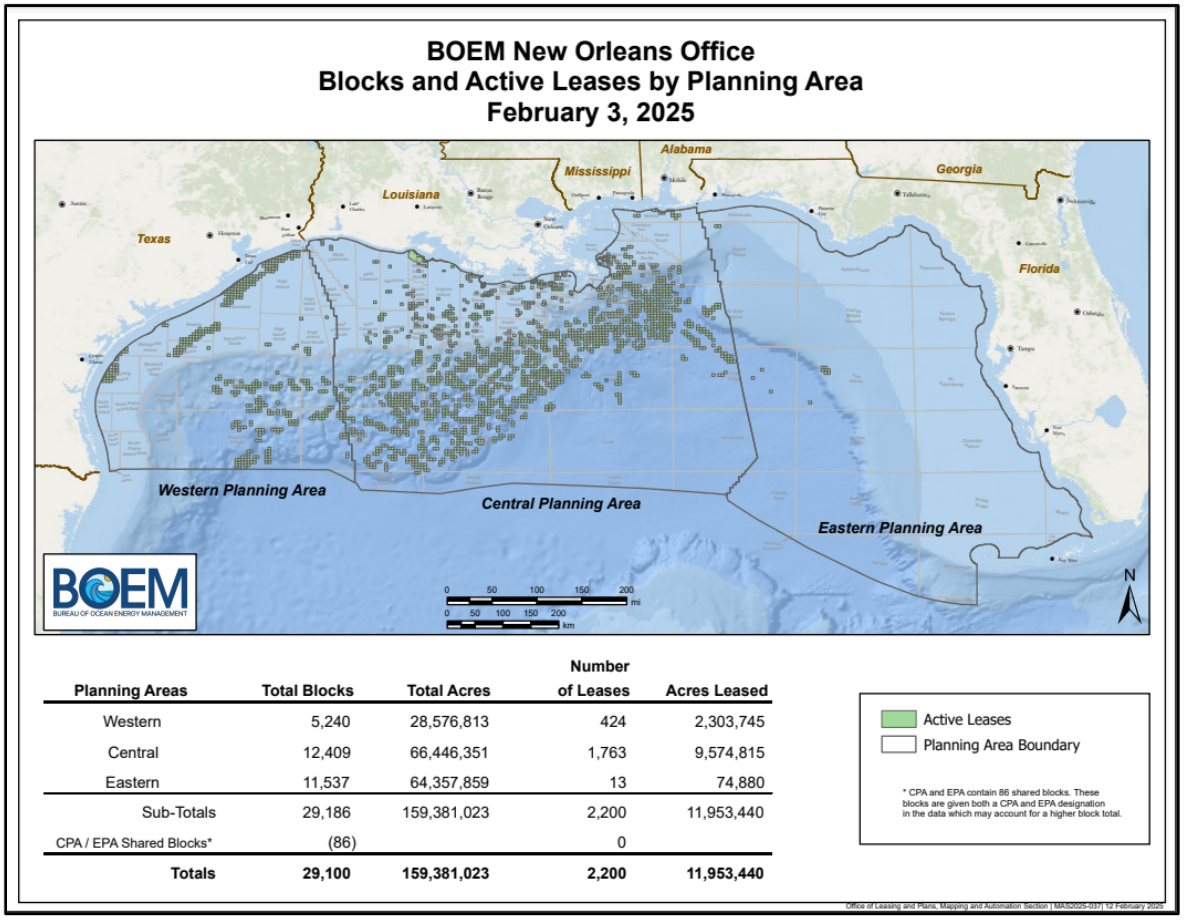
This consultation and opinion focus on the ongoing or future oil and gas-related program activity on the OCS in the Gulf of America authorized by either BOEM or BSEE. This opinion supersedes all previous section 7 consultations completed under the ESA for BOEM and BSEE (or their predecessor agencies). The scope of this consultation is DOI's management and regulation of OCS oil and gas-related activities under the OCSLA from 2025 through 2029

[2] https://trumpwhitehouse.archives.gov/presidential-actions/memorandum-withdrawal-certain-areas-united-states-outer-continental-shelf-leasing-disposition/

[3] On December 20, 2006, President Bush signed into law the GOMESA, which made available new areas for leasing in the EPA and placed a moratorium on other areas in the Gulf of America through June 30, 2032. This area was withdrawn from leasing on September 8, 2020, by the Trump Administration using authority under Section 12(a) of the OCSLA (43 U.S.C. § 1341(a)) through June 30, 2032.

analyzed in the 2020 opinion (because the timing of the program has not changed). For this consultation, the Bureaus' focused BA with appendices, several Programmatic EISs, and other supplemental information was used in this description of the action. The sections pertaining to USEPA and NMFS' Permits and Conservation Division actions rely on information provided for the 2020 opinion and we have updated some of the analyses related to these agencies, but the focus of this opinion is on BOEM and BSEE actions. For this consultation, as for the 2020 consultation, BOEM, BSEE, and NMFS determined a comprehensive, Gulf-wide, programmatic consultation approach is most efficient for analyzing the effects of the Oil and Gas Program activities.

For oil and gas leasing purposes, the Gulf of America is divided into three geographic leasing areas: the Western Planning Area (WPA), the Central Planning Area (CPA), and the Eastern Planning Area (EPA; Figure 1). This consultation considered all areas under federal jurisdiction that encompass all activities associated with the oil and gas program in the WPA, CPA and a small portion of the EPA that is not under moratorium. The five-year leasing schedules are projected by BOEM for each planning area (BOEM 2023a). BOEM has provided reasonably foreseeable projections for the likely leasing scenarios and activities related to such lease sales for five years from the date of issuance of the opinion (approximately 2029) for inclusion in this reinitiated consultation (BOEM and BSEE 2024). This opinion analyzes effects for the five-year leasing schedule, plus the 40-year projected life of a given lease, for a total of 45 years.



Planning Areas	Total Blocks	Total Acres	Number of Leases	Acres Leased
Western	5,240	28,576,813	424	2,303,745
Central	12,409	66,446,351	1,763	9,574,815
Eastern	11,537	64,357,859	13	74,880
Sub-Totals	29,186	159,381,023	2,200	11,953,440
CPA / EPA Shared Blocks*	(86)		0	
Totals	**29,100**	**159,381,023**	**2,200**	**11,953,440**

Figure 1. Leases currently active in each planning area of the Gulf of America (Map available at https://www.boem.gov/Gulf-of-Mexico-Region-Lease-Map/)

Projections of activities related to permitting and plan approvals for OCS oil and gas activities, including those resulting from all prior active leases and future lease sales (Table 2), as well as projections for G&G activities (Table 3) and bottom impacts (Table 4), are within the scope of this opinion. As noted, a lease life is typically up to 40 years from lease sales held in 2029, which is the end of the ten-year lease sale period considered in the 2020 opinion (five-year period remaining that is considered in this opinion). In addition, BOEM has the authority to extend the term of a lease if it continues to be actively producing. All plans and permits receive environmental review by the Bureaus, and some actions require further biological review by the Bureaus depending on their potential to result in effects to ESA-listed species or their habitats.

Table 2. Summary of projected annual activity levels by depth zone for the Central Planning Area (CPS) and Western Planning Area (WPA) of the action area (Based on BSEE analysis of activity levels and trends from 2012 to 2022)

Activity	WPA	WPA	WPA	WPA	WPA	CPA	CPA	CPA	CPA	CPA	Total Action Area[1]
Depth (m)	0-60	61-200	201-800	801-1,600	>1,600	0-60	61-200	201-800	801-1,600	>1,600	All
Exploration and Delineation Wells	0	0	0-1	0	0-3	0-1	0-2	0-1	0-2	12-27	12-36
Development and Production Wells	0-3	0-2	0-1	0	1-3	1-20	4-27	6-28	1-4	14-24	26-111
Permanent Plug and Abandoned Wells	6-23	16-69	2-44	0-3	4-11	68-181	70-215	29-99	0-24	34-57	230-725
Installed Production Structures	0-1	0-1	0-1	0-1	0-1	0-4	0-5	0-2	0-1	0-2	0-5
Major modification of Production Structures	0-2	0-1	0-1	0-1	0-1	0-16	0-19	0-23	0-2	0-7	0-25
Total Production Structures Removed	1-11	5-18	0-7	0-1	0-1	27-108	24-58	4-12	0-1	0-1	60-110
Production Structures Removed Using Explosives	0-3	0-5	0-1	0	0	4-26	3-15	0-3	0	0	5-25
Subsea Structures Installed	0-1	0-1	0-1	0-1	0-1	0-1	2-3	1-2	0-1	9-20	12-32
Subsea Structures Removed	0-1	0-1	0-1	0-1	0-1	0-2	0-3	0-2	0-1	2-15	2-21
Method of Transportation % Piped[2]	9S-100%	9S-100%	9S-100%	100%	100%	9S-100%	9S-100%	9S-100%	100%	100°/4	>99%
Method of Transportation % Barged	0-2%	0-2%	0-2%	0%	0%	0-2%	0-2%	0-2%	0%	0%	<1%
Method of Transportation %Tankered[3,4]	0%	0%	0%	0%	<1%	0%	0%	0%	0%	<1%	<1%
Length of Installed Pipelines (km)[5]	0-7	0-6	0-2	0-1	0-2	0-38	0-92	0-68	0-27	0-758	0-1,001
Subsea Pipeline Repairs or Modifications[6]	-	-	-	-	-	-	-	-	-	-	340-447
Length of Decommissioned Pipelines In-place (km)	22--65	0-181	0-85	0-25	0-98	98-482	178-342	81-188	16-119	0-595	394-2,179
Length of Decommissioned Pipelines Removed (km)	0-4	0-8	0-2	0-1	0-1	5-42	0-13	0-8	0-1	0-4	5-83

Activity	WPA	WPA	WPA	WPA	WPA	CPA	CPA	CPA	CPA	CPA	Total Action Area[1]
Service-Vessel Trios (1,000s)[7]	1-15	1-8	<1-2	<1-3	<1-2	21-77	13-35	3-6	5-8	4-8	47-163
Helicopter-Operations (1,000s)[8]	<1-1	<1-1	<1	<1-2	<1-3	<1-5	<1-6	<1-1	1-4	7-13	9-36

[1]Totals may not equal sum of all planning area and depth categories because maximum activity levels in each category are unlikely to occur across the Total Action Area. Totals based on historical leasing trends, drilling trends, oil and gas discovery volumes, production activity and other BOEM short-term forecasts as data and information used as input for the forecast models. Division among depth zones and planning area based on relative activity levels.
[2]100 percent of gas assumed to be piped.
[3]Tankers are forecasted to occur only in water depths >1,600m, otherwise pipelines are used.
[4]Tankers transport oil and gas; however, they are not regulated by BOEM or within the scope of the activities to be analyzed in the Bureaus' BA (i.e., not part of the action).
[5]Projected length of pipelines does not include length in State waters.
[6]A portion of pipeline repair and modification permits do not include offshore activities, such as pipeline cessation or notif ication of operations requests or flow direction changes.
[7]Trips include vessel activities associated with structure modification as maintenance and/or operations.
[8]Helicopter trips may include circuits. This means that each take-off and landing is counted as a trip and is not necessarily one trip offshore or one trip onshore. Trips may occur between platforms or across a water depth.

Table 3. Summary of projected levels of geological and geophysical activities over 10 years for the Gulf of America Oil and Gas Program (BOEM 2016; BOEM 2017e)

Geological or Geophysical Activity	Number	Miles
HRG Surveys (Airgun and Non-Airgun)	716	103,025
VSP Surveys	561	16,992
SWD Surveys	100	0
2D Surveys	23	149,800
3D Surveys	69	649,420
WAZ Surveys	62	561,432
4D Surveys	101	1,108,378
Total 3D, WAZ, 4D Survey	232	2,319,230
CSEM	12	8,120
CPT	100	--
Corings	795	--
Grab Sample	1	--
Vibracores	0	--
Jet Probe	0	--
Bottom Sampling Subtotal	896	--
Shallow Drill Test Wells	2	--
COST Wells	1	--
Bottom-Founded Monitoring Buoy	0	--

2D = two-dimensional; 3D = three-dimensional; 4D = four-dimensional; COST = Continental Offshore Stratigraphic Test; CPT = cone penetrometer test; CSEM = controlled source electromagnetic; HRG = high-resolution geophysical; m^2 = square meters; SWD = seismic while drilling; VSP = vertical seismic profile; WAZ = wide azimuth (survey).

Table 4. Spatial extent of bottom impacts for geological and geophysical activities over 10 years for the Gulf of America Oil and Gas Program (BOEM 2016; BOEM 2017e)

Geological or Geophysical Activity	Square Meters
Bottom Impacts (10 m^2/sample * 896 samples)	8,960
Bottom Impacts (20,000 m^2/COST well)	60,000
Bottom Impacts – Bottom Founded Monitoring Buoys (Footprint 0.56 m^2/buoy + Sweep 34,000 m^2/buoy)	0
Total Bottom Impacts	68,960

3.1 Bureau of Ocean Energy Management and Bureau of Safety and Environmental Enforcement

This section describes (1) BOEM and BSEE's statutory responsibilities and regulatory authorities, (2) oil and gas program stages, review processes and associated plans and permits approved or issued, (3) implementation of OCSLA stages, and (4) activities authorized under oil and gas plans and permits. It also describes changes to and new information since the 2020 biological opinion for review processes, associated plans and permits issuance, and activities authorized under oil and gas plans and permits, as well as oil spill prevention, preparedness, containment, and response activities regulated by the Bureaus. In this section, we also discuss oil spill prevention, preparedness, containment, and response activities regulated by BOEM, BSEE and other federal agencies. Although not legally permitted discharges, oil spills do regularly result from oil and gas activities in the Gulf of America; therefore, their effects are analyzed in this opinion.

3.1.1 Responsibilities and Authorities under the Outer Continental Shelf Lands Act

Under the OCSLA, the Secretary of the DOI has the responsibility to "prepare and periodically revise, and maintain an oil and gas leasing program" in order to "best meet national energy needs" (43 USC §1344(a)). The Act further requires the Secretary to ensure that the U.S. government receives fair market value for acreage made available for leasing, and that offshore conventional (oil and gas) or renewable energy development activities conserve resources, operate safely, and take maximum steps to protect the environment. The Secretary of the DOI has delegated responsibility to implement OCSLA activities relevant to this opinion to BOEM and BSEE.

BOEM is responsible for leasing (including pre- and post-lease activities), exploration, and development plan approval and administration, environmental studies, NEPA analyses, resource evaluation, and economic analysis. BOEM reviews and approves plans for OCS oil and gas exploration and development. BOEM's Office of Strategic Resources, which is responsible for the development of the National Outer Continental Shelf Oil and Gas Leasing Program, oversees assessments of the oil, gas, and other mineral resource potential of the OCS, inventories oil and

gas reserves and develops production projections, and conducts economic evaluations that ensure the receipt of fair market value by United States taxpayers for OCS leases.

BOEM has jurisdiction over OCS air emissions in the Gulf of America west of 87.5° W longitude (off the coasts of Texas, Louisiana, Mississippi, and Alabama). The criteria pollutants include carbon monoxide, nitrogen oxides, sulphur dioxide, suspended particulates, total hydrocarbons, and volatile organic compounds. An overview of BOEM's air regulations is available at https://www.boem.gov/environment/environmental-studies/overview-air-quality-regulations and the current National Ambient Air Quality Standards for the six criteria pollutants are available at https://www.epa.gov/criteria-air-pollutants/naaqs-table.

BSEE is responsible for enforcing safety and environmental regulations, and permitting and overseeing certain post-lease activities (e.g., drilling), offshore regulatory programs, oil-spill response, training and environmental compliance functions. BSEE's Offshore Regulatory Program develops standards and regulations to enhance operational safety and environmental protection for the exploration and development of offshore oil and natural gas on the OCS. BSEE has oversight over pipeline applications and rights-of-way, and authorizes permits to drill. BSEE's Oil Spill Response Division is responsible for developing standards and guidelines for offshore operators' Oil Spill Response Plans (OSRP) through reviews of industry OSRPs to ensure compliance with regulatory requirements and coordination of oil spill drill activities. BSEE's Environmental Compliance Division provides regulatory oversight focused on compliance by operators with all applicable environmental regulations, as well as oversight for lessee and operator obligations under OCS leases. BSEE's inspectors issue Incidents of Non-Compliance and have the authority to impose sizeable civil penalties for regulatory infractions. In some cases, criminal penalties are also available.

3.1.2 Overview of Oil and Gas Program Stages, Review Processes and Associated Plans and Permits Approved or Issued by the Action Agencies

The OCS leasing process consists of five distinct stages: (1) the five-year planning program (i.e., the National Oil and Gas Leasing Program), (2) pre-leasing activity and the lease sale, (3) exploration, (4) development and production, and (5) decommissioning (Figure 2). The timeline of activities from a single lease sale is approximately 40 years. G&G surveys are not limited to lease sale activities and are considered separate from leasing.

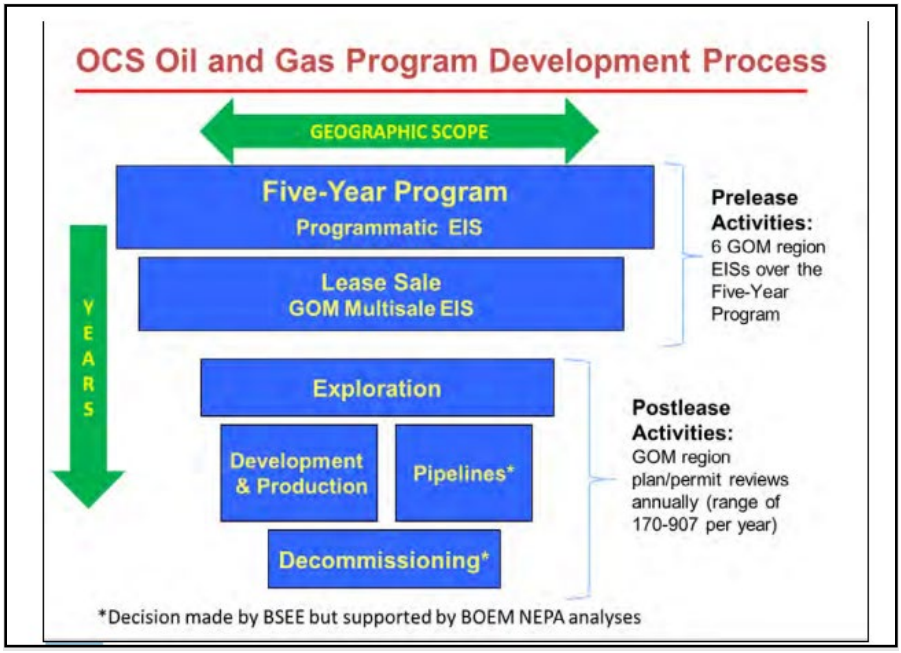


Figure 2. OCS Oil and Gas Program (BOEM 2017b)

3.1.2.1 National OCS Oil and Gas Leasing Program

The Secretary of the DOI is required to prepare a five-year leasing plan, subject to annual revisions, that governs any offshore leasing that takes place during the period of plan coverage. The approved schedule is called the National OCS Oil and Gas Leasing Program (National OCS Program). Although no actual plans or permits are approved at this stage, each National OCS Program establishes a schedule of proposed lease sales, providing the general timing, size, and location of the leasing activities. The National OCS Program is based on multiple considerations, including the Secretary's determination as to what will best meet national energy needs for the five-year period and the extent of potential economic, social, and environmental impacts associated with development. Once a National OCS Program is approved, offshore areas included in the plan are made available through scheduled lease sales. Due to the staged decision-making process under OCSLA, BOEM prepares an EIS under the NEPA in conjunction with the plan for each National OCS Program.

On September 29, 2023, BOEM issued the *Proposed Final Program for the 2024-2029 National OCS Oil and Gas Leasing Program* (National OCS Program), as well as the Final Programmatic Environmental Impact Statement for the 2024-2029 Program (both documents can be found at https://www.boem.gov/oil-gas-energy/national-program/national-ocs-oil-and-gas-leasing-program). The National OCS Program provides a framework and general guide for leasing during the Program's term and the Secretary of the Interior has discretion under the OCSLA and other applicable laws to determine whether and when to hold individual lease sales (refer to 43 U.S.C. § 1344(e)). Therefore, BOEM conducts region-specific reviews by Program Areas (i.e.,

the portions of the OCS planning areas that remain in consideration for leasing during the National OCS Program development process). The *2023 GOM Regional Oil and Gas Programmatic Environmental Impact Statement* (PEIS) examined a proposed Federal action to hold an oil and gas lease sale offered in Federal OCS waters. Activities considered are included herein. These two documents include supplemental information relevant to the description of the action, and are the basis for how BOEM conducts their environmental reviews during planning and decision making processes.

3.1.2.2 Lease Sales

After a lease sale schedule is finalized in an approved National OCS Program, (the program is for five years), the next stage of OCSLA decision-making takes place when each lease sale is conducted. The lease sale process is governed by a variety of federal laws and regulations; however, Section 8 of the OCSLA and its implementing regulations establish the mechanics of the leasing process. The process begins when the Director of BOEM publishes a call for information and nominations regarding potential lease areas. Pre-lease activities (i.e., off-lease G&G surveys) require permits issued by BOEM. In the Gulf of America, typically the permittees are third-party vendors that acquire data and then sell it to industry. After the permittees have collected data, BOEM may selectively acquire data to update their mineral resources database. Industry uses these data to locate areas having potential for oil and gas production and to prepare bids for lease sales. Although the lease sale in and of itself does not authorize any impact producing activity beyond ancillary[4] activities, due to the staged decision-making process under OCSLA, BOEM is able to conduct NEPA analyses of all lease sales in a given area or areas under the five-year-program in an EIS. In the Gulf of America, this programmatic NEPA (formerly known as a Multi-sale EIS) covers leasing events and reasonably foreseeable activities tied to leases. This programmatic document can be supplemented as prescribed in NEPA when necessary. After appropriate NEPA is completed, BOEM makes a decision on whether (and how) to hold a lease sale on an individual basis. If the decision is to hold the lease sale, the Director of BOEM publishes a Final Notice of Sale, which includes, among other things, a list of lease sale block offerings, in the Federal Register at least 30 days prior to the date of the sale. The Final Notice of Sale must describe the areas subject to the sale and any stipulations, terms, and conditions applicable to any individual sale. Additionally, the impacts of all activities and alternatives are analyzed via the NEPA process and a corresponding Record of Decision is published.

3.1.2.3 Exploration

Exploration for oil and gas pursuant to an OCSLA lease must comply with an approved exploration plan submitted by lessees. BOEM requires a detailed environmental analysis to accompany submission of an exploration plan. BOEM analyzes the environmental impacts of the

[4]Ancillary activities, which do not require a permit, are those activities conducted on a lease or unit. If any off-lease data are to be collected, then a permit would be required. BOEM encourages operators to contact BOEM if unsure about need for a permit.

proposed exploration activities under NEPA. Extensive environmental review at this stage may be constrained by or rely heavily upon previously prepared NEPA documents. If the regional supervisor disapproves of the proposed exploration plan based on one of the limitations established by OCSLA (e.g., serious harm or damage to the environment; see 43 USC §1351(h)(1)(D)(i)), the lessee may make necessary modifications and resubmit the plan to address the issues raised. Once a plan has been approved, drilling associated with exploration becomes subject to the relevant BSEE regulations governing approval of an application for a permit to drill, which require a detailed analysis of the specific drilling plan.

3.1.2.4 Development and Production

During development and production, the scale of activities significantly increases. Additional regulatory review and environmental analysis are required by the OCSLA before this stage begins. Operators are required to submit a Development and Production Plan (DPP) for areas where significant development has not occurred before or a less extensive Development Operations Coordination Document (DOCD) for those areas, such as certain portions of the Western Gulf of America, where significant activities have already taken place. The information required to accompany submission of these documents to BOEM is similar to that required at the exploration phase, but must address more specific details of planned operations. After DPP or DOCD approval, the operator submits applications for specific activities to BSEE for approval (e.g., for production wells).

3.1.2.5 Decommissioning

Operators are required decommission all wells and associated facilities and remove obstructions from their lease within one year of lease termination, or prior to termination if the operator or DOI deems the structure unsafe, obsolete or no longer useful for operations. Operators must apply for and obtain a BSEE permit approval for safe and adequate removal methods.

The OCSLA authorizes the Secretary of the DOI to promulgate regulations on lease suspension and cancellation. The Secretary's discretion over the use of these authorities is specifically limited to a set number of circumstances established by the Act. A lease may be suspended (1) when it is in the national interest, (2) to facilitate proper development of a lease, (3) to allow for the construction or negotiation for use of transportation facilities, or (4) when there is "a threat of serious, irreparable, or immediate harm or damage to life (including fish and other aquatic life), to property, to any mineral deposits (in areas leased or not leased), or to the marine, coastal, or human environment" OCSLA ((43 USC § 1334(a)). Regulations implementing OCSLA also indicate that BSEE may suspend leases for other reasons, including (1) when necessary to comply with judicial decrees, (2) to allow for the installation of safety or environmental protection equipment, (3) to carry out NEPA or other environmental review requirements, or (4) to allow for "inordinate delays encountered in obtaining required permits or consents" (30 C.F.R. §250.172).

3.1.3 Implementation of Outer Continental Shelf Lands Act Stages

The OCSLA stages are implemented sequentially through various permits, plans, and environmental reviews approved by BOEM or BSEE throughout the life of a lease (Figure 3). However, for purposes of this ESA section 7 consultation, when considering lease blocks, entire planning areas, or the Gulf of America oceanic basin collectively, OCSLA stages will not be evaluated sequentially and activities stemming from individual leases cannot be considered in isolation, because all phases of exploration, development, and production are occurring on many active leases simultaneously.

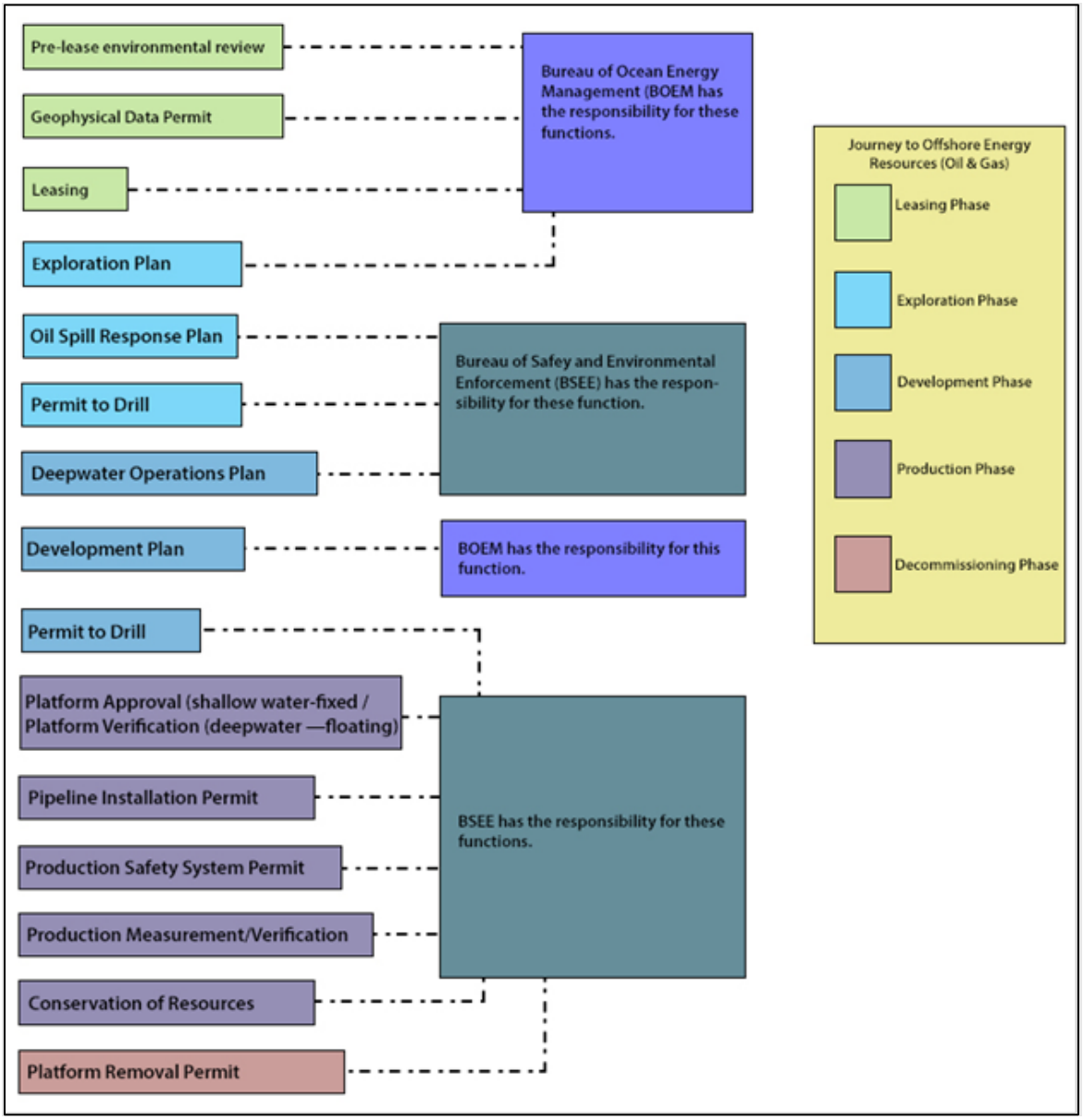


Figure 3. Responsibilities and functions of BOEM and BSEE for permitted activities under OSCLA in the Gulf of America

3.1.3.1 Geological and Geophysical Permits

BOEM is responsible for issuing permits and authorizations for G&G activities in federal waters under the OCSLA (see 30 C.F.R. Parts 550, 551, 580 and 585) as well as under Section 188(a) of the Energy Policy Act of 2005. BSEE is responsible for ensuring compliance with authorization conditions. BOEM issues permits for all types of geological and geophysical activities on the OCS and has permitted over 12,000 seismic surveys (2D and 3D) and more than 400 coring permits in the Gulf of America since the 1953 passage of OCSLA. These G&G surveys generally occur at two different stages of leasing. Off-lease exploratory surveys (e.g., those that occur prior to lease issuance or after lease issuance but outside of the leased block) require a G&G permit (duration of up to one year). Off-lease surveys tend to cover larger oceanographic areas and can last from weeks to months (up to one year). Post-lease issuance G&G activities ("on-lease G&G") are generally localized to the well or lease blocks around an exploratory or development well. On-lease surveys are generally of short duration, hours to a few weeks. On-lease surveys are considered an ancillary activity that require written notification of a revised exploration plan (EP) describing the G&G activity for approval by BOEM (see below description of EPs), but do not require a permit to conduct the activity. Pursuant to regulations at 30 C.F.R. §250.208(a), operators must notify the BOEM Gulf of America OCS Region in writing at least 30 calendar days before conducting any G&G exploration or development activity. Furthermore, the BOEM Gulf of America Region may require a written notice of at least 30 calendar days before conducting any other ancillary activity (30 C.F.R. §250.208(b)). Notice to Lessees No. 2009-G34 provides guidance and clarification on the procedures for conducting these activities (http://www.bsee.gov/Regulations-and-Guidance/Notices-to-Lessees/2009/09-G34.aspx).

Geological and geophysical surveys have changed substantially over the last decade. More precise imaging of the subsurface resulted in 3D surveys becoming the standard pre-requisite for oil and gas exploration during the 1990s. Imaging subsalt and complex geologic structures has remained a barrier to data acquisition. In these environments, more advanced acquisition techniques such as multi-component, wide-azimuth (WAZ), full-azimuth, multi-azimuth (MAZ), and coil surveys that use multiple sound sources are now being used in the Gulf of America to enhance seismic imaging quality to levels not available in the past. It is reasonable to expect that G&G technologies will continue to change in the future.

Permits for G&G require the following information to be submitted in a permit application: a description of drilling methods or sampling, equipment to be used, estimated bore holes or sample locations, navigation system, method of sampling, description of analyzed or processed data, estimated completion date, a map, plot, or chart showing latitude and longitude, specific block numbers, and total number of borings and samples. Further, before issuing a permit, BOEM requires that the applicant provide notice of their receipt of a LOA under the MMPA or decision from NMFS that a LOA is not required.

3.1.3.2 Exploration Plans

An Exploration Plan (EP) must be submitted to BOEM for review and approval before any exploration activities can begin on a lease, with the exception of preliminary activities such as hazard surveys or geophysical surveys. The EP describes exploration activities, drilling rigs or vessels, proposed drilling and well-testing operations, environmental monitoring plans, and other relevant information including a proposed schedule of the exploration activities.

An EP may be one of three types. An *Initial Exploration Plan* describes all exploration activities planned by an operator for a specific lease(s), the timing of these activities, information concerning drilling vessels, the location of each well, and an analysis of both offshore and onshore impacts that may occur because of the plan's implementation. A *Revised Exploration Plan* describes changes to proposed activities already included in a previously approved Exploration Plan. A *Supplemental Exploration Plan* includes a description of proposed activities on a lease(s) that were not included in an original Exploration Plan for that lease(s). Revised plans often describe additional exploration plans and wells, and ancillary activities such as G&G surveys.

After receiving an EP, BOEM determines if the plan is complete and adequate before technical and environmental reviews. BOEM evaluates the proposed exploration activities for potential impacts relative to geohazards and manmade hazards (including existing pipelines), archaeological resources, endangered species, areas of biological concern, water and air quality, oil-spill response, State Coastal Zone Management Act (CZMA) requirements, and other uses (e.g., military operations) of the OCS.

Currently, a review of EPs and DOCDs (see next section) occurs at the receiving department (e.g., BOEM plans department) as part of their process for deeming an application is complete using a checklist, such as a DP thruster sound review. This department forwards to BOEM biologists those plans that (1) have potential adverse impacts to biological communities, (2) have sound-producing sources such as DP vessels and seismic airgun surveys, or (3) have an entanglement risk such as with some Ocean Bottom Node (OBN) surveys.

BOEM then reviews the EP compliance with all applicable laws and regulations. A NEPA review (e.g., a Categorical Exclusion Review [CER], EA, or EIS as appropriate) is prepared as documentation of the environmental review of the EP. The NEPA review is based on available information, which may include multiple internal reviews of the geophysical report by subject matter experts (e.g., for determining the potential presence of deepwater benthic communities), archaeological report, air emissions data, live-bottom survey and report, biological monitoring plan, and recommendations by the affected state(s), Department of Defense (DOD), FWS, NMFS, and/or BOEM. After an EP is approved and prior to conducting drilling operations, the operator is required to submit and obtain approval from BSEE for an Application for Permit to Drill (APD).

3.1.3.3 Development Operations Coordination Documents

A Development Operations Coordination Document (DOCD) is a plan submitted to BOEM that describes development and production activities proposed by an operator for a lease or group of leases. The description includes the timing of these activities, information concerning drilling vessels, the location of each proposed well or production platform or other structure, and an analysis of both offshore and onshore impacts that may occur because of the plan's implementation. A Supplemental DOCD describes proposed activities on a lease(s) that were not included in a previously approved DOCD and will require approval of additional permit(s). A revised DOCD describes changes to the proposed activities included in a previously approved DOCD, but will not require the approval of additional permit(s).

After EP or DOCD approval, the operator submits applications for specific activities to BSEE for approval. These applications include plans for drilling wells, well-test flaring, temporary well abandonment, installing a well protection structure, production platforms, satellite structures, subsea wellheads and manifolds, and pipelines, installation of production facilities, commencing production operations, platform removal and lease abandonment, and pipeline decommissioning.

3.1.3.4 Deepwater Operations Plans

A deepwater operation plan (DWOP) provides information necessary for BSEE to review and approve a deepwater development project, and any other project that uses non-conventional production or completion technology, such as high pressure, high temperature (HPHT) equipment A DWOP supplements other submittals required by the regulations, such as BOEM-approved EPs, Development and Production Plans (DPPs), and DOCDs, and BSEE permit applications. BSEE uses the information in DWOPs to determine whether a project will be developed in an acceptable manner, with respect to operational safety and environmental protection issues involved with non-conventional production or completion technology. Once a DWOP is approved, the information associated with the technology or methodology is required to be addressed in an associated EP, DPP, DOCD, and/or BSEE permit application for review under a site-specific NEPA analysis prior to the activity occurring on the OCS.

3.1.3.5 Drilling Permit

Before a drilling permit can be approved, several related approvals must be in place: an approved EP or DOCD and documented compliance with regulations requiring an OSRP, compliance with NEPA, approval of an oil spill financial responsibility document, a geological and geophysical review of all the relevant hydrocarbon-bearing zones determination, verification of worst case discharge (WCD) scenarios, and a demonstration that blowout preventer control systems comply with regulations.

When BSEE identifies deficiencies, the drilling permit application is returned to the operator and may be resubmitted with the needed information. Similarly, BSEE can also withhold approval if the activities in the permit application do not conform with those outlined in detail in the associated EP or DOCD, and require that the operator submit a revised or supplemental EP or

DOCD to BOEM for review and approval in compliance with 30 C.F.R. §550.281(b). To date, BSEE's Gulf of America Region has not formally denied a permit application; however, there have been numerous situations in which an operator has "withdrawn"/canceled an application or completely revised their originally proposed activity in response to potential permit conditions and/or proposed environmental standards developed by BOEM and BSEE to ensure adequate resource protection. BSEE and the operator work cooperatively to ensure that all regulatory requirements are met before the application may be approved. Depending on the specific characteristics of the well and the applicable regulatory requirements, this process can take anywhere from a few days to many months. An additional application is required for a permit to modify an approved well. There are no statutory or regulatory deadlines on this stage of the leasing process; within only the applicable limits of the lease term, the operator may take as long as needed to correct the information or gather missing information and resubmit the application.

3.1.3.6 Oil Spill Response Plans

An OSRP or references to regional OSRPs must accompany any EP or DOCD. As a result of the Oil Pollution Act of 1990, the BSEE is tasked with several oil-spill response duties and planning requirements. Within BSEE, the Oil Spill Preparedness Division addresses all aspects of offshore oil-spill prevention, planning, preparedness, and response. BSEE reviews and approves all OSRPs and requires lessees to conduct the training, equipment testing, and periodic drills listed in the OSRP. BSEE also conducts unannounced drills to ensure compliance with OSRPs. BOEM is responsible for ensuring oil-spill financial responsibility for facilities in offshore waters located seaward of the coastline or in any portion of a bay connected to the sea either directly or through one or more other bays. The BSEE regulations (30 C.F.R. §254) require that all owners and operators of oil handling, storage, or transportation facilities located seaward of the coastline submit an OSRP for approval before an operator can use a facility. The term "facility" means any structure, group of structures, equipment, or device (other than a vessel), which is used for one or more of the following purposes: exploring for, drilling for, producing, storing, handling, transferring, processing, or transporting oil. A mobile offshore drilling unit (MODU) is classified as a facility when engaged in drilling or down-hole operations. Operators are required to submit a Worst Case Discharge (WCD) analysis for exploratory and development drilling operations according to NTL 2010-N06 (Information Requirements for Exploration Plans, Development and Production Plans, and Development Operations Coordination Documents on the OCS) as part of BOEM's evaluation of EPs and DOCDs, and BSEE's evaluation of APDs (https://www.boem.gov/NTL-2015-N01/). A WCD estimate is required under OPA for oil spill planning purposes. Owners or operators of offshore pipelines are required to submit an OSRP for any pipeline that carries oil, condensate, or gas with condensate; pipelines carrying essentially dry gas do not require an OSRP. Current OSRPs are also required for abandoned facilities until they are physically removed or dismantled.

OSRPs are a requirement of the Clean Water Act, and according to that Act, BSEE must approve OSRPs that contain the following elements:

(i) be consistent with the requirements of the National Contingency Plan and Area Contingency Plans (ACPs);

(ii) identify the qualified individual having full authority to implement removal actions, and require immediate communications between that individual and the appropriate Federal official and the persons providing personnel and equipment pursuant to clause;

(iii) identify, and ensure by contract or other means approved by the U.S. President the availability of, private personnel and equipment necessary to remove to the maximum extent practicable a worst case discharge (including a discharge resulting from fire or explosion), and to mitigate or prevent a substantial threat of such a discharge;

(iv) describe the training, equipment testing, periodic unannounced drills, and response actions of persons on the vessel or at the facility, to be carried out under the plan to ensure the safety of the vessel or facility and to mitigate or prevent the discharge, or the substantial threat of a discharge;

(v) be updated periodically; and

(vi) be resubmitted for approval of each significant change.

Following DWH, BSEE issued NTL 2012-N06, Guidance to Owners and Operators of Offshore Facilities Seaward of the Coast Line Concerning Oil Spill Response Plans, that clarifies, "The response strategy should also consider ….wildlife protection, rescue and rehabilitation strategies and real-time response capability." Specifically, the NTL requires plans to include:

- procedures to rehabilitate wildlife that have become oiled,
- a discussion on how the Lessee will obtain authorization to initiate capturing and cleaning of wildlife,
- a thorough discussion of wildlife rehabilitation procedures including personnel, equipment, and supplies that will be used to establish and operate a rehabilitation station, and
- the source of those personnel, equipment, and supplies.

The NTL also specifies that in regard to stranded oiled animals, "The term 'remove' is defined at 30 C.F.R. §254.6 as 'containment and cleanup of oil from water and shorelines or the taking of other actions as may be necessary to minimize or mitigate damage to the public health or welfare, including, but not limited to, fish, shellfish, wildlife, public and private property, shorelines, and beaches."

3.1.3.7 Pipeline Permits

BSEE is responsible for regulatory oversight of the design, installation, and maintenance of OCS producer-operated oil and gas pipelines. BSEE's operating regulations for pipelines, found at 30 C.F.R. §250 Subpart J, are intended to provide safe and pollution-free transportation of fluids in

a manner that does not unduly interfere with other users of the OCS. Pipeline applications are submitted and reviewed separately from DOCDs. Pipeline permit applications may be for on-lease (lease term [LT]) pipelines or rights-of-way (ROW) for pipelines that cross other lessees' leases or unleased areas of the OCS. LT pipelines are included as part of the activities described in DOCDs, while ROW pipelines are not always included in plans. Pipeline permits include installation, maintenance, and decommissioning of subsea tie-ins (SSTIs), including pipeline end terminations (PLETs), pipeline end manifolds (PLEMs), and inline trees. SSTI systems provide connections between subsea infrastructure and flowlines, umbilicals, modules and pipelines for import or export of oil or gas. Subsea flowlines are used for the transportation of crude oil and gas from subsea wells, manifolds, offshore processing facilities, as well as reinjection of water and gas into the reservoir. Tie-in connections are designed for ultradeep waters (depths exceeding 10,000 ft). Pipeline permit applications require the pipeline location drawing, profile drawing, safety schematic drawing, pipe design data, a shallow hazard survey report, and an archaeological report, if applicable.

The responsibility for transportation-related facilities, including pipelines, located landward of the coastline, was re-delegated to the Department of Transportation by Executive Order 12777. The DOT retains jurisdiction for deepwater Ports and their associated seaward pipelines pursuant to Executive Order 12777 (Oct. 18, 1991). The term "coastline" is defined in the Submerged Lands Act (43 USC § 1301(c)) to mean "the line of ordinary low water along that portion of the coast which is in direct contact with the open sea and the line marking the seaward limit of inland waters."

Requirements for decommissioning OCS pipelines are found in 30 C.F.R. §250.1750 through 30 C.F.R. §250.1754. The 30 C.F.R. §250, Subpart Q regulations are further elaborated in NTL No. 2001-G08 that provide lessees and contractors additional information and application/reporting procedures.

3.1.3.8 Structure Installation and Modification Permits

As per 30 C.F.R. §250.900, lessees are obligated to "design, fabricate, install, use, maintain, inspect, and assess all platforms and related structures on the [OCS] so as to ensure their structural integrity for the safe conduct of drilling, workover, and production operations." Lessees must obtain approval from BSEE, through a Structure Installation Permit, before installing (or moving an existing) platform, performing major modification or repair to any platform, or converting an existing platform or mobile offshore drilling unit for a new purpose. Permit applications are reviewed to ensure activities proposed are consistent with those described in the lessee's EP or DOCD. Major modifications include structural changes to a platform or modifications that increase loading on a platform by 10% or more. Minor modifications require notification from the lessee to BSEE.

3.1.3.9 Platform or Other Facility Removal Permits for Decommissioning

During exploration, development, and production operations, temporary and permanent equipment and structures are often required to be embedded in or placed onto the sea floor around activity areas. In compliance with section 22 of the OCS Oil and Gas Lease Form (Form BOEM-2005) and OCSLA regulations (see 43 USC § 1334 and 30 C.F.R.§250.1710—Wellheads/Casings and 30 C.F.R. §250.1725—Platforms and Other Facilities), operators are required to remove all such sea floor obstructions and facilities from their leases within one year of lease termination or after a structure has been deemed obsolete or unusable. These decommissioning regulations also require the operator to sever bottom-founded objects and their related components at least 5 m (15 ft) below the mudline (30 C.F.R. §250.1716(a)—Wellheads/Casings and 30 C.F.R. §250.1728(a)—Platforms and Other Facilities). Additional requirements establish site-clearance verification procedures (30 C.F.R. §250.1740 to 30 C.F.R. §250.1743) that may include running trawls, remotely-operated vehicles (ROVs), or survey sonars over predetermined radii, depending upon water depth and structure type. There are over 1,400 active production platforms in the Gulf of America (BOEM 2016).

The severance operations are generally categorized as explosive or non-explosive. All of the current terms and conditions of structure and well removal activities that are included in the action under consultation are outlined in NTL 2018-G03, "Idle Iron Decommissioning Guidance for Wells and Platforms," which BSEE last renewed on December 11, 2018.

3.1.3.10 Air Quality Permits under OCSLA

Air pollutants are commonly emitted from oil and gas activities in the OCS area. These activities may involve equipment that combust fuels, or systems that transport and/or transfer hydrocarbons. The USEPA and BOEM are responsible for administering the CAA and OCSLA, respectively, for air emissions resulting from oil and gas related activities over portions of the OCS. This section addresses BOEM's responsibilities under the OCSLA; Section 3.2 below addresses USEPA responsibilities.

BOEM is responsible for implementing air quality measures on OCS oil and gas activities in Gulf of America waters west of 87.5°W longitude. OCSLA mandates that the Secretary of the Interior prescribe regulations providing for compliance with the National Ambient Air Quality Standards (NAAQS) established pursuant to the CAA, to the extent that the OCS oil and gas activities authorized under OCSLA significantly affect the air quality of any state (43 USC §1334(a)(8); see also 30 C.F.R. Part 550). The USEPA has set NAAQS for six principal pollutants called "criteria" pollutants: carbon monoxide, lead, nitrogen dioxide, ozone, particle matter[5] (listed as $PM_{2.5}$ and PM_{10}), and sulfur dioxide. All new or supplemental EPs and DOCDs, and revised DOCDs must include air emissions information sufficient to determine whether an air quality review is required (30 C.F.R. §550.218 and §550.249).

[5] BOEM has not adopted the revised standards for particulates.

BOEM regulations establish a systematic review process for air quality emissions during the plan approval to determine if the projected emissions from a facility result in onshore ambient air concentrations that may require appropriate emissions controls to mitigate potential onshore air quality degradation. Permit applicants must first conduct an initial screening analysis to determine whether emissions exceed established "exemption" levels as detailed in BOEM Notice to Lessees NTL-2020-N02 (https://www.boem.gov/sites/default/files/documents/about-boem/NTL-2020-N02.pdf). If these exemption levels are exceeded, the applicant must perform modeling to determine whether the BOEM "significance" levels will be exceeded onshore. When modeling demonstrates that BOEM's significance levels will be exceeded, best available control technologies (BACTs) must be applied. Conversely, when modeling demonstrates no impacts according to BOEM's significance levels, no BACT is required and a plan may be approved.

3.1.4 Description of Activities Authorized under Plans and Permits

The following sections describe in detail the activities implemented under the plans and permits discussed above, including inspection and enforcement activities by the action agencies, and measures required by all operators specifically to avoid or minimize harm to the environment and protected resources. This discussion will facilitate identification of the routes of potential adverse effects to ESA-listed species or designated critical habitats from the action that will be discussed in this opinion. We note that BOEM/BSEE did not project Oil and Gas Program activity in the EPA because of the Presidential withdrawal. Therefore, the annual activity level estimates in Table 2 and the activity subsections below do not include estimates for the EPA with the exception of G&G projections for the CPA that include those portions of the EPA not currently withdrawn, but only for geological coring and CSEM activities in those portions of the EPA.

According to discussions with BOEM, we understand that the annual levels provided in Table 2 of this opinion are substantially different from those in Table 2 in the 2020 opinion because: (1) the most current scenarios rely on data that include years of very low activity, such as 2020 (due to the COVID-19 pandemic); and (2) data collected and reported by the Bureaus during annual activity reviews led to changes in activity level estimates. Under any of these activities, technologies continue to evolve to meet the technical, environmental, and economic challenges of oil and gas development. New technologies as part of the Oil and Gas Program are discussed in Section 3.1.4.11, below.

3.1.4.1 Geological and Geophysical Surveys

G&G surveys routinely occur every day in the Gulf of America and, as relevant to the action, are conducted to: (1) obtain data for hydrocarbon and mineral exploration and production; (2) aid in siting of oil and gas structures, facilities, and pipelines; (3) identify possible seafloor or shallow-depth geologic hazards; and (4) locate potential archaeological resources and benthic habitats that should be avoided. Data needs and the target of interest drive the selection of a specific technique or suite of techniques.

Specific G&G surveys may span a single day, weeks, or months. G&G surveys are conducted in federal or state waters of the Gulf of America; however, BOEM and BSEE only have jurisdiction in federal waters. Extensive G&G exploration activity has occurred in the Gulf, mainly in the WPA and CPA. More advanced acquisition techniques such as multi-component, wide-azimuth (WAZ), full-azimuth (FAZ), multi-azimuth (MAZ), and coil surveys that use multiple sound sources, and high resolution geophysical (HRG) surveys, which include airgun and non-airgun equipment. BOEM defines two main categories of seismic surveys: (1) deep seismic (OBN), Vertical Seismic Profile (VSP), or borehole, 2D, 3D, 4D, and (2) HRG. Using recent permit application information, BOEM estimated future seismic equipment (Table 3, PEIS) will be used in the Gulf to enhance seismic imaging quality to levels not available in the past. It is reasonable to expect that G&G technologies will continue to change in the future. Permits for G&G require the following information to be submitted in a permit application: a description of drilling methods or sampling; equipment to be used; estimated bore holes or sample locations; navigation system; method of sampling; description of analyzed or processed data; estimated completion date; a map, plot, or chart showing latitude and longitude; specific block numbers; and total number of borings and samples. Further, before BOEM issues a permit, the applicant is required to notify BOEM of their receipt of a Letter of Authorization (LOA) under the MMPA or decision from NMFS that a LOA is not required. BOEM will not issue a permit without this notification. Notice to Lessees (NTL) No. 2009-G34 provides guidance and clarification on the procedures for conducting ancillary activities (30 C.F.R. §550.208; https://www.bsee.gov/notices-to-lessees-ntl/notices-to-lessees/ntl-2009-g34-ancillary-activities-december-1-2009).

BOEM's draft PEIS address oil and gas (O&G), renewable energy (REN) and marine minerals program areas (Beckwith and Fuentes) However, this opinion only covers BOEM's Oil and Gas Program.

The O&G program area is the only one that conducts deep-penetration seismic surveys, non-acoustic marine geophysical surveys, and airborne remote surveys. Most, if not all deep-penetration seismic surveys require the use of airguns. Seismic surveys evaluate subsurface geological formations to assess potential hydrocarbon reservoirs and optimally site exploration and development wells. The two dimensional (2D) surveys provide a cross-sectional image of the Earth's structure while three dimensional (3D) surveys provide a volumetric image of underlying geological structures. Repeated 3D surveys result in time lapse, or four dimensional (4D), surveys that assess the depletion of a reservoir. The vertical seismic profile (VSP) surveys provide information about geologic structure, lithology, and fluids. Deep-penetration seismic surveys include:

- 2D Seismic Surveys ;
- 3D Seismic Surveys ;
- Ocean-Bottom 2D Seismic Surveys (Cable or Nodes) ;
- Ocean-Bottom 3D Seismic Surveys (Cable or Nodes) ;

- Wide-Azimuth and Related Multi-Vessel Surveys ;
- Borehole Seismic Surveys (2D and 3D VSP Surveys) ;
- Vertical Cable Surveys ; and
- 4D Time-Lapse Surveys ;

Non-acoustic marine geophysical surveys include marine gravity surveys, marine magnetic surveys, marine magnetotelluric surveys, or marine controlled source electromagnetic surveys. These efforts use electromagnetic signals to develop a conductivity/ resistivity profile of the seafloor, helping to identify economic hydrocarbon accumulations and aid with archaeological surveys. Airborne gravity surveys and airborne magnetic surveys are used to assess structure and sedimentary properties of subsurface horizons. Airborne magnetic surveys evaluate deep crustal structure, salt-related structure, and intra-sedimentary anomalies.

Airgun high-resolution geophysical surveys are high-resolution seismic surveys conducted under the O&G and REN program areas. These surveys employ a single airgun to assess shallow hazards, benthic habitats, renewable energy structure emplacement. The O&G and REN program areas also use acoustic pingers, transponders, transceivers, responders, remotely operated vehicles (ROVs), and autonomous vehicles (AUVs) to assist in the execution of surveys, either by providing location or facilitating underwater service tasks. Additionally, water guns are no longer used as a seismic source except in extremely rare instances.

Non-Airgun Acoustic High-Resolution Geophysical Surveys are conducted under the O&G, REN, and MMP program areas. These surveys include subbottom profiling surveys, side-scan sonars, and single beam and multibeam echosounders to assess shallow hazards, potential sand and gravel resources for coastal restoration, archaeological resources, and benthic habitats. Devices used in subbottom profiling surveys include, sparkers, boomers, and pingers.

Geological and Geotechnical Surveys conducted under the O&G, REN, and MMP program areas employ grab and box sampling and geologic coring to collect surface and near surface sediment samples to assess seafloor properties for siting structures such as platforms, pipelines, or cables. The O&G and REN program areas will also use shallow test drilling, continental offshore stratigraphic test (COST) wells, and cone penetrometer tests. The different types of geologic cores extracted include:

- gravity corers;
- multicorers;
- piston corers;
- rotary corers;
- ROV push cores; and
- vibracorers.

Cone penetrometer tests for geologic coring allow assessment of sediment characteristics for use in coastal restoration projects. Shallow test drilling is conducted to place test equipment into a borehole to evaluate gas hydrates or other properties. The COST wells evaluate stratigraphy and hydrocarbon potential without drilling directly into oil and gas bearing strata.

Seismic surveys are performed before lease sales to identify potential areas of hydrocarbons to inform future leasing decisions, including review of seismic data by BOEM to determine fair market value of a lease. Seismic surveys also occur after a lease is issued for a variety of reasons, such as further identifying drilling locations (and thus potentially reducing the number of dry holes); identifying archaeological sites, potential shallow geologic and manmade hazards for engineering; monitoring reservoir levels over time; and site planning for bottom-founded structures.

In general, seismic surveys are deep penetrating and are used to obtain data about geologic formations greater than 300 m below the sea floor. Typical seismic surveying operations tow a seismic sound source eight to 12 m below the sea surface. The seismic sound source is generally an airgun array, but it may also be a boomer, sparker, or other technology. One or more streamers (cable(s) with hydrophone signal receivers) are also towed behind the vessel. For towed equipment that has the potential to capture/entrap sea turtles, such as tail buoys, turtle guards are used. An alternative to streamers is the deployment of geophones either connected to ocean-bottom cables (OBC) or ocean-bottom nodes (OBN) placed individually on the sea floor. The airgun array produces underwater sound waves by releasing compressed air into the water column, creating an acoustical energy pulse. The intermittent release of compressed air creates a regular series of strong acoustic impulses separated by silent periods lasting up to 16 seconds (s), depending on survey type and depth to the target formations. The acoustic signals are reflected off subsurface structures and sediments and recorded back near the surface via the hydrophones in the streamer(s) or nodes/geophones. Streamers are often three to 12 km in length. The speed at which the vessels tow them varies depending on the type of survey, but it is typically between three and 4.5 knots (kt; about 5-8 km per hour) with gear deployed.

An airgun source can consist of a single device, but most often consists of an array or arrays of airguns configured in different ways to produce a desired signal to map certain areas for deep geologic features and oil and gas deposits. Airguns can be towed behind a vessel or suspended into the water from a drilling rig or workboat to survey the area around a well being drilled. The general principal of the airgun is that air is highly pressurized into a cylinder (the airgun); the airgun releases the pressure and discharges a sound pulse toward the sea floor. The pulse travels to the sea bottom and penetrates the subsurface, and the sound signals are reflected by subsurface geologic features (Figure 4 and Figure 5). Signals are recorded by hydrophones towed behind a vessel, geophones deployed down a well, or by receivers (cables or nodes) placed directly on the seafloor.

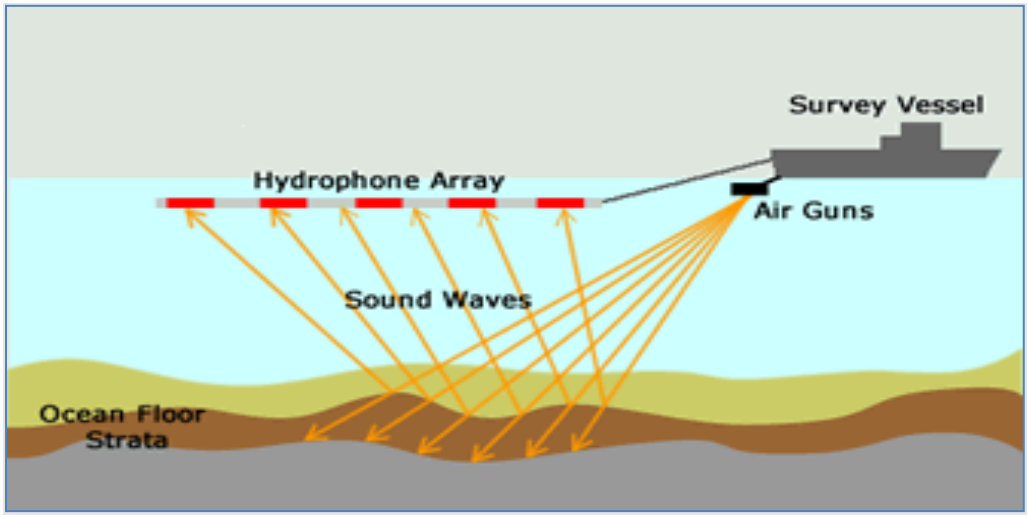


Figure 4. Diagram of a seismic survey vessel towing both an airgun array and hydrophone cables

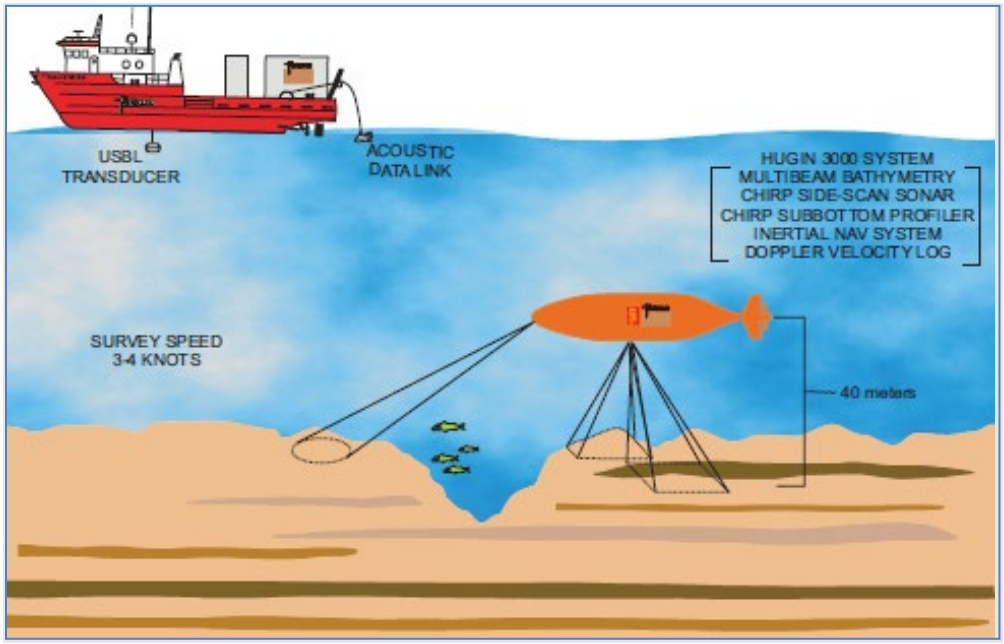


Figure 5. Example of a common high-resolution geophysical survey configuration in the Gulf of America

The simultaneous discharge of highly pressurized air from the airguns results in a very loud "bang" several times each minute. The frequency of the bangs depends on the survey and number of source vessels used. Pathways for the transmission of seismic survey sound include direct paths through the water from the airguns, indirect paths that include reflection from the sea surface and bottom, and other pathways depending on the type of bottom sediments. For specific projects, seasonally and spatially variable environmental characteristics such as temperature and salinity can be modeled because they also play a role in determining the frequencies and sound level propagation.

Other G&G sound sources involve various types of sonars that map bottom and subsurface features in greater detail. These HRG surveys are conducted in a similar way, but they use sound sources other than airguns. HRG surveys typically use mid- and high-frequency sound sources attached to the vessel, a towfish (an instrument towed behind a vessel), or an AUV. The largest differences between airgun sound sources and HRG surveys include the frequency of the sound sources (HRG sources are higher frequencies), the source level of the sound sources (HRG source levels are a lower sound level than airguns), and the tow depth of the sound sources (HRG sources are deployed lower in the water column than airguns).

Pressure Inverted Echo Sounders (PIESs) are oceanographic instruments utilized for subsidence monitoring or to measure the speed of sound in the water column (USDOI BOEM 2023b). They transmit an acoustic pulse (typically once or twice an hour) that reflects off the sea surface and detect the pulse on the seabed to measure two-way travel time through the water column. They simultaneously measure pressure at the seabed (USDOI BOEM 2023b). Pressure measurements are converted to depth to find the acoustic distance traveled from the seabed to the surface and back again. By combining depth and travel time, the average sound speed in the water column can be calculated (USDOI BOEM 2023b). Some PIESs are designed to be free-fall deployed, but ROV deployments (e.g., tripod base configuration) were the preferred method in the past. When deployed using a free-fall descent, the PIES unit can be integrated into a flotation collar and attached via a biodegradable manila rope to a carbon (black) steel anchor weight, which will secure the unit on the seafloor until released. Seafloor spacing varies when placed by an ROV; examples include spacing at 400 m X 400 m or 1,200 m X 1,200 m. When used in conjunction with Ocean Bottom Nodes during ROV placement, PIESs may be deployed near the same time at node locations. The sampling interval of PIES can be configured serially before deployment and via its internal acoustic telemetry link. PIESs log data at programmable intervals for a time and can be deployed for months or even several years, depending on battery life (USDOI BOEM 2023b). They operate in water depths up to 6,000 m and are recovered via an ROV or acoustic release for retrieval at the sea surface. PIESs are narrowband, intermittent sources, with frequencies from 12–20 kilohertz (kHz; USDOI BOEM 2023b).

3.1.4.2 Deep Seismic Airgun Surveys

For 2D seismic surveys, a single streamer is towed behind the survey vessel, together with a single source or airgun array. Seismic vessels generally follow a systematic pattern during a survey, typically a simple grid pattern for 2D work, with lines typically no closer than half a kilometer. In simplified terms, 3D surveys collect a very large number of 2D slices, with minimum line separations of only 25-30 m. A 3D survey may take many months to complete (e.g., three to 18 months) and involves a precise definition of the survey area and transects, including multiple passes to cover a given survey area. For seismic surveys, 3D methods represent a substantial improvement in resolution and useful information relative to 2D methods. Consequently, most areas in the Gulf of America surveyed using 2D have been re-surveyed using 3D methods.

The 3D seismic surveying provides the opportunity to create higher resolution subsurface images and to resolve imaging challenges, thereby enabling a more accurate assessment of potential hydrocarbon reservoirs. As a result, the oil and gas industry is able to optimally locate and successfully develop wells, while minimizing the number of exploratory wells required. State-of-the-art interactive computer mapping systems can handle much denser data coverage than the older 2D seismic surveys. Multiple-source and multiple-streamer technologies are used for 3D seismic surveys. A typical 3D survey might employ a dual array of 18 air guns per array. At 10 m from the source, the resultant pressure is approximately ambient pressure plus one atmosphere. The streamer array might consist of six to eight parallel cables, each 3,000-12,000 m long, spaced 25-100 m apart. An 8-streamer array used for deepwater surveys is typically 700 m wide. A series of 3D surveys collected over time (commonly referred to as four-dimensional or 4D seismic surveying) is used for reservoir monitoring and management (the movement of oil, gas, and water in reservoirs can be observed over time). Increasingly, the data collected in a 3D seismic survey can be processed to provide near surface images adequate for many of the needs previously met by high-resolution surveys.

Wide-azimuth towed-streamer (WAZ) surveys have emerged in the last few years as a step change in marine surveying technology in the Gulf of America. This came about because the risky exploration and development of deepwater subsalt reservoirs required seismic data to have better illumination, higher signal-to-sound ratio, and improved resolution. Wide azimuth acquisition configurations involve multiple vessels operating concurrently in a variety of source vessel-to-acquisition vessel geometries. Several source vessels (usually two to four) are used in coordination with single or dual receiver vessels either in a parallel or rectangular arrangement with a typical 1200-m vessel spacing to maximize the azimuthal quality of data acquired. It is common to have sources also deployed from the receiver vessels in addition to source-only vessels. This improves the signal-to-sound ratio and helps to better define the salt and subsalt structures in the deep waters of the Gulf of America. Coiled (spiral) surveys are a further refinement of the wide azimuth acquisition of subsalt data. These surveys can consist of a single source/receiver arrangement or a multi-vessel operation with multiple sources where the vessels navigate in a coiled or spiral pattern over the area of acquisition.

Deep seismic surveys penetrate deeper into the crust layers than other survey types, high energy and low frequency (2D, 3D, 4D or WAZ) and may be done on leased blocks for more accurate identification of potential reservoirs, thereby aiding in the identification of additional reservoirs in “known” fields. Three-dimensional technology can be used in developed areas to identify bypassed hydrocarbon-bearing zones in currently producing formations and new productive horizons near or below currently producing formations. It can also be used in developed areas for reservoir monitoring and field management. Four-dimensional seismic surveying is predominantly used for on-lease reservoir monitoring and management. Through time-lapse surveys, the movement of oil, gas, and water in reservoirs can be observed over time, and that information is used to adjust production techniques and decisions, leading to more efficient production of the reservoir and the ultimate recovery of a greater portion of the original oil and

gas in place. Surveying may occur periodically throughout the productive life of a lease, as frequently as every six months.

3.1.4.3 Ocean-Bottom Airgun Surveys

Ocean-bottom surveys can use either cables or nodes. OBC surveys were originally designed to enable seismic surveys in congested areas (e.g., producing fields) with their many platforms and producing facilities. OBNs are deployed and retrieved by either cable or remotely operated vehicles (ROVs) that are now used as an alternative to cables. OBC surveys have been found to be useful for obtaining multi-component (i.e., seismic pressure, vertical, and the two horizontal motions of the water bottom, or sea floor) information. OBC surveys and nodal acquisition require the use of multiple ships (usually two ships for cable or node layout/pickup, one ship for recording, one ship for shooting, and two utility boats). These ships are generally smaller than those used in streamer operations. Operations are conducted "around the clock" and begin by dropping the cables off the back of the layout boat or by deployment of the nodal receivers by ROVs. Cable length or the number of nodes depend upon the survey demands; cable length is typically 4.2 km but can be up to 12 km. Depending on spacing and survey size, hundreds of nodes can be deployed and re-deployed over the span of the survey. Groups of seismic detectors, usually hydrophones and vertical motion geophones, are attached to the cable in intervals of 25-50 m. Multiple cables/nodes are laid parallel to each other using this layout method with a 50-m interval between cables/nodes. Typically, dual airgun arrays are used on a single-source vessel. When the cable/node is in place, a ship towing an airgun array (which is the same airgun array used for streamer work) passes between the cables/nodes, firing every 25 m. Sometimes a faster source ship speed of 6 kt, instead of the normal 4.5 kt speed, is used with a decrease in time between gun firings. After a source line is shot, the source ship takes about 10-15 minutes to turn around and pass down between the next two cables or line of nodes. When a cable/node is no longer needed to record seismic data, it is picked up by the cable pickup ship and is moved over to the next position where it is needed. The nodes are retrieved by an ROV. A particular cable/node can lay on the bottom anywhere from two hours to several days, depending upon operation conditions. Normally a cable will be left in place about seven to ten days. However, nodes may remain in place until the survey is completed or recovered and then re-deployed by an ROV.

Location of the cables/nodes on the bottom is done by acoustic pingers located at the detector groups and by using the time of first arrival of the seismic pulse at the detector group. Acoustic pingers use frequencies in the 9-13 kHz range. A detector group is a node or group of nodes that enable the seismic ship to accurately determine node location. To obtain more accurate first arrival times, the seismic data are recorded with less electronic filtering than is normally used. This detailed location is combined with normal navigational data collected on the source ship. In deep-water, the process of accurately locating bottom cables/nodes is more difficult because of the effects of irregular water bottoms and of the thermal layers, which affect travel times and travel paths, thus causing positioning errors.

3.1.4.4 High-Resolution Airgun Surveys

High-resolution airgun surveys collect data on surface and near-surface geology to identify archaeological sites, potential shallow geologic and manmade hazards for engineering, geohazards and soil conditions; assist with site planning for bottom-founded structures; and identify potential benthic biological communities (or habitats) and archaeological resources needing review and mitigation measures for OCS exploration and development plans. Information can also be recovered at much greater depths, so that some surveys are used for exploration purposes. A typical operation consists of a ship towing an airgun or array (about 25 m behind the ship) and a 600-m streamer cable with a tail buoy (about 700 m behind the ship). The ship travels at 3-3.5 kt (5.6-6.5 km per hour), and the airgun is fired every seven to eight seconds (or about every 12.5 m along a track line). Typical surveys cover one lease block, which is usually 4.8 km on a side. BOEM regulations require information be gathered on a 300- by 900-m grid, which amounts to about 129 km of trackline data per lease block. Including line turns, the time to survey one block is about 36 hours; however, streamer and airgun deployment and other operations add to the total survey time. For blocks identified by BOEM as having a high probability for the presence of historic archaeological resources (i.e., shipwrecks), grid points must be spaced 50-m apart (see NTL No. 2011-Joint-G01, http://www.boem.gov/Regulations/Notices-To-Lessees/2011/2011-JOINT-G01-pdf.aspx).

3.1.4.5 Non-Airgun, Sound-Producing High-Resolution Surveys

High-resolution surveys may use airguns but also use other sound sources, such as sub-bottom profilers (at 2.5-7 kHz), echosounders (single-beam at 12-240 kHz; multibeam at 50-400 kHz), boomers (at 300-3,000 hertz [Hz]), sparkers (at 50-4,000 Hz), compressed high intensity radar pulse (CHIRP) sub-bottom profiler (at 4-24 kHz), pingers (at 2 kHz), and side-scan sonars (16-1,500 kHz). These sound sources are typically powered either mechanically or electromagnetically.

Deep-Tow, Sidescan Sonar, Single Beam Echosounder, or Multibeam Echosounder Surveys

These surveys are conducted primarily for studies associated with the placement of production facilities and pipelines and typically use a towfish or an AUV to provide information on the presence of sand flows, hydrates, seeps, and bottom topography (e.g., hard bottom). Operations using towfish are conducted from ships towing cables up to 7 km long, which enable operations in water depths up to 3,000 m deep. Close to the end of the cable is a 30-45-m long section of chain to keep the sensor package tracking at approximately 25-30 m above the bottom. This requires the chain to be dragged along the sea floor, which cuts a trench in the sea floor approximately 10 centimeters (cm) wide by 15 cm deep (4 inches [in] wide by 6 in deep). In situations where the chain could entangle in shipwrecks, wellheads, or other obstructions or where reef colonies live, the chain is removed, and the sensor package is kept above the sea floor by adjusting the length of the tow cable. Maintaining a constant elevation above the sea floor by adjusting the cable length is very difficult, and the elevation above the sea floor is somewhat

greater in this case. These sources are often used simultaneously with airguns during deep-penetration seismic surveys.

Subbottom Profiling Surveys

Sparkers, boomers, pingers and CHIRPs each function differently but all provide similar data for shallower penetration of the subsurface (first few inches to feet). Sparkers use electricity to turn water into a vapor pulse that can penetrate several hundred feet into the subsurface and they are usually towed on one side of the ship opposite the hydrophone array on the other side of the ship. Boomers use electricity to cause two spring-loaded plates to push away from each other. They are usually towed behind the vessel on a towed sled. A pinger creates a weaker sound source that remains at one frequency and CHIRPs sweep through multiple frequencies and receive relatively clear echo returns.

Non-Sound Producing Geophysical Surveys

Marine gravity data can be collected with instruments on the sea floor, in boreholes, ships, helicopters or planes. Data were originally collected on the sea floor, but technology has moved the collection point to ships. Marine gravity meters have, in some cases, been housed in a ship while it is conducting a seismic survey. Another method of collection uses dedicated ships (about 50 m long) to collect an independent gravity dataset. Global positioning navigation systems and larger, more stable seismic ships make it possible to achieve the same order of accuracy with gravity meters placed in seismic ships as in dedicated ships. Data grids for gravity surveys typically range from 0.8 x 1.6 km or 1.6 x 1.6 km to higher altitude flying 6 x 19 km or 13 x 39 km.

Marine magnetic surveys measure Earth's magnetic field to determine structure and sedimentary properties of subsurface horizons. These surveys are usually conducted in conjunction with a seismic survey, allowing the navigation information to be used for both surveys. The development of low-power digital sensors has allowed the sensor package to be towed behind the seismic source array, which has greatly improved the operational efficiency of magnetic surveys.

Magnetotelluric surveys are passive measurements of Earth's electromagnetic fields. Electromagnetic surveys are used to help delineate potential oil and gas reservoirs. Many geological processes in the crust and upper mantle of the sea floor involve the interaction of fluid phases with surrounding rock. The conductivities of hydrothermal phases are different from those of host rock, and collectively they offer distinct profiles of electrical conductivity/resistivity depending on the specific geological process involved. Controlled source electromagnetic surveys (CSEM) induce very low frequency (typically less than 2 Hz) electromagnetic signals into the upper layers of the sea floor via a towed dipole. The signals propagate laterally to an array of receivers kilometers away. The variations in the electromagnetic field relative to the geometry of the receiver arrays and distance provide a conductivity/resistivity profile of the sea floor. From the profile, hydrocarbon reservoirs can be

differentiated from water reservoirs and surrounding rock. Table 5 shows the projected activity levels for non-sound producing G&G activities, including CSEM.

Aeromagnetic and Airborne Gravity Surveys are conducted to assess structure and sedimentary properties of the subsurface. Aeromagnetic surveys specifically look for deep crustal structure, salt-related structure, and intra-sedimentary anomalies. They are often flown by twin-engine, fixed-wing aircraft, typically Cessna 404s or 208s, Piper Aerostars, or Navajos. The flight lines are on the order of 400 km long at a height of 75-150 m above the surface and are flown at speeds of about 220 km per hour.

Geological and Geochemical Sampling

Geochemical sampling is conducted to obtain samples of the sea floor for physical and/or chemical analyses. Sampling results are used to site structures such as platforms and pipelines. Chemical analyses (surface geochemical prospecting) are based on the premise that upward migrated petroleum from deep source rocks and reservoirs can be detected in near-surface sediments and can be used to evaluate exploration potential. Bottom sampling uses devices that penetrate anywhere from a few centimeters to several meters below the sea floor. Samples of near-surface sediments are typically obtained by dropping a piston core or gravity core (dart-essentially a weighted tube) to the ocean floor and recovering it with an attached wire line. Table 5 through Table 7 shows the projected activity levels for non-sound producing G&G activities, including coring for each planning area. Samples can also be obtained using a grab (a device with a jaw-like mechanism) or with a dredge, which is a wire cage dragged along the sea floor. Shallow coring is done by conventional rotary drilling equipment from a drilling barge or boat. Penetration is usually limited to the recovery of several feet of consolidated rock. Usually a program of bottom sampling and shallow coring is conducted simultaneously using a small marine drilling vessel.

Table 5. Projected levels of non-sound producing geological and geophysical activities in the Western Planning Area over a 10-year period in survey line distance (miles [mi]). Parenthetical numbers represent number of surveys (from (BOEM 2017e)

Year	Geologic Coring	CSEM	Drilling Test [A]
Year 1	0	0	0
Year 2	0	660 mi (1)	0
Year 3	10 cores (1)	0	0
Year 4	0	0	0
Year 5	40 cores (1)	660 mi (1)	0
Year 6	0	660 mi (1)	0
Year 7	0	0	1 well (1)
Year 8	0	0	0
Year 9	20 cores (2)	660 mi (1)	0

Year	Geologic Coring	CSEM	Drilling Test [A]
Year 10	0	0	0
Totals	70 cores (4)	2,640 mi (4)	1 well (1)

[A] Penetration <150 m (500 ft). CSEM = controlled-source electromagnetic. Typically, one OCS block is nine square miles (23.3 square kilometers [km^2], 2,331 hectares, or 5,760 acres).

Table 6. Projected levels of non-sound producing geological and geophysical activities in the Central Planning Area over a 10-year period in survey line distance (miles [mi]). Parenthetical numbers represent number of surveys (from (BOEM 2017e)

Year	Geologic Coring	CSEM	Drilling Test [A]
Year 1	20 cores (2)	760 mi (1)	0
Year 2	80 cores (3)	1,520 mi (2)	0
Year 3	90 cores (4)	0	0
Year 4	20 cores (2)	760 mi (1)	0
Year 5	60 cores (2)	0	0
Year 6	20 cores (2)	760 mi (1)	0
Year 7	0	0	0
Year 8	95 cores (5)	0	0
Year 9	0	760 mi (1)	1 well (1)
Year 10	95 cores (5)	0	0
Totals	480 cores (25)	4,560 mi (6)	1 well (1)

[A] Penetration <150 m (500 ft). CSEM = controlled-source electromagnetic. Typically, one OCS block is nine square miles (23.3 square kilometers [km^2], 2,331 hectares, or 5,760 acres).

Table 7. Projected levels of non-sound producing geological and geophysical activities in the Eastern Planning Area over a 10-year period in survey line distance (miles [mi]). Parenthetical numbers represent number of surveys (from (BOEM 2017e)

Year	Geologic Coring	CSEM	Drilling Test [A]
Year 1	15 cores (1)	0	0
Year 2	30 cores (2)	0	0
Year 3	30 cores (2)	0	0
Year 4	80 cores (2)	0	0
Year 5	0	460 mi (1)	0
Year 6	30 cores (2)	0	0
Year 7	0	0	0
Year 8	30 cores (2)	0	0
Year 9	0	460 mi (1)	0

Year	Geologic Coring	CSEM	Drilling Test [A]
Year 10	30 cores (2)	0	0
Totals	245 cores (13)	920 mi (2)	0

[A] Penetration <150 m (500 ft). CSEM = controlled-source electromagnetic. Typically, one OCS block is nine square miles (23.3 square kilometers [km^2], 2,331 hectares, or 5,760 acres).

3.1.4.6 Drilling

Oil and gas operators use different drilling terms to represent distinct stages in the discovery and exploitation of hydrocarbon resources. "Exploration well" generally refers to the first well drilled on a prospective geologic structure to confirm that a resource exists and to validate how much of the resource can be expected. If the quantities of the discovered resource appear to be economically viable, one or more follow-up "delineation wells" help define the amount of the resource or the extent of the reservoir. Following a discovery, an operator often temporarily plugs and abandons exploration and/or delineation wells to allow time for a development scenario to be generated and for equipment to be built or procured. For all new leases issued in the five-year period following issuance of this opinion (i.e., through about 2029), the Bureaus estimate the following annual activity levels for exploration and delineation wells that were revised for this consultation based on activity levels since the 2020 opinion was issued:

- WPA: 0-4 exploration and delineation wells annually
- CPA: 12-33 exploration and delineation wells annually

For all new leases issued in the five-year period following issuance of the opinion (i.e., through about 2029), BOEM and BSEE estimate the following activity levels for development and production wells that were revised for this consultation based on activity levels since the 2020 opinion was issued:

- WPA: 0-9 development and production wells annually
- CPA: 26-103 development and production wells annually

Exploration and delineation wells are typically drilled with MODUs; for example, jack-up rigs, semi-submersible rigs, submersibles, platform rigs, or drill ships. Non-MODU drilling units, such as inland barges, are also used. The type of rig chosen to drill a prospect depends primarily on water depth. The depth ranges for exploration rigs are in Table 8.

Table 8. Drilling rig types typically associated with each corresponding depth range (BOEM 2017b, pgs 3-18)

MODU or Drilling Rig Type	Water Depth Range (meters)
Jack-up, submersible, and inland barges	≤ 100
Semi-submersible and platform rig	100-3,000
Drillship	≥ 600

An average exploration well requires 30-120 days (mean of 60 days) to drill. The actual time for each well depends on many factors, including the depth of the prospect's potential target zone, the complexity of the well design, and the directional offset of the wellbore needed to reach a particular zone. A typical scenario assumes that the average exploration or delineation well depth will be approximately 12,055 ft (3,674 m) below mudline.

Figure 6 shows a generic well schematic for a relatively shallow exploration well in the deepwater Gulf of America. This well design was abstracted from actual well-casing programs from projects in the Mississippi Canyon and De Soto Canyon OCS areas and from internal BOEM data. A generic well configuration cannot capture all of the possible influences that can impact how a well is designed. These influences include (1) unique geologic conditions at a specific well location, (2) directional drilling requirements, (3) potential sidetrack(s), and (4) company preferences. For exploratory wells, contingencies (such as anticipated water-flow zones in the formation) must also be considered in the casing program.

Delineation and production wells are sometimes collectively termed "development wells." A development well is designed to extract resources from a known hydrocarbon reservoir. Sometimes an operator will decide to drill a series of development wells, move off location, and then return with a rig to complete all the wells at one time. If an exploration well is clearly a dry hole, the operator permanently abandons the well without delay. BOEM estimates that 89-90 percent of development wells will become "producing wells." Development wells may be drilled from movable structures, such as jack-up rigs, fixed bottom-supported structures, floating vertically moored structures, floating production facilities, and drill ships (either anchored or dynamically positioned drilling vessels). The range of these production systems are shown in Figure 7. The typical process includes setting and cementing the production casing, installing some down-hole production equipment, perforating the casing and surrounding cement, treating the formation, setting a gravel pack (if needed), and installing production tubing. One form of formation treatment is known as fracking, or hydraulic fracturing, which is pressurizing the well to force chemicals or mechanical agents into the formation. Mechanical agents, such as sand or small microspheres (tiny glass beads), can be used to prop open the created factures which then act as conduits to deliver hydrocarbons to the wellbore. Well treatment chemicals are commonly used to improve well productivity. Well completion techniques and chemicals vary depending on the rock properties of the reservoir. For example, acidizing a reservoir to dissolve cementing agents and improve fluid flow is the most common well treatment in the Gulf of America. BOEM (2017a) describes a typical process after the casing has been cemented, as to perforate the casing and cement, inject water, brine or gelled brine as carrier fluid for a "frac pack"/sand proppant pack and gravel pack; treating/acidizing the reservoir formation near the wellbore; installing production screens; running production tubing; and installing a production tree. More than 65 percent of the well completions may use frac-packs, or fracturing and gravel packing completion (BOEM 2017a). Well stimulation activities are BSEE-regulated by an "Application for Permit to Modify."

In contrast to onshore fracking in low-permeability shale reservoirs, the majority of fracking offshore are frac-packs, which are small scale by comparison and most commonly used for high-permeability formations to reduce the concentration of sand and silt in the produced fluids and maintain high flow rates. Frac-packs, which use similar chemicals as those onshore, also remain proximally close to the borehole (usually less than about 30 m) (BOEM 2017a).

The type of production structure (Figure 7) installed at a site depends mainly on water depth, but also on the total facility lifecycle, the type and quantity of hydrocarbon production expected, the number of wells to be drilled, and the number of anticipated tie-backs from other fields. All of these factors can influence an operator's procurement decision. The number of wells per structure varies according to the type of production structure used, the prospect size, and the drilling/production strategy deployed for the drilling program and for resource conservation.

Production systems can be fixed, floating, or subsea. BOEM has described and characterized production structures in its deepwater reference document (BOEM 2017a). In water depths of up to 1,312 ft (400 m), a typical scenario assumes that conventional, fixed platforms that are rigidly attached to the sea floor will be the type of structure preferred by operators. In water depths of less than 656 ft (200 m), 20 % of the platforms are expected to be manned (defined as having sleeping quarters on the structure). In depths between 656 and 1,312 ft (200 and 400 m), all structures are assumed to be manned. It is also assumed that helipads will be located on 66 % of the structures in water depths less 197 ft (60 m), on 94% of structures in water depths between 197 and 656 ft (60 and 200 m), and on 100 % of the structures in water depths greater 656 ft (200 m). At water depths greater than 1,312 ft (400 m), platform designs based on rigid attachment to the sea floor are not expected to be used. The 1,312-ft isobath appears to be the current economic limit for this type of structure.

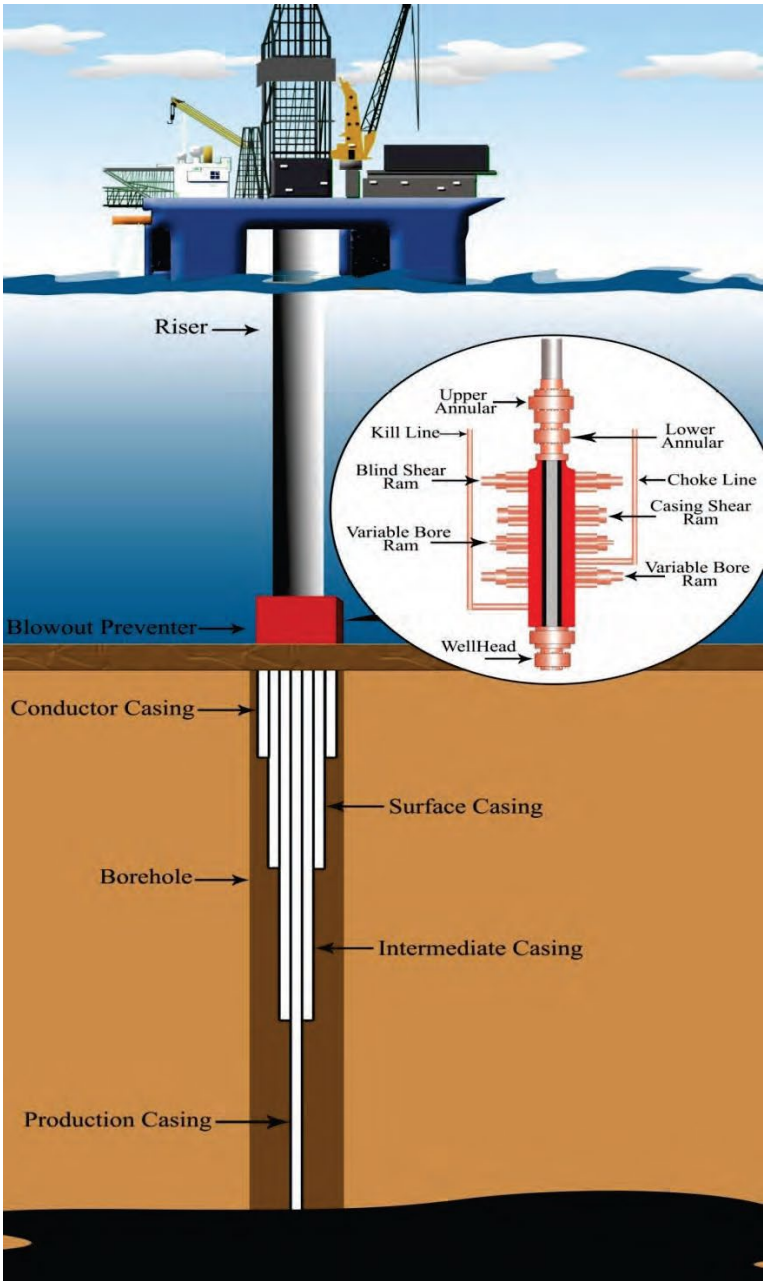


Figure 6. General well schematic (BOEM 2017b)

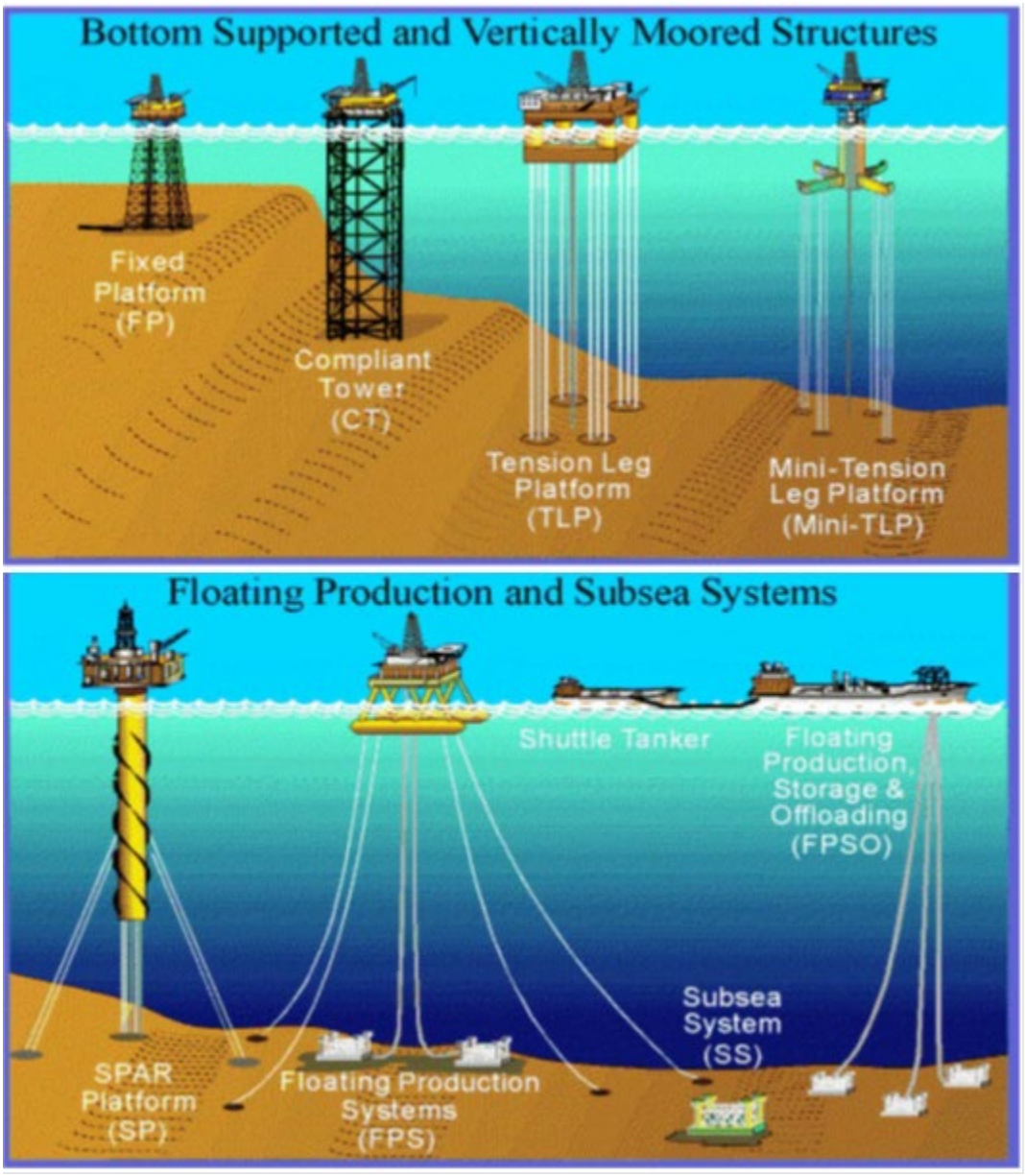


Figure 7. Deepwater development systems (BOEM 2017b)

High Pressure High Temperature Projects

BSEE defines high pressure (HP) as an internal absolute pressure rating greater than 15,000 pounds per square inch absolute (psia) at the wellhead and high temperature (HT) as a temperature rating greater than 350° F. Due to these high pressures and/or temperatures, special equipment that complies with BSEE's HPHT regulations, including the *Oil and Gas and Sulfur Operations in the Outer Continental Shelf High Pressure High Temperature Updates* (89 FR 71076, effective October 29, 2024) and guidance is necessary for drilling, completing, and producing HPHT wells. BSEE considers HPHT equipment to be nonconventional technology, and production from HPHT wells requires a high level of scrutiny during the plan approval process.

HPHT wells have HPHT properties at the wellhead. Industry has successfully drilled HPHT wells both onshore and in shallow water offshore since the 1970s (OOC 2018). Conventional subsea oil and gas equipment can be used to discover reservoirs that have HPHT properties, but those wells cannot be produced using conventional subsea equipment because the conventional equipment cannot replace the drilling mud to complete the well and conventional subsea equipment cannot withstand the pressures or temperatures of the HPHT environment. Due to the HPHT conditions, special subsea equipment must be fabricated to withstand high pressures and/or temperatures to complete and produce HPHT wells. BSEE is collaborating with industry to develop subsea HPHT equipment as the technology is developed and proven successful. Future standards for subsea HPHT designs will be based on and updated with proven technology (OOC 2018).

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To implement the new technology before engineering standards for subsea oil-field equipment are fully developed and adopted, BSEE conducts stepwise, detailed evaluations of HPHT applications according to NTLs for HPHT development (NTL 2019-G02, “Guidance for Information Submissions Regarding Proposed High Pressure and/or High Temperature (HPHT) Well Design, Completion, and Intervention Operations”; NTL 2019-G03, “Guidance for Information Submissions Regarding Site Specific and Non-Site Specific HPHT Equipment Design Verification Analysis and Design Validation Testing ”; and NTL 2019-G04, “Requesting Approval to Consider External Hydrostatic Pressure Effects When Calculating Internal Pressure Containment Capability for Pressure Containing and Pressure Controlling Subsea Equipment ”). HPHT equipment must be qualified and reviewed by BSEE before it can be manufactured and used for a site-specific project. Operators must verify and validate HPHT components to ensure that they are fit-for-service. They must be able to show that potential failures are mitigated before any designs are verified. No equipment design can be used in the field until it has gone through design verification analysis and design validation testing for the prototype.

Risk assessments for new and emerging equipment provide a supplemental method for identifying and mitigating risks of accidents, to protect human safety and marine life. The development of standards for design, manufacture, and testing of HPHT equipment will help to minimize the risk of structural failure or the fatigue failure of equipment that could result in an oil spill due to loss of containment.

In addition to HPHT standards, other requirements must be met before an operator obtains a permit to drill, complete, and produce a subsea HPHT well. Both BOEM and BSEE conduct a

rigorous permit review process that includes technical, safety, and environmental reviews. BSEE procedures currently require that every technology review include an analysis of the mechanical barriers in place to keep oil and gas from escaping in the event of a failure. Comprehensive testing and approval processes for the deployment of non-conventional HPHT subsea technology substantially reduces the risk of potential accidents. To ensure safety, BSEE also inspects equipment before it is used.

Industry has been working on subsea HPHT technology for many years. However, engineering standards take time to create following the development of new technology. Therefore, the implementation of new HPHT technology, or non-conventional technology, has preceded the development of an engineering standard (Pallanich 2017). Numerous HPHT engineering standards for subsea oil-field equipment are currently being developed to address these advancements in technology. The challenge has been to understand how to adapt existing engineering design methods to the design of subsea oil-field equipment using materials that can withstand the HPHT environment. To implement the new technology before development of engineering standards for subsea oil-field equipment, BSEE evaluates HPHT applications according to recently published guidelines.

HPHT equipment must be qualified and reviewed by BSEE before it can be manufactured and used for a site-specific project. Operators must verify and validate HPHT components to ensure that they are fit-for-service for a site-specific project. They must be able to show that potential failures are mitigated before any designs are verified and validated to be fit -for-service. No equipment design can be used in the field until it has gone through design verification analysis and design validation testing for the prototype.

For HPHT equipment to be verified, it must pass a design verification analysis, which determines if the equipment is able to withstand potential modes of failure. During design verification analysis, several verification analytical checks occur, including plastic collapse (burst/rupture checks), local failure (strains exceed certain limits), ratcheting (deformation), bolting, and fatigue analysis using fracture mechanics or nominal stress (S/N) methods. Seal testing cannot be done analytically and must be done with a physical test.

After verification, HPHT equipment must pass validation testing defined by engineering standards. A prototype is physically tested to ensure that it performs in the HPHT environment in order to demonstrate compliance with specification requirements. Validation testing may include pressure testing, bending testing, compression testing, tension testing, and other tests as defined based on the potential modes of failure.

BSEE uses independent third parties (I3P) to review the design verification analysis and design validation testing during the approval process. After the equipment is qualified through design verification analysis and validation testing, the I3P must review, analyze, and summarize their findings. The I3P and operator review the original equipment manufacturer (OEM) qualification documents and submit comments to the OEM separately. The OEM resolves all comments and

then releases the documents to the I3P to prepare summary reports for submittal to BSEE during the permit application process. These reports become part of the permanent BSEE record and are an integral part of the approval process (OOC 2018).

An operator must submit an associated EP, DPP, or DOCD to BOEM and several applications to BSEE for HPHT projects, Application for Permit to Drill (APD), Application for Permit to Modify (APM), and DWOP. Many of the applications also include I3P verification for new technology. Though standards are still being developed for HPHT equipment, BSEE has published guidance on requirements for HPHT projects based on research and collaboration with industry over the past decade. To provide operators with guidance on BSEE requirements for HPHT projects, BSEE published a series of NTLs.

3.1.4.7 Vessel Operations

The Gulf of America Oil and Gas Program involves the operation of a variety of vessels. These include service vessels, barges, tankers, and G&G survey vessels. Vessel characteristics are determined by activity. For example, there may be vessels specific to anchor handling or pipe laying. Following are descriptions of the types of vessels used in the Gulf of America oil and gas program.

Service Vessels

Service vessels transport personnel and supplies between service bases (Figure 8) and offshore platforms, drilling rigs, derrick barges, and pipeline construction barges. Service vessels carry fresh water, fuel, cement, barite, liquid drilling fluids, tubulars, equipment, food, and other supplies to offshore sites. These vessels are usually fast moving and smaller relative to the larger drilling and production vessels associated with the program. A trip is considered the transportation from a service base to an offshore site and back; in other words, a round-trip. BOEM anticipates the following levels of vessel trips over a 5-year period for leases sold between 2025 and 2029:

- WPA: 1,000-30,000 service vessel trips annually.
- CPA: 46,000-134,000 service vessel trips annually.

For cumulative scenarios over the next 70 years, BOEM estimates between 55,842 and 169,614 service vessel trips annually BOEM (2017a), which based on a comparison to an estimate of the total vessel traffic in the Gulf of America in 2022, represents between six and 19% of all vessel traffic. All trips are assumed to originate from the designated service base to an offshore site and back.

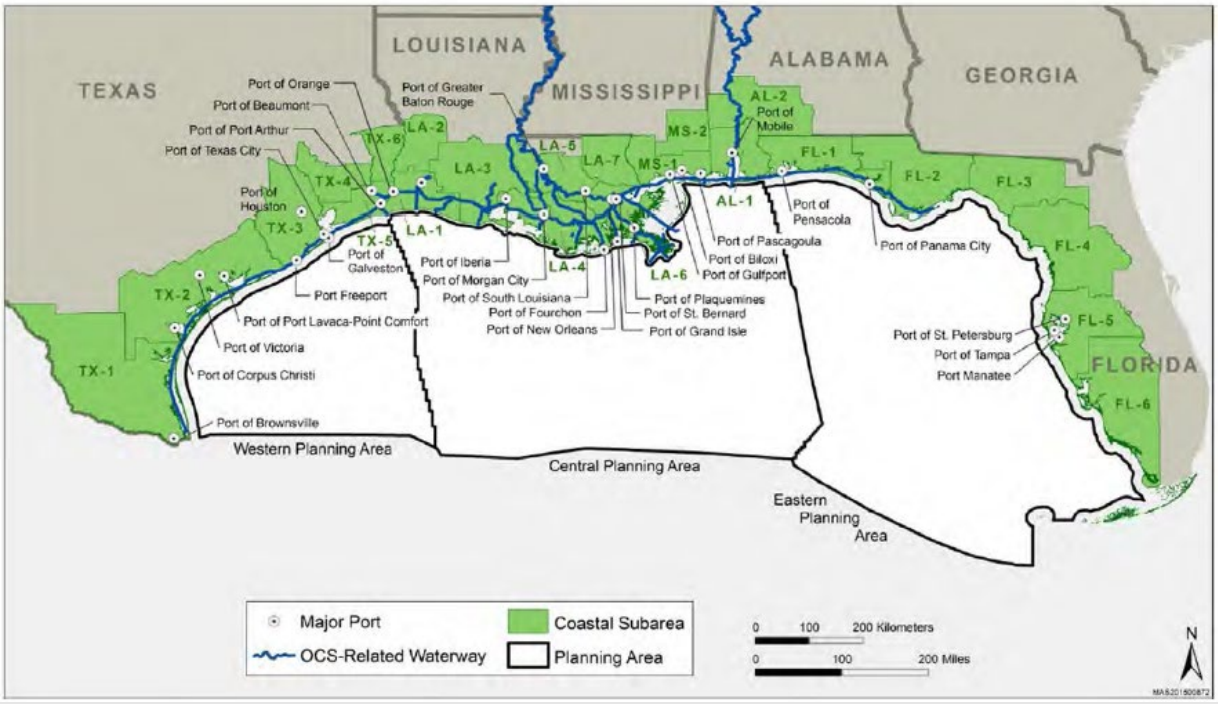


Figure 8. OCS-related service bases in the Gulf of America (BOEM 2017b)

Service vessels primarily used in deep water are offshore supply vessels (OSVs), fast supply vessels, and anchor-handling towing supply/vessels (AHTSs). The USCG defines an offshore service vessel (OSV) as a vessel propelled by machinery other than steam that is of more than 15 gross tons and less than 500 gross tons and that regularly carries goods, supplies, individuals in addition to the crew, or equipment in support of exploration, exploitation, or production of offshore mineral or energy resources (46 CFR 90.10-40). Other deepwater specialty service vessels are well stimulation vessels. The OSVs and AHTSs carry the same type of cargo (i.e., fresh water, fuel, cement, barite, liquid drilling fluids, tubulars, equipment, food, and miscellaneous supplies) but have different functions. The AHTSs also differ from the supply vessels by their deepwater mooring deployment and towing capabilities.

Barges

Barges may be used to transport oil and gas, supplies such as chemicals or drilling mud, or wastes between shore bases and offshore platforms. Barges are non-self-propelled vessels that must be accompanied by one or more tugboats. Because of this, barge transport is usually constrained to shallow waters, close to the shoreline. Barging of OCS oil from platforms to shore terminals is an option used by the oil industry in lieu of transporting their product to shore via pipeline. A platform operator generally decides at the beginning of a development project whether the production will be barged or piped. Barging is used infrequently as an interim transport system before the installation of a pipeline system. About one percent of the oil produced in less than 60 meters in both the WPA and the CPA during the action is expected to be

barged to shore. Over the 40-year life of the leases, less than one percent of the total oil produced is expected to be barged.

Other types of barging operations may be carried out in connection with OCS operations. Besides barging from platform to shore terminal, some platform operators choose to barge their oil to other platforms where it is then off-loaded to storage tanks and later piped to shore. Barges may be used to transport oil from deepwater sites during extended well testing, an activity that is likely to increase in the future. Storage and barging of the well stream from extended well tests is an alternative to flaring the gas and burning the liquids produced during well testing. No information is currently available on the number of barge trips associated with these other types of offshore oil barging operations.

Tankers

Tankers are used to transport oil from floating production and storage and off-loading units (FPSOs). FPSOs are floating production systems that store crude oil in tanks located in the hull of the vessel and that periodically off-load the crude to shuttle tankers for transport to shore. FPSOs may be used to develop marginal oil fields or to access areas too distant from the existing OCS pipeline infrastructure. Shuttle tankers vary in size, but they are primarily limited by the 34- to 47-ft water depths of U.S. Gulf Coast refinery ports. Because of these depth limitations, shuttle tankers are likely to have a cargo capacity of between 500,000-550,000 barrels (bbl). All shuttle tankers are required to be double hulled.

In the Gulf of America, two FPSO systems – one associated with the Cascade Chinook Project, and another associated with the Shell Stones Project – have shuttle tankers currently in operation. These tankers make seven-day round trips to refineries along the Gulf Coast, serving an area from Corpus Christi, Texas, to Pascagoula, Mississippi. As new wells and FPSOs enter into operation, additional shuttle tankers will be put into service and will visit FPSOs every three to five days. BOEM projects that, in the next 70 years, at a maximum one new FPSO system would be put in place. For this FPSO, as well as the two currently in operation, BOEM estimates that when operating at maximum capacity, maximum offloading would occur once every 3.3 days, which would equate to 110 shuttle tanker transits across the Gulf of America annually per FPSO (BOEM 2017c).

Vessels Associated with Geological and Geophysical Activities

G&G activities are also expected to produce vessel traffic. BOEM estimated those levels, which are displayed in Table 9.

Table 9. Annual vessel traffic associated with G&G activities

Survey Type	Projected Vessel-Months[A]	Estimated Transits to Shore Base for Survey Vessels	Estimated Transits to Shore Base for Service Vessels
Vessel Based (2D, 3D, 4D, WAZ)	345	32.8	1,936.8
Platform Based (VSP, SWD)	6.6	16.5	1.9
Vessel Based (Non-Airgun HRG)	7.2	28.8	0
Other	1.7	2.4	10.7
Oil and Gas G&G Activities	Subtotal	80.5	1,949.4

A - Vessel months are used as a measure of vessel utilization, or vessel activity, necessary to complete the data acquisition. Vessel months were calculated by multiplying the projected number of survey events times the mean number of vessels used in that survey type times the mean duration of that survey type. 2D = two-dimensional; 3D = three-dimensional; 4D = four-dimensional; G&G = geological and geophysical; HRG = high-resolution geophysical; SWD = seismic while drilling; VSP = vertical seismic profile; WAZ = wide azimuth (survey).

Vessel Operation Conservation Measures

To minimize the potential for vessel strikes to marine animals, the Bureaus programmatically apply a protocol, "*Vessel Strike Avoidance and Injured and/or Dead Aquatic Protected Species Reporting,*" which clarifies 30 C.F.R. §550.282 and 30 C.F.R. §250.282 and incorporates the vessel strike avoidance measures recently updated through consultation with NMFS. The Bureaus monitor for any takes that occur because of vessel strikes and require that any operator immediately report the striking of any marine animal (30 C.F.R. §550.282, 30 C.F.R. §250.282, and vessel strike protocol). These measures will continue being applied under the program into the foreseeable future.

3.1.4.8 Helicopter Operations

For all new leases issued in the 5-year period following issuance of this opinion (i.e, through about 2029), the Bureaus estimate the following annual helicopter activity levels (see also Table 10 below for G&G activity level estimations), which have been updated for the reinitiation:

- WPA: 0-3,000 helicopter trips annually.
- CPA: 0-29,000 helicopter trips annually.

Helicopters are a primary mode of transporting personnel between service bases and offshore platforms, drilling rigs, derrick barges, and pipeline construction barges. Helicopters are routinely used for normal crew changes and at other times to transport management and special service personnel to offshore exploration and production sites. Equipment and supplies are sometimes transported via helicopter as well. Protected species surveys during decommissioning activities also utilize helicopters. Helicopter trips are considered a flight segment; that is, from a take-off to a landing, regardless of other stops offshore. In areas of heavy industry activity, helicopter segments can be a matter of minutes, hopping from one structure to the next. To meet

the demands of deepwater activities, the offshore helicopter industry is purchasing new helicopters that travel farther and faster, carry more personnel, are all weather capable, and have lower operating costs. The number of helicopters operating in the Gulf of America is expected to decrease in the future as helicopters that operate are expected to be larger and faster.

Table 10. Helicopter traffic associated with G&G activities over 10 years (BOEM 2017e)

Survey Type	Estimated Helicopter Transits Needed to Support Surveys
Vessel Based (2D, 3D, 4D, WAZ)	7,329
Platform Based (VSP, SWD)	168
Vessel Based (Non-Airgun HRG)	0
Other	0
Oil and Gas G&G Activities Total	7,497

2D = two-dimensional; 3D = three-dimensional; 4D = four-dimensional; G&G = geological and geophysical; HRG = high-resolution geophysical; SWD = seismic while drilling; VSP = vertical seismic profile; WAZ = wide azimuth (survey).

3.1.4.9 Offshore Infrastructure/Construction

Following 30 C.F.R. §250.900 lessees need to obtain approval before installing or modifying a platform. For all new leases issued in the 5-year period following issuance of the opinion (i.e., through about 2029) for this consultation, the Bureaus estimate the following activity levels for installation of OCS structures:

- WPA: 0-1 installation of OCS structures annually.
- CPA: 0-5 installations of OCS structures annually.

BSEE does a technical review of all proposed OCS oil and gas structure designs and installation procedures. All proposed facilities are reviewed for structural integrity. The lessee must design, fabricate, install, use, inspect, and maintain all platforms and structures on the OCS to assure their structural integrity for the safe conduct of operations at specific locations. Applications for platform and structure approval are filed in accordance with 30 C.F.R. §250.901. Design requirements are presented in detail at 30 C.F.R. §§250.904-250.909. The lessee evaluates characteristic environmental conditions associated with operational functions to be performed. Factors such as waves, wind, currents, tides, temperature, and the potential for marine growth on the structure are considered. In addition, pursuant to 30 C.F.R. §§250.902 and 250.903, BSEE has established a program to assure that new structures meeting the conditions listed under 30 C.F.R. §250.900(c) are designed, fabricated, and installed using standardized procedures to prevent structural failures. After installation, platforms and structures are required to be periodically inspected and maintained under 30 C.F.R. §250.912.

Types of Offshore Structures

Bottom-founded or floating structures may be placed over development wells to support production from a prospect. These structures provide the means to access and control the wells.

They are a staging area for processing and treating produced hydrocarbons from the wells, initiating export of the produced hydrocarbons, conducting additional drilling or reservoir stimulation, conducting workover activities, and carrying out eventual abandonment and decommissioning procedures. The variety of offshore infrastructure installed for hydrocarbon production includes fixed and floating platforms, caissons, well protectors, casing, wellheads, and conductors, and pipelines. Subsea wells may also be completed to produce hydrocarbons from the shelf and in the deepwater portions of the Gulf of America. The subsea completions require a host structure to control their flow and to process their well stream. The subsea well is controlled via an umbilical cable from the host.

Fixed, jacketed platforms are the most common surface structures in the Gulf of America and account for about 60% of all bottom-founded surface structures on the shallow continental shelf. Fixed platforms are brought on location as complete units or in sections on an installation barge towed by powerful tugboats. If the structure is fabricated in sections, it is generally composed of two segments called the *jacket* (the lower portion) and the *deck* (the portion above the water line). The platform's tubular-steel jacket is then launched from a barge, upended, and lowered into position by a derrick barge with a large crane. The jacket is anchored to the sea floor by piles driven through the legs. The deck section with one or more levels is then lifted atop the jacket and welded to the foundation. The platform may have a helipad installed on its deck section. Platforms may or may not be manned continuously.

Caissons, the second most numerous structures, account for about 30% of bottom-founded, surface structures in the Gulf of America. Caissons are located primarily on the shallow continental shelf. Simpler in design and fabrication than traditional jacketed platforms, most caissons consist of a steel pipe that generally ranges from 36-96 in (91-244 cm) in diameter. The caisson pipe is driven over existing well(s) to a depth that allows for shoring against varying sea states. Though primarily installed for well protection, some caissons may also be used as foundations for equipment and termination or relay points for pipeline operations.

Well protectors account for about ten percent of all bottom-founded surface structures in the Gulf of America. Well protectors are used primarily to safeguard producing wells and their production trees from boat damage and from battering by storms and floating debris. Similar to fixed platforms, well protectors consist of small piled jackets with three or four legs generally less than 36 in (91 cm) in diameter, which may or may not support a deck section.

Installation of Structures

Structure installation and commissioning activities may take place over a period of a week to a month, typically at the beginning of a platform's potential 40-year production life. Commissioning activities involve the emplacement, connecting, and testing of the structure's modular components that are assembled on site. The time required to complete the operations to start production at a structure depends on the complexity of its facilities. To keep floating structures on station, a mooring system must be designed and installed. Lines to anchors or piling

arrays attach the floating components of the structure. With a tension leg platform (TLP), tendons stem from a base plate on the sea bottom to the floating portion of the structure. Most exploration drilling, platform, and pipeline emplacement operations on the OCS require anchors to hold the rig, topside structures, or support vessels in place. Anchors disturb the sea floor and sediments in the area where dropped or emplaced. Dynamically positioned rigs, production structures, and vessels are held in position by four or more propeller jets and do not cause anchoring impacts. Mooring buoys may be placed near drilling rigs or platforms so that service vessels need not anchor or for when they cannot anchor (in deeper water). The temporarily installed anchors for these buoys are usually smaller and lighter than those used for vessel anchoring and, thus, will have less impact on the sea bottom. Moreover, installing one buoy will preclude the need for numerous individual vessel-anchoring occasions. Service vessel anchoring is assumed not to occur in water depths greater than 150 m (492 ft) and only occasionally in shallower waters (vessels would always tie up to a platform or buoy in water depths greater than 150 m). Barges generally tie up to a production system rather than anchor. Barges and other vessels are also used for both installing and removing structures. Barge vessels use anchors placed away from their location of work.

Modification of Structures

Modification of platform structures may be required to repair damage to or materially alter the platform for new operations. These modifications can be major, where structural components of the platform are modified or the loading on the platform is increased by 10% or more. They can also be minor, where smaller components of the platform are modified, added, or removed. The majority of structure modification work occurs above the water. Structure modification operations that include in water work are carried out the same as structure installation operations.

Pile Driving of Structures

In addition to various pieces of support equipment used in construction, such as vessels and cranes, pile driving is the primary method by which fixed structures are attached to the sea floor and provide stability for other support structures. Classified as either impact hammers or vibratory hammers, the design of the pile driving hammer assembly varies depending upon the medium powering the system; however, most assemblies contain a specialized control unit, piston, ram, and anvil. The impact hammer systems used for OCS-related work predominantly utilize steam, pneumatic, or hydraulic assemblies. Most of the steam and pneumatic systems used in the Gulf of America are limited to surface operations and have energy outputs (torque) ranging from 15,000-60,000 ft/pound (lb; 20-82 kilonewton meters [kNm]). Hydraulic impact hammer systems can be used in both surface and subsea operations and most generally range from 11,000-370,000 ft/lb (15-500 kNm). Almost all vibratory hammer systems use hydraulic power and, due to their configuration, they can be used for both surface and subsea operations. All activities proposing use of vibratory hammers will be sent to NMFS for project-specific review before receiving approval. Plan and permit proposals sent to NMFS for project-specific review will include detailed descriptions of proposed vibratory hammer activities.

Operators determine the type and size of pile driving equipment they require based upon the dimensions and design of the object being driven, water depths, equipment configuration (surface vs. subsea), sediment/substrate types, and the nature of the operations being conducted. Sediment types are varied in the Gulf of America, but for shallow sea bed activities such as these they are generally classified as consisting of muds (directly off river deltas/outlets), clays (mostly from the Louisiana-Texas border westward), and unconsolidated sands or silt (most of the shelf of the Northern Gulf of America). Each sediment type offers differing levels of friction that must be overcome to allow the pile to penetrate to a sufficient depth. There are two primary pile-driving operations on the OCS: (1) the setting of casing conductors (also known as drive pipe) for drilling operations, and (2) pile emplacement for securing oil and gas structures and facilities to the seafloor. Table 11 summarizes pile-driving activity in the Gulf of America between 2020 and 2023.

Table 11. Bureau-reported pile-driving data from 2020-2023

Impact Hammer Size	Number of Pile Drivings	Object Driven	Avg Object Diameter (in)	Objects Driven per Activity	Avg Total Strikes	Avg Water Depth (ft)	Avg Strikes per ft	Avg Highest Hammer Energy (kJ)	Avg Drive Depth BML (ft)	Avg Pile Driving Hours per Day
S-90	27	Well conductor/ Drive pipe	24	1	6827.7	191.2	29.2	61.4	264.3	4.4
S-150	3	Well conductor/ Drive pipe	27.3	1	8437.5	941	48.5	129.1	575.3	6.2
S-280	1	Caisson/ pile	36	3	5234.7	285	29.5	252.5	174.7	2.2

From (BOEM and BSEE 2024).

Casing Conductor (Drive Pipe) Installation

Due to the frequency of exploratory and development drilling operations on the OCS, the greatest number of pile-driving operations involve the setting or installation of casing conductors. Most casing conductors range in diameter from 12-36 in (30-92 cm) and have wall thicknesses that run from 0.25-0.75 in. These are generally driven into the substrate until the conductor "meets refusal" or cannot be driven further without damage. Conductor casings can also be jetted into the sea bed; however, the ease of mobilization of hammer drivers coupled with their speed of penetration, minimizes the use of jetting equipment, which requires more time to deploy and is often unviable due to water depth and sediment type. Most casing conductor driving operations occur in water depths less than 200 m. Based on the number of activities since 2020, BOEM estimates three to twelve well drive pipe installations per year using impact pile driving (including new wells and side tracking with slot recovery) total for exploratory and development drilling operations. This estimate should be caveated due to limitations of oil and gas exploration and production during the COVID-19 pandemic and oil and gas pricing from 2020-2022.

Structure/Facility Pile Installation

Pile-driving operations are also conducted during oil and gas structure/facility installations on the Gulf of America OCS. Structure piles are generally forged or rolled-sheet constructed steel pipes that range in diameter from 24-96 in (61-244 cm) and have wall thicknesses that run from 0.5-2 in. The piles are inserted into the legs of the platform jackets, along the inner wall of a caisson, or into sleeves configured into skirt bracings or sea floor templates for structures in certain deepwater/unstable environments. As with conductor casings, piles are generally driven into the substrate until it "meets refusal" or reaches a sufficient depth to ensure stability. Once set to the proper depth/refusal, the pile is then welded or grouted to the jacket leg, caisson, or sleeve to affix the facility to the seafloor. Installing structure piles requires the use of larger hydraulic impact hammers such as an IHC S-280 (280 kNm maximum energy capacity). Once set to the proper depth and/or refusal, the pile is then welded or grouted to the jacket leg, caisson, or sleeve to affix the facility to the seabed. Most structure installation pile driving operations occur in water depths less than 200 meters. Impact pile driving is anticipated to occur in some, but not all, structure installation and modifications in depths below 200 m. Based on the number of activities since 2020, BOEM estimates zero to two structure installations or major modifications (three-four piles per structure) per year using impact pile driving throughout the Gulf. This estimate should be caveated due to limitations of oil and gas exploration and production during the COVID-19 pandemic and oil and gas pricing from 2020-2022.

Deepwater and subsea installations primarily use suction embedding (anchor piles), but some vibratory-hammer pile installation work is still conducted on the shelf to 'pin' the jacket assembly to the seabed prior to deck installation (Scaggs 2010). Based on the number of shelf facilities installed over the last five years, BOEM/BSEE estimate about 20 structures annually (with an average of approximately four-piles per structure), all of which are projected to be in less than 150-meters water depth. Because BOEM does not require pile-installation reporting under OCSLA regulations, a projection of 80 instances of vibra-hammer use per year is estimated.

Pipelines

Pipelines are the primary means of transporting produced hydrocarbons from offshore oil and gas fields to distribution centers or onshore processing points. Pipelines on the OCS are designated as either gathering lines or trunklines. Gathering lines are typically shorter segments of small-diameter pipelines (generally 4-12 inches [10-30 centimeters]) that transport the well stream from one or more wells to a production facility or from a production facility to a central facility serving one or several leases (e.g., a trunkline or central storage or processing terminal). Trunklines are typically large-diameter pipelines (as large as 36 in [91 cm]) that receive and mix similar production products and transport them from the production fields to shore (Table 12). A trunkline may contain production from many discovery wells drilled on several hydrocarbon fields. The OCS-related pipelines near shore and onshore may merge with pipelines carrying materials produced in state territories for transport to processing facilities or to connections with pipelines located farther inland.

Pipelines are installed by lay barges that are either anchored or dynamically-positioned while the pipeline is laid. Conventional pipe-laying barges use an array of eight anchors that each weigh 9,000 kilograms (kg; 19,842 lb) to position the barge and to move it forward along the pipeline route. These anchors are continually moved as the pipe-laying operation proceeds. The area actually affected by these anchors depends on water depth, wind, currents, chain length, and the size of the anchor and chain. Pipeline sections may be welded together on a conventional lay barge as it moves forward on its route or they may be welded together at a fabrication site onshore and wound onto a large-diameter spool or reel. Once the reel barge is on location, the pipeline is straightened and lowered to the sea floor on its intended route. Both types of lay barge use a stinger to support the pipeline as it enters the water. The stinger helps to prevent undesirable bending or kinking of the pipeline as it is installed. In some cases, pipelines or segments of pipelines are welded together onshore or along a beach front area and then towed offshore to their location for installation.

BSEE is responsible for regulatory oversight of the design, installation, maintenance, and removal of OCS producer-operated oil and gas pipelines. The BSEE's operating regulations for pipelines, at 30 C.F.R. §250 Subpart J, are intended to provide safe and pollution-free transportation of fluids in a manner that does not unduly interfere with other OCS users.

The coastline marks the boundary that determines which agency is responsible for a facility. The BOEM/BSEE of the DOI is responsible for offshore facilities, including pipelines but not deepwater ports, located seaward of the coastline. The USEPA is responsible for non-transportation-related offshore facilities located landward of the coastline. The U.S. Coast Guard (USCG) and the Research and Special Programs Administration of the DOT will handle transportation-related offshore facilities, including pipelines, located landward of the coastline.

For all new leases issued in the 5-year period following issuance of the opinion (i.e., through about 2029) for this consultation, the Bureaus estimate the following activity levels:

- WPA: 0-18 km of pipelines annually
- CPA/EPA: 0-1,000 km of pipelines annually

For the OCS Program, which includes proposed lease sales in the WPA, CPA, and EPA, 0-12 new pipeline landfalls are projected from 2020 through 2070 (over the 40-year lease life for leases awarded during the first ten years after this opinion is issued). Most, if not all, of the OCS pipeline installed is expected to tie into the existing infrastructure.

Table 12. Outer continental shelf pipeline landfalls installed between 1996 and 2009

Segment Number	Year Installed	Product Type	Size (inches)	Company	State
10631	1996	Oil	24	Equilon Pipeline Company LLC	Louisiana
12470	1996	Oil	24	Manta Ray Gathering Company LLC	Louisiana
11217	1997	Gas	30	Enbridge Offshore	Louisiana

Segment Number	Year Installed	Product Type	Size (inches)	Company	State
11496	1997	Oil	12	ExxonMobil Pipeline Company	Louisiana
11952	2000	Oil	18-20	ExxonMobil Pipeline Company	Texas
14470	2004	Oil	10	Chevron USA Inc.	Louisiana
13972	2004	Oil	24	Manta Ray Gathering Company LLC	Texas
13987	2004	Oil	24	Manta Ray Gathering Company LLC	Texas
13534	2005	Oil	30	BP Pipelines (North America)	Louisiana
13534	2005	Oil	30	Mardi Gras Endymion Oil Pipeline Co.	Louisiana
17108	2007	Gas/ Condensate	16	Stone Energy Corporation	Louisiana
17691	2009	Gas/Oil	08	Stone Energy Corporation	Louisiana

BSEE evaluates the design, fabrication, installation, and maintenance of all OCS pipelines. BSEE evaluates proposed pipelines for an appropriate cathodic protection system that is required to protect the pipeline from leaks resulting from external corrosion of the pipe, an external pipeline coating system to prolong the service life of the pipeline, measures to protect the inside of the pipeline, proposed operating pressure of the line, and protection of other pipelines crossing the proposed route. BSEE also evaluates protective safety devices such as pressure sensors and remotely-operated valves, the physical arrangement of those devices proposed to be installed by the applicant for the purposes of protecting the pipeline from possible overpressure conditions and for detecting and initiating a response to abnormally low-pressure conditions. Proposed pipeline routes are evaluated for potential impacts on biological communities. Operators are required to periodically inspect pipeline routes and conduct monthly overflights to inspect pipeline routes for leakage.

3.1.4.10 Air Emissions

Air emissions are a component of offshore oil and gas operations. Various activities associated with offshore oil and gas development can release air pollutants to the atmosphere. Emissions are generated during exploration and production activities when fuels are combusted to power drilling rigs, engines and generators. Additional emissions come from helicopter and vessel traffic that support offshore operations, including seismic surveys, resupply missions, and personnel transport. Air pollutants are also released during venting and flaring events, to dispose of excess hydrocarbon vapors or natural gas. Flaring and venting may also be necessary to remove potentially damaging completion fluids from a wellbore and to provide sufficient reservoir data for the operator to evaluate reservoir development options during unloading/testing operations and/or in emergency situations. Current regulatory guidance for air

emissions can be found on BOEM's website at https://www.boem.gov/overview-air-quality-regulations.

The OCSLA (43 USC §1334(a)(8)) requires the Secretary of the DOI to promulgate and administer regulations for compliance with the NAAQS, pursuant to the CAA (42 USC §7401 et seq.), to the extent that authorized activities significantly affect the air quality of any state. Under provisions of the CAA Amendments of 1990, the USEPA Administrator has jurisdiction in OCS areas in the Gulf of America eastward of 87.5°W longitude (see Section 3.2.2for USEPA's air permitting action).Figure 9 displays the jurisdictional boundaries between BOEM and USEPA. BOEM implementing regulations in 30 C.F.R. § 550 Subpart C apply to those air emission sources in the Gulf of America westward of 87.5ºW longitude. BOEM issued NTL 2014-G01 that discusses collecting and reporting information through their online system to provide additional information on its oversight of air emissions on the OCS (https://www.boem.gov/BOEM-NTL-No-2014-G01/). USEPA's OCS Air Regulations at 40 C.F.R. Part 55 implement section 328 of the CAA and establish the air pollution control requirements for OCS sources and the procedures for implementation and enforcement of these requirements.

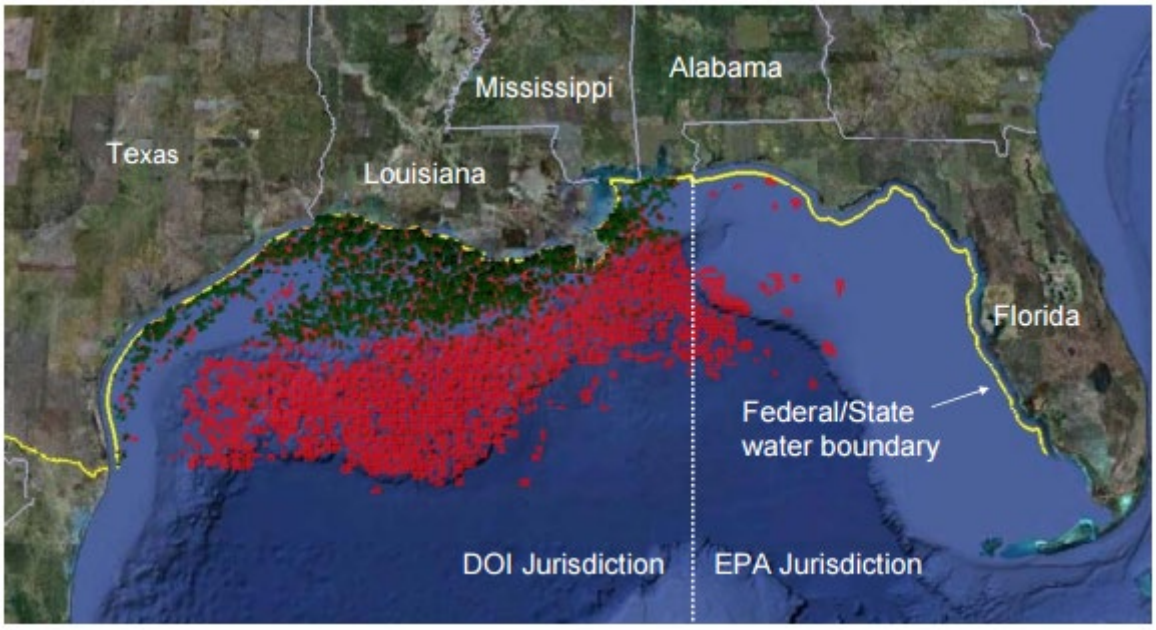


Figure 9. USEPA and BOEM air quality jurisdictional boundaries. Lease blocks that were active in 2012 are shown in red and dark green areas depict platforms (Ramseur 2012)

BOEM Air Quality Review Requirements

All new or supplemental EPs and DOCDs must include air emissions information sufficient to determine whether an air quality review is required (30 C.F.R. §§550.218 and 550.249). The BOEM regulations require a review of air quality emissions to determine if the projected emissions from a facility would be expected to result in onshore ambient air concentrations above BOEM significance levels. The regulated pollutants include carbon monoxide (CO),

particulate matter (PM_{10} and $PM_{2.5}$), sulphur oxides (SO_x), nitrogen oxides (NO_x), volatile organic compounds (VOCs), lead (Pb), ammonia (NH_3), and total suspended particulates (TSP).

The BOEM uses a two-level hierarchy of evaluation criteria to evaluate potential impacts of offshore emission sources to onshore areas. The evaluation criteria are the exemption level and the significance level. If the proposed activities exceed the criteria at the first (exemption) level, the evaluation moves to the significance level criteria. The initial evaluation compares the worst-case emissions to the BOEM exemption criteria. If the proposed activity emissions are below the exemption levels, the action is exempt from further air quality review. If exemption levels are exceeded, a second step of refined modeling is required using the American Meteorological Society/Environmental Protection Agency Regulatory (AERMOD) model or the California Puff (CALPUFF) model as outlined in NTL-2020-N02 (https://www.boem.gov/sites/default/files/documents/about-boem/NTL-2020-N02.pdf). The NTL identifies the approved air quality models for use in assessments within BOEM jurisdiction and provides background on BOEM's regulatory authority, the rationale for model selection, and the transition from previously used models. The NTL outlines the use of AERMOD for short-range transport (within 50 kilometers of the shoreline) and CALPUFF for long-range transport (beyond 50 kilometers). Additionally, the NTL allows for the consideration of alternative models on a case-by-case basis, following the guidelines in Appendix W of 40 CFR part 51 and approval from the BOEM Regional Director and/or Chief Environmental Officer.

The modeled potential onshore impacts are compared with BOEM significance levels. If these significance levels are exceeded in an attainment area (an area that meets applicable NAAQS), the operator would be required to apply best available control technology to the emissions source. If the affected area is classified as nonattainment, further emission reductions or offsets may be required.

According to BSEE, field compliance verification is conducted for air quality inspections on OCS facilities (BSEE presentation to NMFS, May 19, 2019). These efforts monitor active operations and determine compliance with environmental standards.

3.1.4.11 New or Unusual Technologies

Emergent technologies continue to evolve to meet the technical, environmental, and economic challenges of deepwater development. New or unusual technologies (NUTs) must be identified by the operator in its EP, DPP, DWOP, and DOCD or through BOEM's plan review processes.

Some new technologies differ from established technologies in how they function or interface with the environment. These include equipment or procedures that have not been installed or used in Gulf of America OCS waters. Having no operational history, they have not been assessed by BOEM (or NMFS) through technical and environmental reviews. New technologies may be outside the framework established by BOEM or BSEE regulations and, thus, their performance (e.g., safety, environmental protection, efficiency) has not been addressed by BOEM or BSEE. The degree to which these new technologies interface with the environment and the potential

impacts that may result are considered in determining the level of NEPA review that would be initiated.

Under any of the oil and gas program proposed activities, NUTs may be identified through the Bureaus' permitting process, by the operator in OCS plans and permit applications, or through the Bureaus' plan review and authorization processes. If BOEM's review of a permit or plan determines that a NUT is part of the proposed work, the permit or plan cannot be approved until an environmental assessment (EA) is prepared and a review of the plan is completed. BOEM does not designate specific technologies as NUT until industry identifies and brings them to BOEM for approval. Some of the technologies proposed for use by operators are often extended applications of existing technologies and interface with the environment in essentially the same way as well-known or conventional technologies. These technologies and any associated equipment or operations are reviewed by BOEM to determine if mitigation measures are required to reduce or negate unnecessary impacts to OCS resources. Some examples of new technologies that do not affect the environment differently and that are deployed in the Oil and Gas Program are synthetic mooring lines, subsurface safety devices, and multiplex subsea controls. Those that do not have an environmental effect that varies from what is considered in this opinion would not require further review or consultation with NMFS.

The degree to which these new technologies interface with the environment and the potential impacts that may result are considered in determining the level of NEPA review that would be initiated and whether project-specific review would be triggered as defined in this opinion.

BOEM has developed a NUT review checklist to help facilitate decisions on the appropriate level of engineering and environmental review needed for a proposed technology. The questions operators must address for a NUT review include:

1. Has the technology or hardware been used previously or extensively in the Gulf of America OCS Region under operating conditions similar to those anticipated for the activities proposed in this plan (therefore technically not considered NUT)?
2. Does the technology function in a manner that potentially causes different impacts to the environment than similar equipment or procedures did in the past?
3. Does the technology have a significantly different interface with the environment than similar equipment or procedures did in the past?
4. Does the technology include operating characteristics that are outside the performance parameters established by 30 C.F.R. §550?

A senior NEPA coordinator conducts the NUT Review with the assistance of the engineers in the BSEE Technical Assessment Section and the senior plan coordinator. Any proposed NUT that is determined to function in a manner that potentially causes different impacts to the environment than similar equipment or procedures did in the past or has a significantly different interface with

the environment than similar equipment or procedures did in the past will meet the extraordinary condition at 43 C.F.R. §46.215(d) and will be evaluated in an EA.

The BOEM has developed a NUT matrix to help facilitate decisions on the appropriate level of engineering and environmental review needed for a proposed technology. Technologies will be added to the NUT matrix as they emerge, and technologies will be removed from the matrix as sufficient experience is gained in their implementation. From an environmental perspective, the matrix characterizes new technologies into three categories: technologies that may affect the environment; technologies that do not interact with the environment any differently than "conventional" technologies; and technologies about which the Bureaus do not have sufficient information to determine their potential impacts to the environment. In this latter case, the Bureaus will seek to gain the necessary information from operators or manufacturers regarding the technologies to make an appropriate determination on potential effects on the environment.

The BSEE project-specific engineering safety review ensures that equipment proposed for use is designed to withstand the operational and environmental conditions in which it would operate.

3.1.4.12 Decommissioning and Structure Removal

Decommissioning requirements are described in 30 C.F.R. § 250.1700 (Subpart Q – Decommissioning Activities). On April 18, 2023, BSEE published a new rule to amend its regulations to clarify decommissioning responsibilities of right-of-use and easement (RUE) grant holders and to formalize BSEE's policies regarding performance by predecessors ordered to decommission OCS facilities (88 FR 23569).

The BSEE NTL 2018-G03, "Idle Iron Decommissioning Guidance for Wells and Platforms," clarifies existing regulations that wells that are not useful (i.e., no longer producing) are required to be plugged by set times implemented by BSEE, or one year after lease termination/expiration. Any well that became "idle" or not useful for lease operations subsequent to the NTL's publication is expected to be plugged no later than three years after the well became "idle." The NTL also clarifies that BSEE will enforce the decommissioning of platforms considered "idle" or no longer useful at the time the NTL was published. Any platform that became "idle" or not useful for lease operations subsequent to the NTL's publication is expected to be decommissioned no later than five years after the platform became "idle." BSEE regulations require the operator to sever bottom-founded objects and their related components at least 4.6 meters (15 feet) below the mudline. All oil and gas facilities and obstructions that would be severed for removal, referred to as target structures, include the following:

- Wellheads and conductors
- Subsea wellheads and conductors
- Subsea production devices (valve assemblies to produce the well, test the system, or shut-in operations)
- Jacketed platforms

- Caissons
- Well protectors (small piled jackets with or without a support deck)
- Cables, chains, and mooring lines
- Suction pile anchors
- Pipelines
- Cement structures and foundations

These are usually completely removed, with components being refurbished and reused, sold for scrap, or sent as waste to a landfill. In some cases, structures or equipment are decommissioned in place. These include pipelines in blocks without significant sediment resources; jacketed platforms, rarely including stripped topside/decks and/or conductors, caissons/well protectors integrated into larger jacket assembly, for artificial reefing (approximately 15-20/year); Subsea wellheads and casings in depths greater than 305 m (approximately 20-28/year); Suction pile anchors in depths greater than 800 m (approximately 1-3/ten-years); and short sections of cables, chains, and mooring lines attached to decommissioned in place suction pile anchors. Operators schedule most of their removal projects from June-December when seas are generally calm (Figure 10).

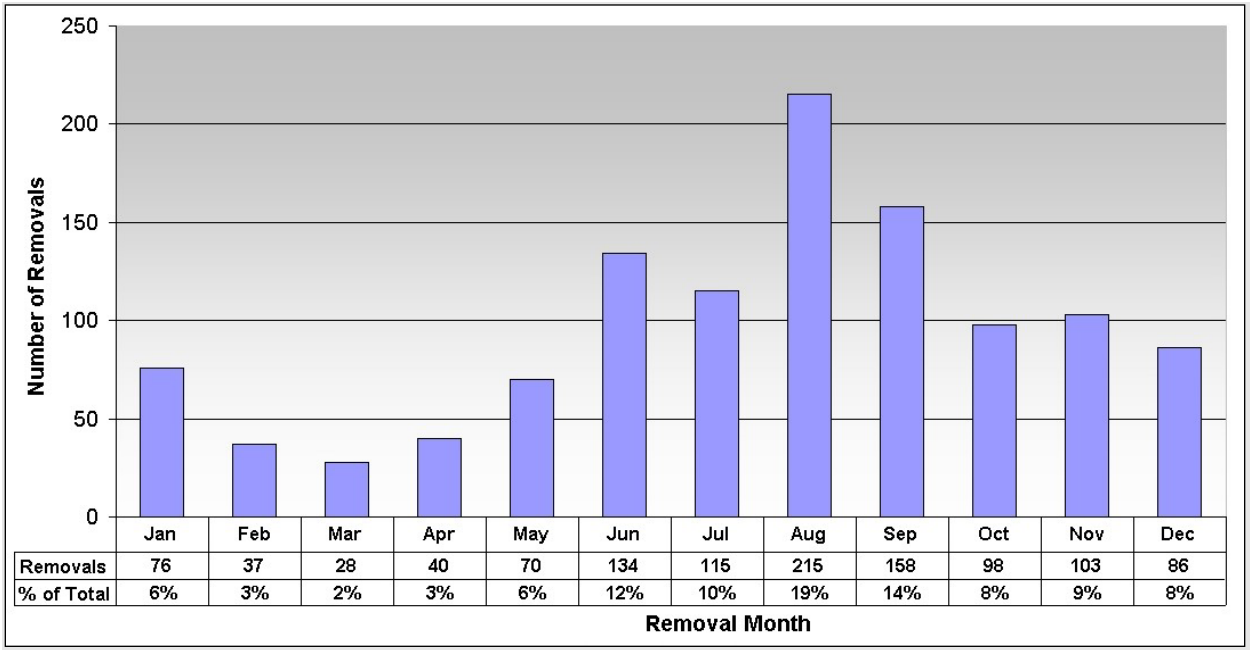


Figure 10. Seasonal trends of removal operations from 1994-2003 (Source: MMS data)

For each structure-removal operation, a project management team develops a decommissioning plan and schedule. The team could be within the company, an independent third party, or a specialized unit within a decommissioning contractor group. Decommissioning operations may employ a single "turn-key" salvage contractor (offers a complete removal package) or up to three

levels of subcontractors. Currently, there are six removal project management companies, seven derrick/lift vessel companies, about 12 non-explosive-severance companies, and two explosive-severance companies. Up to five companies provide turnkey contracts, for either explosive or non-explosive-severance work. Decommissioning options are presented in Figure 11.

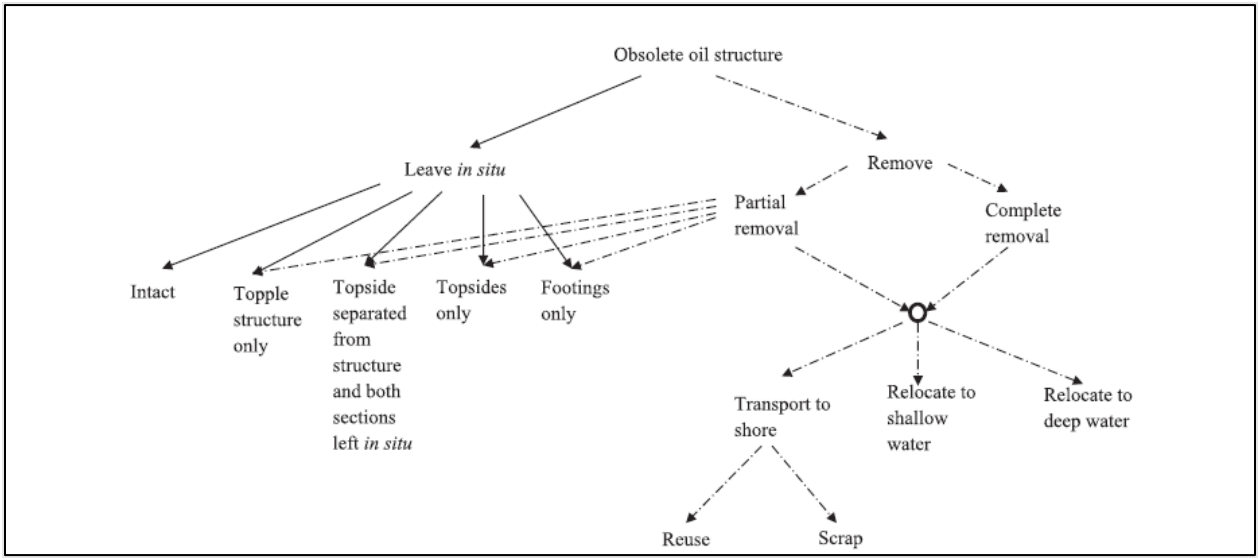


Figure 11. Decommissioning options for an obsolete structure (Fam et al. 2018)

To accomplish these removals, a host of activities are required to (1) mobilize necessary equipment and service vessels, (2) prepare the decommissioning targets (e.g., piles, jackets, conductors, bracings, wells, pipelines), (3) sever the target from the sea bed and/or into manageable components, (4) salvage the severed portion(s), and (5) conduct final site-clearance verification work. Preparatory work could include pipeline flushing and securing, equipment removal, tank/deck cleaning, and survey work. The topside equipment such as living quarters, generators, and processing equipment are removed and taken to shore. The deck section is then detached, lifted from the platform, and transported by barge. Conductors and piles are severed 15 ft below the mudline. The jacket is then disconnected from the seafloor and lifted onto a cargo barge. Depending on the target, a complete removal decommissioning operation may span several days or weeks, and in some cases, even months.

Operators have the option to use explosives for the severance of jacket piles and well conductors. Although mechanical severance techniques are available, such methods can be less reliable and be more costly, particularly as water depth increases. Despite costs and effectiveness, the majority of severance activities in the last decade used mechanical or nonexplosive tools. Explosives are generally placed below the mudline, inside or outside of the target members. Occasionally, specialized explosive devices are required to sever targets that are in open water, above the mudline, such as chains, cables, and pipelines (DEMEX Division of TEI Construction Services 2003). In the sections below, we describe decommissioning as four stages: pre-severance, severance, post-severance, and site clearance.

Platform removals are usually completely removed and those that occurred from 2013 through 2022 are displayed in Table 13. During decommissioning, pipelines are typically pigged (i.e., flushed, cleaned) and then cut to sever them from the structures (e.g., platform riser) to which they are attached. The severed pipeline segment is then abandoned in place or partially or completely removed. If removed, pipeline segments are transported to shore for disposal or recycling (Shams et al. 2023).

Table 13. Platform removals between 2013 and 2022 (BSEE 2023)

Final Disposition	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Reused	8	10	10	1	0	1	2	0	0	0
Reefed	17	18	22	25	14	26	8	4	11	20
Scrapped	199	175	98	178	98	112	80	32	57	66
Annual Totals	224	203	130	204	112	139	90	36	68	86
Percentage Reefed	8%	9%	17%	12%	13%	19%	9%	11%	16%	23%

There are currently 1,366 active platforms in the Gulf of America, most of which are located in water depths of 200 m (656 ft) or less. As of June 21, 2023, the BSEE OCS Facility Infrastructure dashboard indicates In addition, as of January 15, 2025 BSEE data indicate 273 of these structures have applied for decommissioning (BSEE 2025).

Pre-Severance Operations

The first step in a structure-removal operation is the development of a decommissioning plan and schedule. It is the responsibility of a project management team to assess the nature of the operation, taking into consideration, among other things, the target structure(s), marine conditions, available services (e.g., lift vessels, severing subcontractors), and initial operator preferences.

The first set of these activities to occur on the Gulf of America OCS involve the onsite mobilization of lift and support vessels, specialized equipment, and load barges necessary to receive the salvaged structure. The primary mobilization bases would be Fourchon, Cameron, Morgan City, New Iberia, and Intracoastal City in Louisiana and Galveston, Port Aransas, and Port Arthur in Texas. The primary salvage yards for the scrapping or refurbishment of structures are Morgan City (Amelia) and New Iberia in Louisiana and Port Arthur in Texas.

Any requisite preparatory work commences on and near the structure, which could include pipeline flushing and securing, equipment removal, tank/deck cleaning, and survey work. When set, all of the necessary personnel (e.g., welders, equipment operators, severing technicians), vessels (e.g., derrick/jack-up barge, tugs, load barges), and support equipment (e.g., severing tools, ROVs) are mobilized on station at the structure site. Once the lift vessel is on location and positioned, personnel and equipment are staged to begin preliminary work on the structure. For

subsea targets such as casing stubs, divers or ROVs are used to assess the target, conduct any necessary surveys, and assist in either deploying or conducting the below mudline severing methodology.

For surface structures such as caissons and jacketed platforms, a temporary gangway is secured to allow the cutting crews and riggers access to the structure. Depending on the size and design of the platform, modules such as generator shacks and berthing compartments, as well as other large components (e.g., flaring booms, crane assemblies), may need to be cut/disconnected from the topsides and removed. The remaining topsides assembly is then cut from the piles/jacket, lifted, and secured on the load barge. When required, welders connect scaffolds and bracing around the open piles to allow for personnel and equipment access. If internal pile severing will be conducted, crews then install and operate jetting equipment down the pile to washout the existing mud plug (most often sequentially). Once all piles are jetted and gauged (i.e., internal clearance verification) to the proper cut depth, all unneeded equipment is removed from the structure and the severing operations can commence.

To mitigate any potential impacts to biological resources BSEE will require operators to conduct surveys and reporting prior to mobilizing on site and conducting any sea floor disturbing activities. For the biological surveys, operators are to follow NTL No. 2009-G39 (https://www.bsee.gov/notices-to-lessees-ntl/notices-to-lessees/ntl-2009-g39-biologically-sensitive-underwater-features), which requires lessees to avoid or mitigate impacts to topographic features, live bottoms (pinnacle trend features and low relief features such as sea grass communities), and potentially significant biological features. BSEE will also require operators to conduct surveys and report to avoid impacts to potential archaeological resources. The guidelines for these surveys and reporting are detailed in NTL No. 2005-G07.

Severance Operations

As previously mentioned, there are two primary methodologies used in the Gulf of America for cutting decommissioning targets; non-explosive and explosive severance. The choice of severing tool used depends on the target size and type, water depth, economics, environmental concerns, tool availability, and weather conditions. Despite advancements in non-explosive-severance methods and the requisite marine protected species mitigation measures, BSEE expects explosive-severance activities to continue to be used for the foreseeable future (Table 14).

Modeling on structure removal processes done by Kaiser et al. (2005) is presented below, though these data do not reflect the increase in removals since 2010. Since previous studies and environmental reports distinguish explosive severing activities as having the greatest potential to harm marine protected species, the report concentrates on the estimated number of platform removals that may employ explosive cutting. Because an operator's appraisal of when and how to decommission a specific structure involves several complex factors, the main components of the report consist of "optimistic" and "pessimistic" model sets (platform life expectancy,

probabilistic removal, and binary-choice severance selection models) and a section that provides a statistical description of decommissioning operations based upon historical data.

Table 14. Structures Removed and Severance Type in the Gulf of America between 2015 and 2022

Year	Total Structures Removed	Explosive Severance Used (Percentage)	Nonexplosive Severance Used (Percentage)
2015	129	41 (32%)	88 (68%)
2016	199	34 (17%)	165 (83%)
2017	108	22 (20%)	86 (80%)
2018	137	33 (24%)	104 (76%)
2019	88	17(19%)	71 (81%)
2020	36	4(11%)	32 (89%)
2021	68	11(16%)	57 (84%)
2022	84	13 (15%)	71 (85%)

Kaiser et al. (2005) provided projections of removals by modeling structure removal processes until the year 2021 for removals using explosive-severance. For all activities issued in the 5-year period following issuance of the opinion (i.e., through about 2029), the Bureaus' estimate the following structures to be removed with explosives:

- WPA/CPA: 5-25 structure removals annually using explosives. BSEE expects that this annual number will not remain constant and will decline over time.
- No foreseeable structure removals are expected to occur in the EPA.
- No foreseeable structure removals via explosives in waters greater than 200 meters.

Non-explosive methods include abrasive cutters (sand and abrasive-water jets), mechanical cutters (e.g., carbide or rotary), diamond wire cutting devices, and cutting facilitated by commercial divers using arc/gas torches. These methods are relatively slow and potentially harmful to human health and safety (primarily for diver severances) but have little to no impact on the marine environment. For a detailed discussion of these methods, refer to the Minerals Management Service's programmatic environmental assessment for structure removal operations on the OCS in the Gulf (DOI-MMS 2005).

There is a wide range of explosive materials available for use in severing charges in Gulf of America decommissioning activities. Severing contractors are responsible for assessing the type of material needed based upon its characteristics in relation to the target size and design, specific marine conditions, and potential methods of charge deployment. Explosive-severance activities use specialized charges to achieve target severance. Unlike most non-explosive methods, severance charges can be deployed on multiple targets and detonate nearly-simultaneously (i.e.,

staggered at an interval of 0.9 seconds), effecting rapid severances. These devices can be deployed and operated by divers, ROV, or from the surface.

Explosive-severance activity or "detonation event" for most removal targets lasts for only several seconds. For complex targets or in instances where the initial explosive-severance attempts are unsuccessful, more than one detonation event may be necessary per decommissioning operation. Hours or days would be needed to implement mitigation measures and redeploy new charges.

There are three types of charges used in severing structures in the Gulf of America: bulk charges, shaped charges, and fracturing charges. Bulk charges are used most often. Bulk charges are designed to sever targets using the mechanical distortion and subsequent ripping resulting from the shock wave and expanding gas bubble released during the detonation. The charge may be placed in a section of polyvinylchloride pipe or in layers of steel and/or concrete to confine and focus the detonation. The charges are placed either inside or outside of the target.

Shaped charges are placed in special housings designed to create a void between the explosive material and target wall. Employing a phenomenon known as the Monroe Effect, the shock wave deforms the shaped housing into a high-velocity plasma jet within the void. The formed jet cuts through steel targets. Shaped charges are much more efficient in cutting targets, thereby greatly reducing the net explosive weight needed to sever similar-sized targets. Shaped charges can be deployed internal or external to the target structure.

Fracturing charges are currently the least used explosives cutting tools in the Gulf. Generally available as "plaster" or shock-refraction cutters, fracturing charges sever targets by taking advantage of the reflected shock wave resulting from the initial force developed during detonation (Board and Structures 1996). The focus of the shock wave direction results in fracturing of the target wall opposite of the charge, with the ensuing gas bubble expanding and causing the completion of the cut. Not very effective on wells or grouted piles, fracturing charges are primarily available in the form of an adhesive-backed tape, which has always required divers for deployment (Continental Shelf Associates Inc. 2004). Severing contractors are currently working on improvements to the charges, including charge delivery systems that could negate the need for divers.

Post-Severance Operations

Once the operator completes their severance activities, the structure must be removed from the seabed and transported to its final destination (e.g., salvage yard, alternative location, reef site). Similar to its pre-severance duties, the on-station lift vessel is responsible for the post-severance hoisting of the cut material out of the water and onto a load barge or comparable vessel. If the lift vessel cannot pull the structure free from the sediment, on-station supervisors will decide whether or not to reattempt the severing method or to revert to a backup cutter.

All of the lifted components are ultimately arranged on the load barge and sea-fastened (i.e., welded and braced) to the deck to facilitate transport to the final destination (e.g., new location, salvage, recycling, or reefing). Though rarely used in the Gulf, a company may also need to

employ a process called "progressive transport" or "hopping," which allows for the controlled, surface-accessible dividing of oversized jackets. Following the severance of a structure from its foundation, welders install closure plates atop of all exposed jacket legs or piles. Valve assemblies built into each of the closure plates allow compressed air to evacuate water from the tubulars, deballasting the jacket and making it buoyant (Snyder 2000). After being hoisted by and secured to the stern of a lift vessel, the jacket is then towed to a previously surveyed location in shallower water. The set-down locations are expected to be far enough offshore to allow for backloading onto a barge. At the new site, the jacket is ballasted and set back onto the sea floor, exposing several additional feet of the structure above the water. From this position, welders can return to the jacket and set up scaffolding, which allows them to remove the closure plates and begin cutting all of the necessary legs, piles, and diagonal/vertical bracing. Once complete, the severed jacket section is rigged, lifted, and secured to a load barge. If the lift vessel is still not capable of lifting the remaining jacket assembly, welders reattach the closure plates, and the procedure is repeated until successful.

The use of jacket hopping is expected to be extremely rare. However, in instances when proposed, BSEE will require surveys of the route from the initial structure location to each site that the structure would be set down.

Rigs to Reefs Program

It is the policy of BSEE to support and encourage the reuse of appropriate, structural material from obsolete oil and gas platforms as artificial reefs. To start the process, the operator contacts the associated, coastal state agency that manages their approved artificial reef plan and outlines the proposed platform material and preferred location. All five Gulf of America coastal states have approved artificial reef plans and have identified offshore areas suitable for reefing that would not lead to unnecessary impacts to navigation and commercial fisheries. The state agency works with the operator to develop a reefing proposal and secures the required permit from the USACE. The state and operator negotiate the terms of an agreement for a donation from the operator to the state that would allow them to take liability for the material.

Concurrently, the operator submits an application for platform removal to BSEE, which includes the reefing proposal and other decommissioning activities and timelines. The permit application is reviewed by BOEM under a site-specific EA (SEA) and assessed by BSEE to ensure that the proposed reef material and operations will not lead to potential impacts to critical OCS infrastructure, other users of the OCS, and the environment. Over 625 platforms had been converted to permanent artificial reefs in the Gulf of America.

Site Clearance

After all decommissioning work is completed and the structure is salvaged, operators are required to perform site-clearance work to ensure that the sea floor of their lease(s) have been restored to prelease conditions. Based upon requirements found in Subpart Q of the OCSLA regulations (30 C.F.R. §§250.1740 to 250.1743), operators have the option of either trawling

(with commercial nets, Table 15) or conducting diver, high-resolution sonar, or ROV surveys over specific areas for the structure type.

Table 15. Site clearance requirements with trawl nets

Structure	Clearance Requirement
Well site	300-foot-radius circle centered on the well location
Subsea well site	600-foot-radius circle centered on the well location
Platform site	1,320-foot-radius circle centered on the location of the platform
Single-well caisson, well protector jacket, template of manifold	600-foot-radius circle centered on the structure location
If trawling near buried active pipelines	You must contact the pipelines owner to determine the condition of the pipeline before trawling
If trawling near unburied active pipelines 8 inches in diameter or larger	You must trawl parallel to the pipeline, and no closer than 100 feet to either side
If trawling near unburied smaller diameter active pipelines in the area that have obstructions present	You must remove the pipeline
If trawling near unburied active pipelines in the trawl area that are smaller than 8 inches in diameter and have no obstructions present.	You must trawl parallel to the pipeline

NTL 2019-G05 specifies that trawling operations need to be completed in compliance with the following: that trawl nets must have a minimum stretched mesh size of 4 inches at the cod end and 2 inches elsewhere, and a maximum stretched mesh size of 6 inches, any shrimp caught in the net will be released, trawl times will be limited to no more than 30 minutes to allow for the removal of any captured sea turtles, and any turtles caught will be photographed and reported to BSEE and NMFS and resuscitated following NMFS guidelines. The NTL also specifies that platforms and single-well caissons and/or well protectors located in water depths less than 300 ft must be trawled in two directions. The regulations contain specific trawling requirements that are designed to facilitate the removal of any small objects or obstructions (e.g., tools, containers, batteries) that may have been lost or discarded during the operational life of the structure.

NTL 2019-G05 additionally clarifies that:

- An Application for Permit to Modify (APM) or site clearance verification report must include a list of all debris collected as a result of any of the retrieval methods, including material collected in both the heavy-duty and verification nets, items recovered by divers during snag investigations and retrievals, and any lost or recovered trawling gear.
- For Site Clearance Reporting to the Bureaus, operators should provide digital photographs of the items recovered during the use of the heavy-duty trawl nets, site

clearance verification trawl nets, diver recovery, and any other vessels used. Each photograph should be of appropriate scale and size so that individual items can be identified. All photographs of recovered items must also correspond with the items recovered and listed on individual lines within the logs.

Under 30 C.F.R. §250.1741(f), there must be a 300-ft and 500-ft buffer from a shipwreck or sensitive biological feature, respectively. Then the area may be cleared using divers, sonar and/or ROV surveys of the grid area to protect important cultural and biological resources. A high-frequency sonar system is used to determine geodetic positions for each seafloor obstruction, and a dispatched diver(s) or ROV recovers or investigates the object. Unlike trawling, survey-led recovery activities only disturb the seafloor in a limited area around the obstruction, reducing the potential for additional impacts to the benthic environment.

BOEM currently applies the following conditions of approval to permits for site clearance:

Site-clearance Trawling Reporting: If trawling is used to comply with the site clearance verification requirements under 30 C.F.R. §§250.1740-1743, which mandates that turtle excluder devices (TEDs) be removed from the trawl nets to facilitate the collection of seabed debris, you must abide by maximum trawl times of 30 minutes, allowing for the removal of any captured sea turtles. If during your trawling activities, you capture a sea turtle in your nets, you must:

- Contact BSEE's Office of Environmental Compliance at protectedspecies@bsee.gov and NMFS' Southeast Regional Office (NMFS-SERO) at takereport.miifsser@noaa.gov immediately;
- Resuscitate and release any captured sea turtles as per NMFS' guidelines found online at https://www.sefsc.noaa.gov/turtles/TM NMFS SEFSC 580 2010.pdf (see page 3-6; Plate 3-1) or Attachment 10 of this opinion; and
- Photograph the turtle, and complete a sea turtle stranding form for each sea turtle caught in your nets. The form can be found at: https://www.sefsc.noaa.gov/species/turtles/strandings.htm and submit to NMFS and BSEE (to the email addresses noted above).

Post Approval Notification (Structure Removal): Per 30 C.F.R. §250.194(c) and clarified in NTL No. 2005-G07, if during site clearance operations you discover any object of potential archaeological significance you are required to immediately halt operations. In addition, you must immediately report this discovery to BSEE Office of Environmental Compliance (Env-Compliance-Arc@bsee.gov) and contact Dr. Christopher Horrell at (504) 736-2796. Additional guidance will be provided to the operator as to what steps will be needed to protect any potential submerged archaeological resources. Additionally, as specified under 30 C.F.R. §250.1743:

- You are required to provide the trawling logs for both heavy-duty nets and verification nets with descriptions of each item recovered. Should you only pull site clearance verification nets, please clearly state this within the body of the Site Clearance Report. In

addition, provide ALL vessel logs related to vessels that were used to recover items during site clearance operations (e.g. anchor handling vessels, lift boats, dive support vessels, tug boats, etc.). If you did not use any vessels to recover items, please clearly state this within the body of the Site Clearance Report.

- With your Site Clearance Report, you are also required to provide a CD or DVD of all digital photographs of the items recovered during the use of the heavy-duty trawl nets, site clearance verification trawl nets, diver recovery, and any other vessels used. Each photograph must be of appropriate scale and size so that individual items can be identified. All photographs of recovered items must also correspond with the items recovered and listed on individual lines within the logs. In addition, when you submit your photographs, you should label each photograph file name so that it represents the individual trawl line from which the items were recovered.

Progressive-Transport Notification: In accordance with OCSLA requirements (30 C.F.R. §250.1727(g)), if at any point in your decommissioning schedule progressive transport/" hopping" activities are required to section your jacket assembly or support material barge loading, a prior written request must be submitted and approval must be obtained from the Regional Supervisor/Field Operations. Your request to use progressive transport must include a detailed procedural narrative and separate location plat for each "set-down" site, showing pipelines, anchor patterns for the derrick barge, and any known archaeological and/or potentially sensitive biological features. The diagram/map of the route to be taken from the initial structure location along the transport path to each site must also be submitted with your request. If the block(s) that you intend to use as "setdown" sites have not been surveyed as per NTL No. 2009-G39 and NTL No. 2005-G07, you may be required to conduct the necessary surveys/reporting prior to mobilizing on site and conducting any seafloor-disturbing activities.

3.1.5 Oil Spills

Oil spills are not legally permitted because the Oil Pollution Act prohibits any release of oil to the environment, including accidental discharges. Within BSEE, the Oil Spill Preparedness Division addresses all aspects of offshore oil-spill prevention, planning, preparedness, and response (Section 3.1.3.6). BSEE implements regulations found at 30 CFR 250 and 30 CFR 254. Based on requirements for OSRPs established in section 311 of the Federal Water Pollution Control Act (FWPCA), 33 U.S.C. 1321, BSEE reviews, and approves all OSRPs. All spills ≥ 1 bbl must be reported to BSEE and the United States Coast Guard (USCG) via the National Response Center (NRC). BSEE conducts investigations into spills, may assess civil and criminal penalties, oversees spill source control and abatement operations, and conducts research into spill response in the marine environment The United States Coast Guard (USCG) serves as the pre-designated Federal On-Scene Coordinator (FOSC) for oil and hazardous substance pollutions incidents that threaten the coastal zone. The FOSC directs responses and coordinates all efforts at the scene of a release. BSEE and the USCG have signed four Memoranda of Agreement (https://www.bsee.gov/newsroom/latest-news/statements-and-releases/press-releases/bsee-and-

uscg-sign-multiple-agreements) that clarify the responsibilities of each agency regarding oversight of systems and sub-systems as related to: 1) civil penalties, 2) oil discharge planning preparedness, and response, 3) incident notifications and investigations, and 4) Safety and Environmental Systems (SEMS) & Safety Management Systems (SMS).

Sources of spills include drilling platforms, wellheads, vessels, pipelines, and oil barges. The volume of oil released can range from spills < 1 bbl to rare catastrophic spills. When spills occur, the size of the spill depends on several factors: the total amount of oil available, whether stored in tanks, barrels, or present in underground reservoirs; the rate at which it leaks (from a slow, low-pressure leak to a fast, high-pressure release); and the ability of the responsible party or response agencies to contain and control the spill and clean up the oil. An oil release will continue until the reservoir is depleted or until the release is brought under control. Oil releases can occur at any number of points during the exploration, development, production, and transport of oil.

3.1.5.1 Oil Spill Prevention Regulations and Policies

In this subsection, we describe oil spill prevention regulations and policies that were in place or have been updated or created since 2010 and are applicable to the Oil and Gas Program. These rules address key recommendations made after the DWH event; close gaps in existing requirements; and update BSEE's regulations to reflect industry best practices.

The most recent changes include revisions to the 2019 Blowout Preventer Systems and Well Control Rule, effective on October 23, 2023. In 2023, BSEE finalized a rulemaking to address the identified regulatory requirements to help improve operations that use a blowout preventer (BOP), certain BOP capabilities and functionalities, and BSEE oversight of such operations. The final rule:

- Clarifies the general BOP system expectations,
- Modifies the timeframes for commencing a failure analysis,
- Requires submission of independent third-party qualifications,
- Establishes dual shear ram requirements for surface BOPs on existing floating production facilities when an operator replaces an entire surface BOP stack,
- Requires Remotely Operated Vehicle (ROV) open functions on subsea BOPs, and
- Requires submittal of certain BOP test results if BSEE is unable to witness the testing.

BSEE Final Drilling Safety Rule

BSEE's Final Drilling Safety Rule was published on August 22, 2012 (77 FR 50855) and updated on September 7, 2016 (81 FR 61834). The rule is intended to decrease the likelihood of another catastrophic spill by increasing effective measures for spill prevention, and ensuring timely containment should such a spill occur.

The Final Drilling Safety Rule (30 C.F.R. §250) includes updated casing and cementing requirements, updated testing and verification requirements for safety features such as auto shear rams and BOPs, expanded BOP requirements for deepwater drilling operations, and updated provisions to train personnel in well monitoring, control, and maintenance of equipment. A subsea containment system required by BSEE is shown in Figure 12.

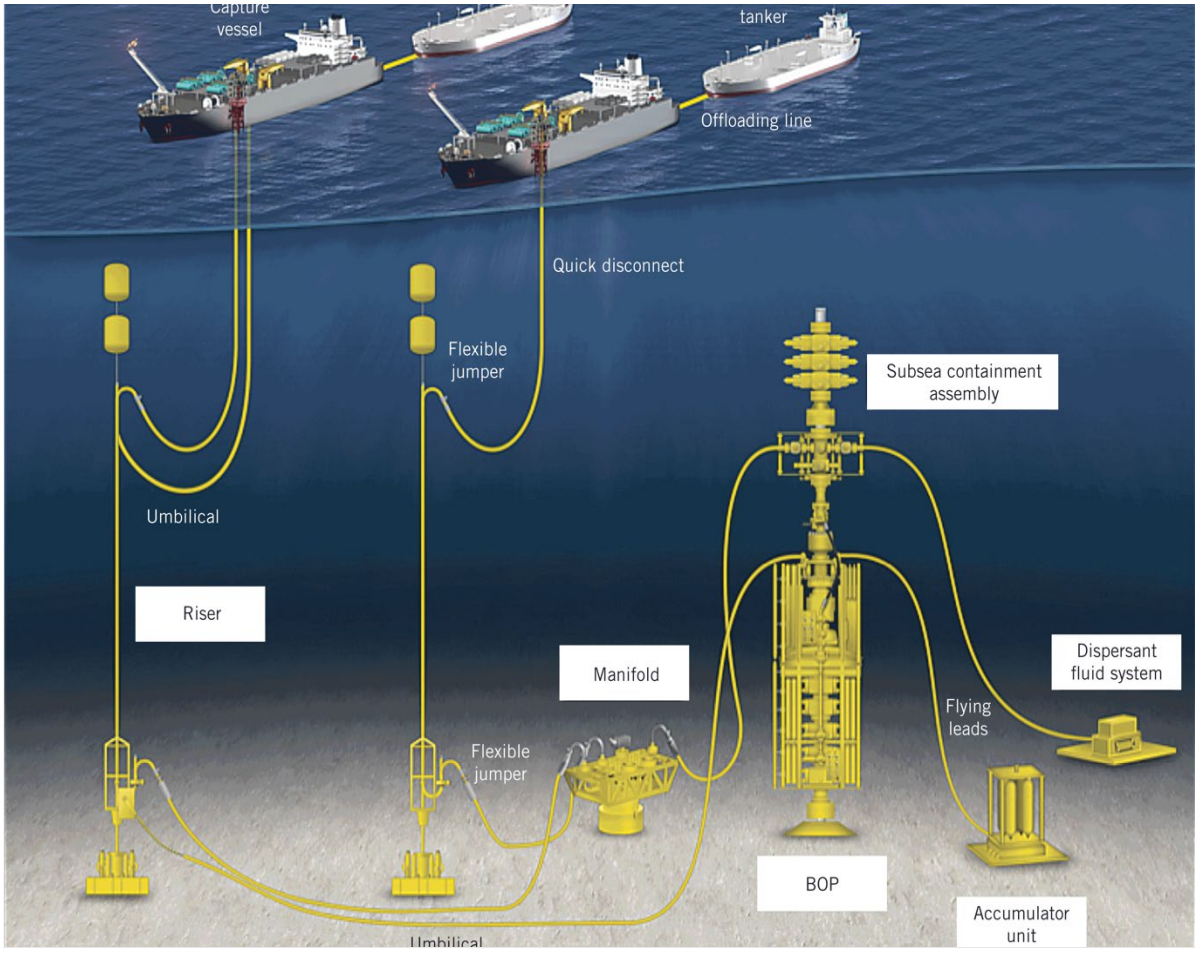


Figure 12. Diagram of a subsea containment system (MWCC 2010)

Additionally, for drilling operations in water depths over 500 feet, the Final Drilling Safety Rule:

- Establishes new casing installation requirements,
- Establishes new cementing requirements,
- Requires independent third-party verification of blind-shear ram capability,
- Requires independent third-party verification of subsea BOP stack compatibility,
- Requires new casing and cementing integrity tests,
- Establishes new requirements for subsea secondary BOP intervention,
- Requires function testing for subsea secondary BOP intervention,

- Requires documentation for BOP inspections and maintenance,
- Requires a Registered Professional Engineer to certify casing and cementing requirements, and
- Establishes new requirements for specific well-control training to include deepwater operations.

Notably, the Final Rule:

- Updates the incorporation by reference to the second edition of American Petroleum Institute (API) Standard 65-part 2, which was issued in December 2010. This standard outlines the process for isolating potential flow zones during well construction. The new Standard 65-part 2 enhances the description and classification of well-control barriers, and defines testing requirements for cement to be considered a barrier.
- Revises requirements from the Interim Final Rule on the Final Rule, which provides for the installation of dual mechanical barriers in addition to cement for the final casing string (or liner if it is the final string), to prevent flow in the event of a failure in the cement. An operator must install one mechanical barrier in addition to cement, to prevent flow in the event of a failure in the cement. The Final Rule clarifies that float valves are not mechanical barriers.
- Revises §250.423(c) to require the operator to perform a negative pressure test only on wells that use a subsea BOP stack or wells with a mudline suspension system instead of on all wells, as was provided in the Interim Final Rule.
- Adds new §250.451(j) stating that an operator must have two barriers in place before removing the BOP, and that the BSEE District Manager may require additional barriers.
- Extends the requirements for BOPs and well-control fluids to well-completion, well-workover, and decommissioning operations under Subpart E – Oil and Gas Well-Completion Operations, Subpart F – Oil and Gas Well-Workover Operations, and Subpart Q –Decommissioning Activities to promote consistency in the regulations.

The updated Rule made changes to subpart H:

- Restructured subpart H to have shorter, easier-to-read sections and clearer, more descriptive headings.
- Updated and improved safety and pollution prevention equipment (SPPE) design, maintenance, and repair requirements in order to increase the overall level of certainty that this equipment will perform as intended, including in emergency situations.
- Expanded the regulations to differentiate the requirements for operating dry tree and subsea tree production systems on the OCS.

- Incorporated by reference new industry standards and update the previous partial incorporation of other standards to require compliance with the complete standards.
- Added new requirements for firefighting systems, shutdown valves and systems, valve closure and leakage, and high pressure/high temperature (HPHT) well equipment.
- Rewrote the subpart in plain language.

On May 5, 2019, BSEE revised the well control rule,[6] which made revisions including certain deregulatory changes to the existing rule. The updates impact offshore oil and gas drilling, completions, workovers, and decommissioning activities. The final regulations address various issues that BSEE identified during the implementation of the 2016 Well Control Rule, as well as numerous questions that have required interpretation of the rule. According to BSEE, the updated final rule:

- Clarifies the rig movement reporting requirements.
- Clarifies and revises the requirements for certain submittals to BSEE to eliminate redundant and unnecessary reporting.
- Clarifies the drilling margin requirements in §§ 250.414 and 250.427.
- Revises § 250.723 by removing references to lift boats from the section.
- Removes certain prescriptive requirements for RTM.
- Replaces the use of a BAVO with the use of an independent third party for certain certifications and verifications of BOP systems and components, and removes the requirement to have a BAVO submit a Mechanical Integrity Assessment report for the BOP stack and system.
- Revises the accumulator system requirements and accumulator bottle requirements to better align with API Standard 53.
- Revises the control station and pod testing schedules to ensure component functionality without inadvertently requiring duplicative testing.
- Includes coiled tubing and snubbing requirements in Subpart G.
- Revises the text to ensure consistency and conformity across the applicable sections of the regulations.

Revises the regulation to include a 21-day BOP testing frequency.

[6] https://www.bsee.gov/guidance-and-regulations/regulations/regulatory-reform/bsee-well-control-rule-2019 and https://www.federalregister.gov/documents/2019/05/15/2019-09362/oil-and-gas-and-sulfur-operations-in-the-outer-continental-shelf-blowout-preventer-systems-and-well

Safety and Environmental Management Systems (SEMS I and SEMS II) Rule

On October 15, 2010, the Safety and Environmental Management System (SEMS) Rule (75 FR 63610, codified at 30 C.F.R. Part 250, Subpart S) was required to be fully implemented by all OCS oil and gas facilities and operators no later than November 15, 2011.
The SEMS Rule:

- Allows stop work authority to any personnel witnessing unsafe practices.
- Identifies safety and environmental information needed for a facility.
- Requires a facility-level hazard risk assessment.
- Requires written procedures and training for safe work practices.

SEMS requires that operators develop and implement provisions to authorize stop-work authority for any offshore industry personnel who witness an imminent risk or dangerous activity, establishes requirements for reporting unsafe working conditions, and requires employee participation in the development and implementation of their SEMS programs.
The SEMS rule was amended by SEMS II, which requires the use of independent third parties to perform the audits of the operators' programs. An audit is required every four years, with an initial two-year re-evaluation.

Workplace Safety Rule (Safety and Environmental Management System Final Rule)

The National Commission on the DWH Oil Spill and Offshore Drilling (Oil Spill Commission) and the National Academy of Engineering recommended a variety of changes to DOI's regulatory scheme, such as the expanded use of safety management systems. The BOEMRE promulgated the performance-based Safety and Environmental Management System (SEMS) Rule on October 15, 2010 (30 C.F.R. §250, Subpart S), which requires full implementation for all OCS facilities and operators no later than November 15, 2011. The SEMS Rule establishes a holistic, performance-based management tool that requires offshore operators to establish and implement programs and systems to identify potential safety and environmental hazards when they drill; clear protocols for addressing those hazards; and strong procedures and risk-reduction strategies for all phases of activity, from well design and construction to operation, maintenance, and decommissioning. It also requires operators to have a comprehensive safety and environmental impact program designed to reduce human and organizational errors. The SEMS applies to all OCS oil and gas operations and facilities under BOEM and BSEE jurisdiction, including drilling, production, construction, well workover, well completion, well servicing, and DOI pipeline activities. The SEMS also applies to all OCS oil and gas operations on new and existing facilities under BOEM and BSEE jurisdiction. BSEE published a Final Rule on the Safety and Environmental Management Systems (SEMS II) on April 5, 2013 (78 FR 20423).

The following is a list of BSEE regulations related to oil spill prevention:

- 30 C.F.R. §250.130 pertains to site inspections of oil and gas offshore facilities

- 30 C.F.R. §250.168 grants BSEE authority to suspend operations for reasons related to both safety and to compliance issues
- 30 C.F.R. §250.187 requires incident reporting by operators so that all incidents may be tracked and reviewed with the intent of preventing a repeat of the incident, thus strengthening overall safety which can lead to fewer oil spills.
- 30 C.F.R. §§250.201, -286 and -400 all relate to the information to be included in plans submitted to BSEE for review and approval, DWOPs and drilling operations requirements such as blowout preventers (BOPs), which all focus specifically on reducing the probability of an oil spill occurrence
- 30 C.F.R. §250, Subpart H pertains to oil and gas production safety systems
- 30 C.F.R. §250, Subparts I and J regulate platforms and structures and pipelines
- 30 C.F.R. §250, Subpart O pertains to well control and production safety training, the goal of which is to ensure a clean and safe OCS
- 30 C.F.R. §250, Subpart S governs SEMS: All operators are required to have a SEMS program, the goal of which is to promote safety and environmental protection by ensuring all personnel aboard a facility are complying with the policies and procedures identified in the SEMS.

BOEM and BSEE have instituted many regulatory reforms in response to many of the recommendations in reports following the DWH event to improve offshore safety and oversight. BOEM provided NMFS a qualitative analysis of oil spill literature, regulatory changes, and improvements issued since DWH. The 2014 Qualitative Review of Safety Measures to Minimize Frequency of Blowouts and Spills and Maximize Containment Capabilities is incorporated by reference and the key points summarized below.

3.1.5.2 Enhanced Inspection Procedures

BSEE has enhanced inspection and enforcement procedures, including a strengthened inspector training program. BSEE conducts its inspections of drilling rigs and production platforms using multi-person, multi-discipline inspection teams. The OCSLA authorizes and requires BSEE to provide an annual scheduled inspection, and a periodic unscheduled (unannounced) inspection of all oil and gas facilities on the OCS. The inspections are to ensure compliance with all regulatory requirements. The annual inspection examines all safety equipment designed to prevent blowouts, fires, spills, or other major accidents. BSEE develops a strategic plan every fiscal year that sets the goal of the unannounced inspections to 10% of the occupied facilities in each district. For example, in 2022, BSEE had a goal of 68 unannounced inspections on occupied facilities, which BSEE met. Unannounced inspections are rotated through the facilities each year to ensure each facility receives unannounced inspections. During these inspections, BSEE conducts reviews of OCS technologies to ensure that the best available and safest technologies (BAST) are applied to OCS operations.

In addition to the annual inspection program, BSEE's Risk-Based Inspection (RBI) Program is intended to focus on higher-risk facilities and operations. The RBI Program uses a systematic approach, employing both a quantitative risk model and subjective performance and risk-related intelligence information, to identify higher-risk facilities on which to focus inspections and resources. BSEE uses data obtained from all facilities in the GOA to develop criteria for categorizing facilities based on spill risk. Overall, the objective and scope of the RBI Program is to assist the Bureau in developing inspection tasks and techniques to enhance its focus on offshore oil and gas facilities that exhibit several distinguishing risk factors; to minimize redundant inspection efforts and cost; to shift from a reactive to a proactive oversight regime; and to implement a risk management tool.

Inspection procedures ensure that regulations are followed regarding: installation of dual mechanical barriers, third-party shearing verification of blowout preventers, subsea ROV and deadman function testing—drilling, subsea ROV function testing—workover/completions, negative pressure tests, and professional engineer certification for well design.

Installation of Dual Mechanical Barriers

The new regulatory section at 30 C.F.R. §250.420(b)(3) requires that the operator install dual mechanical barriers in addition to cement barriers for the final casing string. These barriers prevent hydrocarbon flow in the event of cement failure at the bottom of the well. The operator must document the installation of the dual mechanical barriers and submit this documentation to BSEE within 30 days after installation. These new requirements will ensure that the best casing and cementing design will be used for a specific well.

Blowout Preventers

A BOP is a complex of choke lines and hydraulic rams mounted atop the wellhead that can seal off the casing of a well by remote control at the surface. There are different types of BOPs. The BOPs have been required for OCS oil and gas operations from the time offshore drilling began in the late 1940s. BOPs are important for the safety of the drilling crew, as well as the rig and the wellbore itself. BOPs are typically activated as a last resort upon imminent threat to the integrity of the well or the surface rig. There are two types: ram and annular (also called spherical). Rams are designed to seal an open hole by closing the wellbore with a sharp horizontal motion that may cut through casing or tool strings, as a last resort. One type of ram blowout preventer is called a pipe ram because it closes on the drill pipe by pinching it; however, it cannot seal an open hole. Blind ram blowout preventers are straight-edged rams used to close an open hole. An annular BOP closes around the drill string in a smooth simultaneous upward and inward motion. Both types of BOPs (annular and ram) are usually used together to create redundancy in a BOP stack.

The new regulatory section at 30 C.F.R. §250.451(i) requires that, if a blind-shear ram or casing shear ram is activated in a well-control situation in which the pipe or casing is sheared, the BOP

stack must be retrieved, fully inspected, and tested. This provision will ensure the integrity of the BOP and that the BOP will still function and hold pressure after the event.

Third-Party Shearing Verification of BOPs

Regulation 30 C.F.R. §250.416(e) requires information verifying that BOP blind-shear rams are capable of cutting through any drill pipe in the hole under maximum anticipated conditions. This regulation has been modified to require the BOP verification be conducted by an independent third-party. The independent third party provides an objective assessment that the blind-shear rams can shear any drill pipe in the hole if the shear rams are functioning properly. This confirmation will be required for both subsea and surface BOPs. The NTL 2010-N10, "Statement of Compliance with Applicable Regulations and Evaluation of Information Demonstrating Adequate Spill Response and Well Containment Resources," clarifies how the regulations apply to operators conducting operations using subsea BOPs or surface BOPs on floating facilities. The NTL informs these operators that a statement, signed by an authorized company official stating that the operator will conduct all authorized activities in compliance with all applicable regulations, including the increased safety measures regulations, should be submitted with each application for a well permit.

Subsea ROV and Deadman Function Testing – Drilling

Previous regulations at 30 C.F.R. §250.449(b) required a stump test of the subsea BOP system. In a stump test, the subsea BOP system is placed on a simulated wellhead (the stump) on the rig floor. The BOP system is tested on the stump to ensure that the BOP is functioning properly. The new regulatory section at 30 C.F.R. §250.449(j) requires that all ROV intervention functions on the subsea BOP stack must be tested during the stump test and that one set of rams must be tested by an ROV on the sea floor. In addition to 30 §C.F.R. 250.449(j), the new regulatory section at 30 C.F.R. §250.449(k) requires that the autoshear and deadman systems be function-tested during the stump test and the deadman system during the initial test on the sea floor. The initial test on the sea floor is performed as soon as the BOP is attached to the subsea wellhead. These new requirements will confirm that a well will be secured in an emergency and prevent a possible loss of well control. The ROV test requirement will ensure that the dedicated ROV has the capacity to close the BOP functions on the sea floor. The deadman-switch test on the sea floor verifies that the wellbore closes automatically if both hydraulic pressure and electrical communication are lost with the drilling rig.

Subsea ROV Function Testing – Workover/Completions

Previous regulations did not require subsea ROV function testing of the BOP during workover or well completion operations. The new regulatory sections 30 C.F.R. §250.516(d)(8) and 250.616(h)(1) extend the requirements added to deepwater drilling operations (discussed in the previous section) to well completion operations and workover operations using a subsea BOP stack.

Negative Pressure Tests

Previous regulations at 30 C.F.R. §250.423 required a positive pressure test for each string of casing, except for the drive or structural casing string. This test confirms that fluid from the casing string is not flowing into the formation. The new regulatory section at 30 C.F.R. §250.423(c) requires that a negative pressure test be conducted for all intermediate and production casing strings on all wells to ensure proper casing installation. This test will reveal whether gas or fluid from outside the casing is flowing into the well and ensures that the casing and cement provide an effective seal. Maintenance of pressure under both tests ensures proper casing installation and the integrity of the casing and cement.

Professional Engineer Certification for Well Design

Previous regulations at 30 C.F.R. §250.420(a) specified well casing and cementing requirements but did not require verification by a registered professional engineer. The new regulatory section at 30 C.F.R. §250.420(a)(6) requires that well casing and cementing specifications must be certified by a registered professional engineer. The registered professional engineer will verify that the well casing and cementing design is appropriate for the purpose for which it is intended under expected wellbore conditions. This verification adds assurance that the appropriate design is used for the well, thus decreasing the likelihood of a blowout.

3.1.5.3 Notices to Lessees

Reform has occurred through both prescriptive and performance based regulation and guidance, as well as OCS safety and environmental protection requirements. Under their authorities to issue NTLs (30 C.F.R. §§250.103 and 550.103), the Bureaus have issued the following NTLs relevant to this consultation (see https://www.boem.gov/about-boem/regulations-guidance/guidance-portal and https://www.bsee.gov/guidance-and-regulations/guidance/notice-to-lessees). Each NTL is a formal document that provides clarification, description, or interpretation of a regulation or OCS standard; provides guidelines on the implementation of a special lease stipulation or regional requirement; provides a better understanding of the scope and meaning of a regulation by explaining the Bureaus' interpretation of a requirement; or transmits administrative information such as current telephone listings or a change in Bureau personnel or office address.

- NTL 2022-G01/A01, "Shallow Hazards Program and Surveys"
- NTL 2021-G02, "Inspection and Reporting for Hurricane potential damage"
- NTL 2020-N04, "Flaring and Venting Requests"
- NTL 2020-G01 to -G05, "Inspection and Reporting for Hurricanes"
- NTL 2019-N05, "Incident and Spill Reporting"
- NTL 2019-P02, "Clarification of requirements for electronically stored records and documents"

- NTL 2019-N04, "Clarification of definitions of Max Anticipated Surface Pressure for completion; how to handle a gas reservoir isolated by cement behind the production casing; describes when to use an oil gradient or gas gradient to calculate certain anticipated pressures prior to production"
- NTL 2019-G06, "Inspection and Reporting for Hurricane potential damage"
- NTL 2019-G03, "Provides Guidance for use of well completion, well control & well intervention equipment, and trees and production equipment designed for high pressure/high temperature (HPHT) conditions"
- NTL 2019-G02, "Describes voluntary submissions of plans and information prior to dates required by regulation, in order to aid BSEE's understanding of a DWOP, APD, or APM and thereby facilitate agency review of HPH well design, completion or intervention operations."
- NTL 2019-G04, "Provides guidance for information needed to analyze alternate equipment requests for consider external hydrostatic pressure in the design and calculation of internal pressure containment capability of subsea equipment."
- NTL 2019-P01, "Guidance on protection of personnel from effects of hydrogen sulfide gas, mitigation of property and environmental damage caused by H2S, and detection of H2S, and a collection of standards for compliance with gas monitoring and safety requirements."
- NTL 2016-N01, "Incident of Noncompliance Response System."
- NTL 2016-N04, "Inspection Fees for Fiscal Year (FY) 2016."
- NTL 2015-N06, "Clarification of Cementing Requirements Following Indications or Identification of an Inadequate Cement Job."
- NTL 2015-G02, "Hurricane and Tropical Storm Effects Reports" supersedes NTL 2011-G01.
- NTL 2014-G02, "Designation of Operator of an OCS Oil and Gas or Sulphur Lease."
- NTL 2014-G03, "Release of Well Data and Information."
- NTL 2014-N03, "Well Permitting and Reporting System" supersedes NTL No. 2007-G15.
- NTL 2013-N02, "Significant Change to Oil Spill Response Plan, Worst-Case Discharge Scenario."
- NTL 2012-N06, "Guidance to Owners and Operators of Offshore Facilities Seaward of the Coast Line Concerning Regional Oil Spill Response Plans."

- NTL 2010-N06, "Information Requirements for Exploration Plans, Development and Production Plans, and Development Operations Coordination Documents on the OCS.
- NTL 2010-N10, "Statement of Compliance with Applicable Regulations and Evaluation of Information Demonstrating Adequate Spill Response and Well Containment Resources."

On December 29, 2017, BSEE published a proposed rule to revise some of the regulatory measures discussed above (82 FR 61703). The final rule (84 FR 21908) became effective July 15, 2019. This rule revises regulatory provisions in 30 C.F.R. part 250, subparts A, B, D, E, F, G, and Q on topics such as, but not limited to: Notifications and submittals to BSEE; Drilling margins; Lift boats; Real-time monitoring; BSEE Approved Verification Organizations (BAVOs); Accumulator systems; BOP and control station testing; Coiled tubing; and Mechanical barriers (packers and bridge plugs). The rulemaking incorporates multiple documents by reference, and:

- Clarifies the rig movement reporting requirements.
- Clarifies and revises the requirements for certain submittals to BSEE to eliminate redundant and unnecessary reporting.
- Clarifies the drilling margin requirements in §§ 250.414 and 250.427.
- Revises § 250.723 by removing references to lift boats from the section.
- Removes certain prescriptive requirements for RTM.
- Replaces the use of a BAVO with the use of an independent third party for certain certifications and verifications of BOP systems and components, and removes the requirement to have a BAVO submit a Mechanical Integrity Assessment report for the BOP stack and system.
- Revises the accumulator system requirements and accumulator bottle requirements to better align with API Standard 53.
- Revises the control station and pod testing schedules to ensure component functionality without inadvertently requiring duplicative testing.
- Includes coiled tubing and snubbing requirements in Subpart G.
- Revises the text to ensure consistency and conformity across the applicable sections of the regulations.

Revises the regulation to include a 21-day BOP testing frequency.

3.1.5.4 Oil Spill Response

The BSEE regulations (30 C.F.R. Part 254) require that all owners and operators of oil handling, storage, or transportation facilities located seaward of the coastline submit an OSRP (also called

a Facility Response Plan) for approval before an operator can use a facility (Figure 13). The OSRP describes how an operator intends to respond to an oil spill. The OSRP may be site-specific or regional (30 C.F.R. §254.3). The term "regional" means a spill response plan that covers multiple facilities or leases of an owner or operator, including affiliates, which are located in the same BSEE region. The sub-regional plan concept is similar to the regional concept, which allows leases or facilities to be grouped together for the purposes of (1) calculating response times, (2) determining quantities of response equipment, (3) conducting oil-spill trajectory analyses, (4) determining worst-case discharge scenarios, and (5) identifying areas of special economic and environmental importance that may be impacted and the strategies for their protection. NTL No. 2012-N06 includes guidance on the preparation and submittal of sub-regional OSRP's (https://www.bsee.gov/notices-to-lessees-ntl/ntl-2012-n06-guidance-to-owners-and-operators-of-offshore-facilities-seaward).

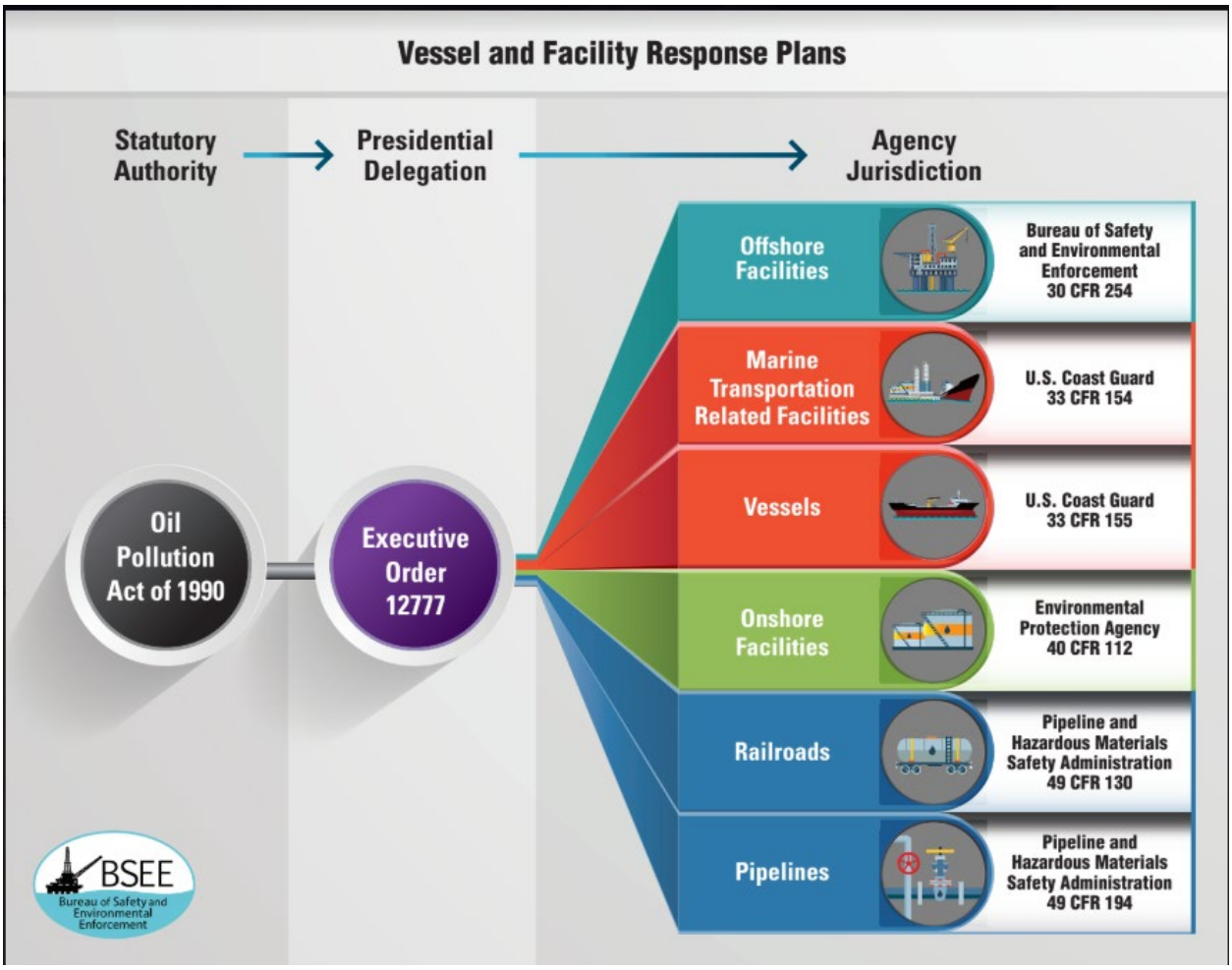


Figure 13. Regulatory agency jurisdictions for Facility Response Plans

The Emergency Response Action Plan serves as the core of the BSEE-required OSRP. A requirement of the OSRP is to demonstrate adequate preparation and response to a WCD from that company's activities. In the Gulf of America, a WCD is based on actual data and estimates

of the largest reservoir size an operator intends to develop or produce. In accordance with 30 C.F.R. §254, the Emergency Response Action Plan requires identification of (1) the qualified individual and the spill-response management team, (2) the spill-response operating team, (3) the oil-spill cleanup organizations under contract for response, and (4) the federal, state, and local regulatory agencies that an owner/operator must notify or that they must consult with to obtain site-specific environmental information when an oil spill occurs. The OSRP is also required to include an inventory of appropriate equipment and materials, their availability, and the time needed for deployment, as well as information pertaining to dispersant use, in-situ burning, a worst-case discharge scenario, contractual agreements, training and drills, identification of potentially impacted environmental resources and areas of special economic concern and environmental importance, and strategies for the protection of these resources and areas. The response plan must provide for response to an oil spill from the facility and the operator must immediately carry out the provisions of the plan whenever an oil spill from the facility occurs. The OSRP must comply with the National Contingency Plan and the ACP. The operator is also required to carry out the training, equipment testing, and periodic drills described in the OSRP. All BSEE-approved OSRPs must be reviewed at least every two years. In addition, revisions must be submitted to BSEE within 15 days whenever (1) a change occurs that appreciably reduces an owner/operator's response capabilities; (2) a substantial change occurs in the worst-case discharge scenario or in the type of oil being handled, stored, or transported at the facility; (3) there is a change in the name(s) or capabilities of the oil-spill removal organizations cited in the OSRP; or (4) there is a change in the applicable ACPs.

The adequacy of OSRPs will be reviewed by BSEE according to "Guidance to Owners and Operators of Offshore Facilities Seaward of the Coast" described in NTL 2012-N06. All operators are required to provide a "Statement of Compliance with Applicable Regulations and Evaluation of Information Demonstrating Adequate Spill Response and Well Containment Resources" (NTL 2010-N10). Operators must submit and have an approved OSRP that must demonstrate adequate plans for the containment, response, and recovery of spilled oil for a WCD. The OSRP must demonstrate adequate preparedness to respond to protected species during a WCD. The OSRP must consider the location of the potential WCD and proximity to protected resources, wildlife protection, rescue and rehabilitation strategies, and real-time response capability.

Because of the DWH event, supplemental information related to oil spill response is now required for new or previously submitted EPs, DPPs, or DOCDs. The required supplemental information includes the following:

- a description of the blowout scenario as required by 30 C.F.R. §550.213(g) and 550.243(h);
- a description of the assumptions and calculations used in determining the volume of the WCD required by 30 C.F.R. §550.219(a)(2)(iv) (for EPs) or 30 C.F.R. §550.250(a)(2)(iv) (for DPPs and DOCDs); and

- a description of the measures proposed that would enhance the ability to prevent a blowout, to reduce the likelihood of a blowout, and to conduct effective and early intervention in the event of a blowout, including the arrangements for drilling relief wells and any other measures proposed.

The early intervention methods could include the surface and subsea containment resources that BOEMRE announced in NTL 2010-N10, which states that BOEMRE will begin reviewing to ensure that the measures are adequate to promptly respond to a blowout or other loss of well control. Additionally, to address new improved containment systems, NTL 2010-N10, "Statement of Compliance with Applicable Regulations and Evaluation of Information Demonstrating Adequate Spill Response and Well Containment Resources," became effective on November 8, 2010. This NTL applies only to operators conducting operations using subsea or surface BOPs on floating facilities. It clarifies the regulatory requirement that lessees and operators must submit a certification statement signed by an authorized company official with each application for a well permit, indicating that they will conduct all of their authorized activities in compliance with all applicable regulations, including the Oil and Gas and Sulphur Operations on the Outer Continental Shelf—Increased Safety Measures for Energy Development on the Outer Continental Shelf (77 FR 50856, August 22, 2012). The NTL also informs lessees that BSEE will be evaluating whether or not each operator has submitted adequate information demonstrating that it has access to and can deploy surface and subsea containment resources that would be adequate to promptly respond to a blowout or other loss of well control.

While oil spills are expected as part of the Oil and Gas Program, oil spill response activities are likely to require separate ESA section 7 consultation, depending on the circumstances of the spill. Some USCG response activities may be pre-authorized under other consultations for use of response measures such as dispersants and in-situ burning.

Vessel Traffic Associated with Oil Spill Response Activities

Localized vessel traffic around the area where an oil spill occurs may increase, according to the size of the spill; however, we would not expect a meaningful increase in overall vessel traffic within the Gulf of America. Therefore, we would expect that vessel traffic would be essentially the same across the Gulf of America whether or not spill response was occurring.

Source Containment

Requirements related to the loss of well control and containment systems are described in NTL 2010-N10. Several oil and gas companies initiated the development of a rapid response system designed to meet BSEE requirements for a subsea well containment system that can respond to an underwater well-control incident in the U.S. Gulf of America, as outlined in NTL No. 2010-N10.

Mechanical Cleanup

Generally, mechanical containment and recovery is the primary oil-spill-response method used. Mechanical recovery is the process of using booms and skimmers to pick up oil from the water surface. It is expected that the oil-spill-response equipment needed to respond to an offshore spill would be called out from one or more of the following oil-spill equipment base locations in Corpus Christi, Aransas Pass, Houston, La Porte, Ingleside, Port Arthur, and Galveston, Texas; Lake Charles, New Iberia, Belle Chase, Cameron, Cocodrie, Morgan City, New Orleans, Sulphur, Houma, Fourchon, Fort Jackson, and Venice, Louisiana; Pascagoula, Mississippi; Theodore and Mobile, Alabama; or Pensacola, Fort Lauderdale, Panama City, and Tampa, Florida. Response times for any of this equipment would vary, dependent on the location of the equipment, the staging area, and the spill site, and on the transport requirements for the type of equipment procured. Oil recovery systems typically have swath widths of only a few meters and move at slow speeds while recovering oil. Therefore, even if this equipment can become operational within a few hours, it would not be feasible for them to encounter more than a fraction of a widely spread slick. For this reason, it is assumed that 10-30%, maximum, of an oil spill in an offshore environment can be mechanically removed from the water prior to the spill making landfall (OTA 1990). During the DWH event, it was estimated that only three percent of the total oil spilled was picked up by mechanical equipment offshore (Lubchenco et al. 2010; Ramseur 2010).

Dispersants

When dispersants are applied to spilled crude oil, the surface tension of the oil is reduced, allowing wind and wave action to break the oil into tiny droplets that are dispersed into the upper portion of the water column. Oil that is chemically dispersed at the surface will move into the top 20 ft (6 m) of the water column where it will mix with surrounding waters and begin to biodegrade (OTA 1990, p. 19). Dispersant use, in combination with natural processes, breaks up the oil into smaller components that allows them to dissipate into the water and degrade more rapidly (Schmidt 2010). Dispersion is thought to increase the likelihood that the oil will be biodegraded, both in the water column and at the surface. Biodegradation is accomplished by bacteria that break down the dispersed and weathered surface oil. Dispersant use must be in accordance with the Regional Response Team's Preapproved Dispersant Use Manual and with any conditions outlined within a Regional Response Team's site-specific, dispersant approval given after a spill event. Consequently, dispersant use will be in accordance with the restrictions for specific water depths, distances from shore, or monitoring requirements. No preapproval has been authorized for the subsea application of dispersants. The effectiveness and impact of subsea dispersant use during DWH are still being studied.

The USEPA issued a letter dated December 2, 2010, providing interim guidance on the use of dispersants for major spills that are continuous and uncontrollable for periods greater than seven days and for expedited approval of subsurface applications. This letter outlines the following exceptions for the use of dispersants until guidelines for their use are revised:

- Dispersants may not be applied to major spills that are continuous in nature and uncontrollable for a period greater than seven days.
- Additional dispersant monitoring protocols and sampling plans may be developed that meet the unique needs of the incident.
- Subsurface dispersants may only be approved on an incident-specific basis as requested by the USCG On-Scene Commander.

In 2011, in response to hotline complaints about the use of dispersants during the DWH incident, USEPA's Office of Inspector General made recommendations to the USEPA Office of Solid Waste and Emergency Response to review and update contingency plans, to incorporate lessons learned from DWH, and to clarify roles and responsibilities for Spills of National Significance. Additionally, recommendations were made to the Office of Research and Development to develop a plan on long-term health and environmental effects of dispersants (USEPA 2011). The Office of Inspector General reported that the agency generally agreed with its recommendations. In January 2015, USEPA proposed amendments to Subpart J of the National Contingency Plan (80 FR 3379, January 22, 2015) (USEPA 2015). The proposed changes would help to ensure that chemical and biological agents have met efficacy and toxicity requirements, and that product manufacturers provide important use and safety information. Further, this would equip the planning and response community with the proper information to authorize and use products judiciously to effectively mitigate health and environmental effects from oil discharges. Proposed amendments include:

- Authorization of use to add clarifications, limitations, notification and guidance.
- Monitoring requirements for agent use.
- Dispersant testing and listing requirements.
- Submissions of confidential business information.

On August 12, 2023, USEPA amended Subpart J of the National Contingency Plan (88 FR 38280), which governs the use of dispersants, other chemicals and other spill mitigating substances when responding to oil discharges into jurisdictional waters of the United States. The changes help to ensure that chemical and biological agents have met efficacy and toxicity requirements, and that product manufacturers provide important use and safety information. Amendments are effective on December 11, 2023, and include:

- Adding new listing criteria for the NCP Product Schedule;
- Revising the efficacy and toxicity testing protocols;
- Clarifying the evaluation criteria for removing products from the NCP Product Schedule; and

- Changes to requirements for the authorities, notifications, and data reporting when using chemical or biological agents in response to oil discharges to Clean Water Act (CWA) section 311 jurisdictional waters and adjoining shorelines. These requirements:
    - Encourage the development of safer and more effective spill mitigating products and better target the use of these products to reduce the risks of oil discharges and response technologies to human health and the environment.
    - Ensure that On-Scene Coordinators (OSCs), Regional Response Teams (RRTs), and Area Committees (ACs) have sufficient information to support agent authorization of use decisions.

In-Situ Burning

In-situ burning is an oil-spill cleanup technique that involves the controlled burning of the oil at or near a spill site. The use of this spill-response technique can provide the potential for removal of large amounts of oil over an extensive area in less time than other techniques. In-situ burning involves the same oil collection process used in mechanical recovery, but instead of going to a skimmer, the oil is funneled into a fire boom and set on fire. In-situ burning is typically more effective than skimmers, but has some limitations on the window of response such as freshness of the oil, meteorological conditions, and concentration of oil available for collection at the surface. Burning agent use is authorized on a case-by-case basis by concurrence of the USCG on-scene coordinator, Regional Response Team and Natural Resource Trustees.

Natural Attenuation

Depending upon environmental conditions and spill size, the best response to a spill may be to allow the natural attenuation of a slick to occur. Natural attenuation may be a preferred option for smaller, non-persistent oils and condensates that form slicks that are too thin to be removed by conventional methods. In addition, natural attenuation may also be a preferred option in some nearshore environments, such as a marsh habitat, when the potential damage caused by a cleanup effort could cause more damage than the spill itself.

Onshore Response and Cleanup

Offshore response and cleanup are preferable to shoreline response and cleanup; however, if an oil slick reaches the coastline, it is expected that the specific shoreline cleanup countermeasures identified and prioritized in the appropriate ACPs for various habitat types would be used. The sensitivity of the contaminated shoreline is the most important factor in the development of cleanup recommendations. The ACPs cover subregional geographic areas and represent the third tier of the National Response Planning System mandated by OPA. The ACPs are a focal point of response planning, providing detailed information on response procedures, priorities, and appropriate countermeasures.

3.1.6 Project Design Criteria to Avoid and Minimize Adverse Effects

Because of previous consultations with NMFS, the Bureaus (and their predecessor agencies) have developed several NTLs for the Gulf of America OCS Leasing Program. These are non-discretionary requirements that are part of the action. Each NTL is a formal document that provides clarification, description, or interpretation of a regulation or OCS standard; provides guidelines on the implementation of a special lease stipulation or regional requirement; provides a better understanding of the scope and meaning of a regulation by explaining the Bureaus' interpretation of a requirement; or transmits administrative information such as current telephone listings and a change in BSEE personnel or office address.

Many effects minimization measures will be applied programmatically throughout the Gulf of America through NTLs or other similar guidance documents, such as Bureau-applied protocols implemented across the program. As needed, protocols or NTLs are reviewed to determine if any changes or updates are required. Protocols or NTLs may be updated when new ESA consultation requirements warrant revision.

In the context of the overarching programmatic, only the protocols and NTLs that pertain to threatened and endangered species protection are described. Each of the protocols or NTLs summarized below may be found at http://www.boem.gov/Notices-to-Lessees-and-Operators and/or at https://www.bsee.gov/guidance-and-regulations/guidance/notice-to-lessees. Some or all of these proposed project design criteria may be altered or augmented as a result of this consultation, through addition of RPMs and terms and conditions, or during project-specific step-down consistency reviews and tiered consultations.

3.1.6.1 Effects Avoidance or Minimization Measures for Lease Activity Implementation

The following sections describe measures taken by BOEM and BSEE to minimize effects of the Oil and Gas Program activities to ESA-listed species. These are measures that, to date, have been implemented as presented below by BOEM and BSEE following completion of previous ESA section 7 consultations with NMFS.

Protected Species Stipulation

The protected species stipulation is applied after a lease sale occurs and is issued for any lease block sold. This stipulation has been applied to post-lease G&G activities since 2001. The stipulation is generally expected to address the following topics (there could be some variation in a stipulation per lease sale):

A. The Endangered Species Act (16 U.S.C. §§ 1531 et seq.) and the Marine Mammal Protection Act (16 U.S.C. §§ 1361 et seq.) are designed to protect threatened and endangered species and marine mammals and apply to activities authorized under the Outer Continental Shelf Lands Act (OCSLA, 43 U.S.C. §§ 1331 et seq.). The Congressional Declaration of Policy included in OCSLA provides that it is the policy of the United States that the OCS should be made available for expeditious and orderly

development, subject to environmental safeguards, in a manner that is consistent with the maintenance of competition and other national needs (see 43 U.S.C. § 1332). Both the BOEM and BSEE comply with these laws on the OCS.

The lessee, its operators, and their recognized representative must comply with the most current programmatically applied conservation measures from the Bureaus and any relevant measures developed as part of a consultation under the ESA or authorization under the MMPA.

3.1.6.2 Effects Avoidance or Minimization Measures for Seismic Surveys

To minimize the effects of seismic surveys, BOEM proposes the continuation of the mitigation and monitoring requirements formerly addressed by NTL 2016-G02 "Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program," in the 2020 opinion, and now as a national protocol (Attachment 1) that provides guidance to an operator for better understanding the regulations for the protection of marine mammals and sea turtles during seismic operations. These measures have been standardized to be applicable across all industries/activities that conduct geophysical surveys, specify the minimum number of PSOs required on each source vessel that will be used, the certification that the minimum sound source required to conduct the survey is used, and protected species data collection and reporting requirements. The protocol also requires PSOs to implement cessation of airgun firing based on observed presence of whales within an exclusion zone of the sound source array. Specific protocols apply to various seismic survey "tiers" (i.e., tier 1, 2, or 3) based on potential impacts to protected species from the use of different survey equipment under each tier. For example, tier 1 surveys have the potential to be the most impactful, involving the use of airgun arrays with a total volume of 1,500 in^3 or with 12 or more airguns, and tier 1 protocols involve the visual monitoring of larger zones (see Attachment 1).

3.1.6.3 Effects Avoidance or Minimization Measures for Marine Debris

The "Marine Trash and Debris Awareness and Elimination" protocol (Attachment 2; formerly NTL 2015-03) provides guidance to prevent intentional and/or accidental introduction of debris into the marine environment. Operators are prohibited from deliberately discharging containers and other similar materials (i.e., trash and debris) into the marine environment (30 C.F.R. §250.300(a) and (b)(6)) and are required to make durable identification markings on equipment, tools, containers (especially drums), and other material (30 C.F.R. §250.300(c)). They also are required to hang placards for awareness. An annual report that describes the marine trash and debris awareness training process and certifies that the training process has been followed for the previous calendar year is to be provided to BSEE by January 31 of each year.

3.1.6.4 Effects Avoidance or Minimization Measures for Vessel Operations

The "Vessel Strike Avoidance and Injured/Dead Protected Species Reporting" protocol (Attachment 3; formerly BOEM NTL 2016-G01) explains how operators must implement measures to minimize the risk of vessel strikes to protected species and report observations of injured or dead protected species. This protocol will be required for every applicable permit and

plan that has associated vessel traffic that is approved by the Bureaus. Vessel operators and crews must maintain a vigilant watch for marine protected species and slow down or stop their vessel to avoid striking protected species. Crews must report sightings of any injured or dead protected species immediately, regardless of whether the injury or death is caused by their vessel, to the Marine Mammal and Sea Turtle Stranding Hotline or the Marine Mammal Stranding Network. In addition, if it was the operator's vessel that collided with a protected species, BSEE must be notified within 24 hours of the strike.

3.1.6.5 Vessel Transits within Rice's Whale Area

The Bureaus adopted the 2020 biological opinion's RPA to protect Rice's whales from vessel strike mortality in the area where they had historically been visually observed, which is now incorporated into the action analyzed here (Attachment 4). This measure applies to all vessels associated with the program (i.e., vessels associated with activities regulated by the Bureaus) and requires that vessels, unless necessary to maintain safety of the vessel or crew, maintain a 500 m minimum distance from Rice's whales and adhere to a year-round 10-kt daytime speed restriction and prohibition on nighttime transits in the Rice's Whale Area described in the RPA for the 2020 opinion (hereafter, the RWA, see Figure 14). If a whale is unidentifiable, it shall be treated as a Rice's whale. All transits must be reported to the Bureaus within 24 hours.

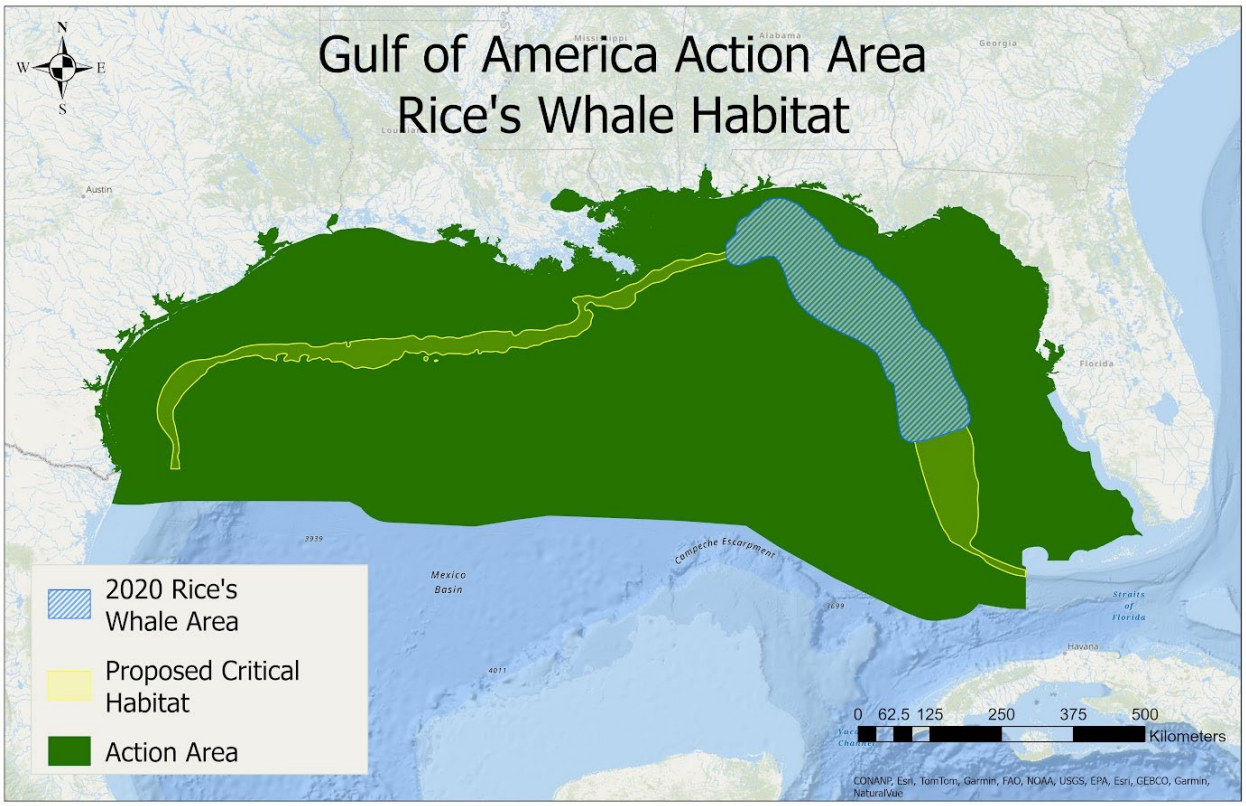


Figure 14. Map showing the RWA and Rice's whale proposed critical habitat in the action area

3.1.6.6 Effects Avoidance or Minimization Measures for Entanglement or Entrapment

To prevent entanglement of protected species in loose lines, the "in-water line precaution protocol" (Attachment 5) requires lines in the water to be taut and non-looping. Any entangled protected species must be immediately reported to BSEE and NMFS.

To prevent entrapment of protected species in moon pools, the "moon pool monitoring protocol" (Attachment 6) requires moon pool doors remain closed, when possible, and otherwise moon pool utilization requires regular monitoring either by visual inspection or video monitoring. If protected species become entrapped, reporting to BSEE and NMFS is required.

3.1.6.7 Effects Avoidance or Minimization Measures for Pile Driving

The "pile driving monitoring and reporting requirements protocol" (Attachment 7) apply to impact pile driving activities in water less than 100 m. In deeper waters or when other pile driving types (e.g., vibratory) are used, the protocol requires step-down review by NMFS.

3.1.6.8 Effects Avoidance or Minimization Measures for the Explosive Removal of Offshore Structures

The Explosive-Severance Scenario Mitigation Protocol (Attachment 8; formerly BSEE NTL 2018-G03 "Idle Iron Decommissioning Guidance for Wells and Platforms") describes the regulations for explosive removal of structures. These measures have essentially not changed since the 2020 biological opinion. All explosives use will require NMFS PSOs from the Platform Removal Observer Program. These requirements necessitate different levels of mitigation, monitoring, and reporting for protected species based on the charge size, water depth (species delineations), and use above or below the sea floor. The use of passive acoustic monitoring (PAM) technicians is required when using explosives in water depths greater than 200 m in order to monitor for vocalizations of deep-diving marine mammals.

3.1.6.9 Effects Avoidance or Minimization Measures for Site Clearance Trawling

Following decommissioning of a structure, operators are required to restore the sea floor to pre-lease conditions by removing any debris that may be on the seafloor. Site clearance is typically conducted with trawl nets. To minimize the effect on sea turtles that may be incidentally captured in the nets, under 30 C.F.R. §§250.1740-1743 BOEM requires the use trawl net(s) with a net bag/cod end with minimum mesh size no smaller than 4 in (10.2 cm) stretched mesh and abide by maximum trawl times of 30 minutes (time measured by doors in to the time doors are out of the water), allowing for the removal of any captured sea turtles. If sea turtles are captured, turtles must be resuscitated and released following the requirements for shrimp trawlers in the Gulf of America.

Sea Turtle Resuscitation Guidelines

According to 50 C.F.R. §223.206(d)(1), any sea turtles taken incidentally during the course of trawling [or other oil and gas] activities must be handled with due care to prevent injury, and if a sea turtle is inactive or comatose, resuscitation must be attempted according to the regulations.

3.1.7 Other Aspects of the Action Important to Effects Avoidance or Minimization

There are a number of statutory and regulatory requirements, other NTLs, review procedures and other practices that BOEM and BSEE adhere to, and this analysis assumes their continued implementation. These requirements and practices are described below, and while they do not directly avoid or minimize effects to listed species, their implementation indirectly benefits listed species by minimizing the risks of potential effects on marine environments from occurring. Continued implementation of these measures will reduce potential effects on the habitats and marine ecosystems in which listed species live.

3.1.7.1 Review Requirements for Safe Exploration Plans and Development Operations and Coordination Documents

Environmental information requirements for lessees and operators submitting an EP are specified in 30 C.F.R. §550.211 through 550.228, and are further explained in NTL 2008-G04, "Shallow Hazards Program," and NTL 2009-G27, "Submitting Exploration Plans and Development Operations Coordination Documents." NTL 2008-G04 provides guidance on information requirements and establishes the contents for OCS plans required by 30 C.F.R. §250 Subpart B. NTL 2010-N06, "Information Requirements for Exploration Plans, Development and Production Plans, and Development Operations Coordination Documents on the OCS," effective June 18, 2010, rescinded the limitations set forth in NTL 2008-G04 regarding a blowout and worst-case discharge scenarios and provides national guidance regarding the content of information in blowout and worst-case discharge scenario descriptions. NTL 2009-G27 clarifies guidance for submitting OCS plans and DOCD's to BOEM's Gulf of America OCS Region.

3.1.7.2 Review Requirements for Safe Drilling Plans

BOEM/BSEE will review all APDs to ensure lessees are using the best available and safest technology to enhance the evaluation of abnormal pressure conditions and to minimize the potential for uncontrolled well flow. Prior to conducting drilling operations, the operator is required to submit and obtain approval from BOEM/BSEE, an APD detailing the project layout at a scale of 24,000:1, design criteria for well control and casing, specifications for blowout preventers, a mud program, cementing program, directional drilling plans, etc.—to allow for BOEM/BSEE's evaluation of operational safety and pollution-prevention measures.

3.1.7.3 Review Requirements for Safe Pipelines

BOEM/BSEE will review proposed pipelines for safe and pollution free design, installation, and maintenance of OCS producer-operated oil and gas pipelines (30 C.F.R. §250 Subpart J). BSEE evaluates the design, fabrication, installation, and maintenance of all OCS pipelines. BOEM prepares NEPA analyses of proposed pipeline routes and installation/modification methodologies will be evaluated to determine the potential impacts on protected species. The design of proposed

pipelines will be evaluated by: (1) reviewing the applicant's calculations to determine proper consideration of such elements as the grade of pipe to be used, the wall thickness of the pipe, derating factors (the practice of operating a component well inside its normal operating limits to reduce the rate at which the component deteriorates) related to the submerged and riser portions of the pipeline, the pressure rating of any valves or flanges to be installed in the pipeline, the pressure rating of any other pipeline(s) into which the proposed line might be tied, and the required pressure to which the line must be tested before it is placed in service; (2) protective safety devices such as pressure sensors and remotely-operated valves, the physical arrangement of those devices proposed to be installed by the applicant for the purposes of protecting the pipeline from possible overpressure conditions and for detecting and initiating a response to abnormally low pressure conditions; and (3) the applicant's planned compliance with regulations requiring that pipelines installed in water depths less than 200 ft (61 m) be buried to a depth of at least 3 ft (1 m; 30 C.F.R. §250.1003). In addition, pipelines crossing fairways require a U.S. Army Corps of Engineers (USACE) permit and must be buried to a depth of at least 10 ft (3 m) and to 16 ft (5 m) if crossing an anchorage area. Operators are required to periodically inspect pipeline routes. Monthly overflights are conducted to inspect pipeline routes for leakage.

Applications for pipeline decommissioning must also be submitted for BOEM and BSEE review and approval. Decommissioning applications are evaluated to ensure they will render the pipeline inert and/or to minimize the potential for the pipeline becoming a source of pollution by flushing.

3.1.7.4 Review Requirements for Safe Wastewater Pollution Control

BOEM/BSEE must assure that oil and gas exploration, development, and production activities on the OCS are conducted in a safe and environmentally responsible manner. 43 U.S.C. § 1347(b) of the OCSLA, as amended, requires that all OCS technologies and operations use best available and safe technologies whenever practical. Oil and gas production safety systems and equipment used on the OCS will be designed, installed, used, maintained, and tested in a manner to assure the safety and protection of the human, marine, and coastal environments (30 C.F.R. § 250 Subpart H). BOEM/BSEE will assist USEPA with assuring that any effluent discharges from OCS facilities will be done in accordance with NPDES permits issued by USEPA. This includes all monitoring requirements as described in the NPDES permits.

3.1.7.5 Review Requirements for Safe Air Quality Control

BOEM will review all permit requests to ensure that lessees have applied for all necessary air quality permits and adequately described any possible emissions of regulated pollutants from their proposed activities.

3.1.7.6 Inspection and Enforcement

The OCSLA authorizes and requires BSEE to provide for both an annual scheduled inspection and periodic unscheduled (unannounced) inspections of all oil and gas operations on the OCS. The inspections are to assure compliance with all regulatory constraints that allowed

commencement of the operation and in the case of environmental compliance, to determine if conditions of approval (CoAs) and other mitigation measures imposed through lease stipulations or via plans or permits to reduce or negate resource impacts were followed and effective. The primary objective of an initial inspection is to assure proper installation of mobile drilling units and fixed structures, and proper functionality of their safety and pollution prevention equipment. After operations begin, additional announced and unannounced inspections are conducted. Unannounced inspections are conducted to foster safe operations, to maintain a BSEE presence, and to focus on operators with a poor performance record. These inspections are also conducted after a critical safety feature has previously been found defective. Poor performance generally means that more frequent, unannounced inspections may be conducted on a violator's operation. The annual inspection examines all safety equipment designed to prevent blowouts, fires, spills, or other major accidents. These annual inspections involve the inspection for installation and performance of all facilities' safety-system components. The inspectors follow the guidelines as established by the regulations, API RP 14C, and the specific BSEE-approved plan. BSEE inspectors perform these inspections using a national checklist called the Potential Incident of Noncompliance (PINC) list. This list is a compilation of yes/no questions derived from all regulated safety and environmental requirements.

BSEE administers an active civil penalties program (30 C.F.R. § 250 Subpart N). A civil penalty in the form of substantial monetary fines may be issued against any operator that commits a violation that may constitute a threat of serious, irreparable, or immediate harm or damage to life, property, or the environment. BSEE may make recommendations for criminal penalties if a willful violation occurs. In addition, the regulation at 30 C.F.R. § 250.173(a) authorizes suspension of any operation in the Gulf of America Region if the lessee has failed to comply with a provision of any applicable law, regulation, or order or provision of a lease or permit. Furthermore, the Secretary of DOI may invoke his authority under 30 C.F.R. § 550.185(c) to cancel a nonproductive lease with no compensation. Exploration and development activities may be canceled under 30 C.F.R. §§ 550.182 and 550.183.

3.1.7.7 Additional Effects Avoidance or Minimization Measures

Additional effects avoidance or mitigation measures may be required by NMFS for site-specific activities as specified in the step-down review process that may lead to a tiered consultation under the programmatic, or by BOEM in a specific plan or by BSEE in a permit. However, because these measures may, or may not, be incorporated in future permits and authorizations, they are not considered as part of this action.

3.2 Environmental Protection Agency

Air and water emissions associated with Gulf of America oil and gas activities and permitted by the USEPA. As such, USEPA is a co-federal action agency for this oil and gas programmatic consultation.

3.2.1 Clean Water Act Responsibilities

Several kinds of waste are generated during both exploration and development of offshore oil and gas. The primary operational waste discharges generated during offshore oil and gas exploration and development are drilling fluids, drill cuttings, various waters (e.g., bilge, ballast, fire, and cooling), deck drainage, sanitary wastes, and domestic wastes. During production activities, additional waste streams include treatment, completion and workover fluids and produced waters. Discharges of produced sand, non-aqueous-based drilling fluids, oil-based drilling fluids, oil-contaminated drilling fluids, and diesel oil are prohibited. Minor additional discharges occur from numerous sources. These discharges may include desalination unit discharges, blowout preventer fluids, boiler blowdown discharges, excess cement slurry, several fluids used in subsea production, and uncontaminated freshwater and saltwater.

The USEPA, through NPDES general permits issued by the USEPA Region that has jurisdictional oversight, regulates specific waste streams associated with or generated from offshore oil and gas activities. Section 301(a) of the CWA, 33 U.S.C. § 1311(a), makes it unlawful for any person to discharge any pollutant, except in compliance with other CWA provisions that may apply, including compliance with an NPDES permit. CWA section 402, 33 U.S.C. Section 1342, authorizes issuance of NPDES permits allowing discharges on the condition the discharge will meet certain requirements, including CWA Sections 301, 304, 306, 401 and 403. Those statutory provisions require NPDES permits to include effluent limitations for authorized discharges that: (1) reflect pollutant reductions achievable through statutorily-specified levels of technology, (2) comply with applicable USEPA-approved state water quality standards, (3) comply with other state requirements adopted under authority retained by states under CWA section 510, 33 U.S.C. Section 1370, and (4) are evaluated to determine the degree of degradation to the territorial seas, waters of the contiguous zone, or the oceans. When issuing permits for discharges into waters of the territorial sea, contiguous zone, or oceans, CWA Section 403 requires the USEPA to consider guidelines for determining potential degradation of the marine environment. Prior to permit issuance, ocean discharges must be evaluated against USEPA's published criteria (40 C.F.R. § 125, Subpart M) for determination of ocean degradation. Permit conditions are based on both technology-based effluent limitations guidelines and other prohibitions and conditions based on the best professional judgment of the permit writer such as the prohibition of discharges near sensitive aquatic communities or federally designated disposal sites. Water-quality based whole effluent toxicity limits are included to ensure certain discharges do not cause unreasonable degradation of the marine environment.

Incidental vessel discharges are regulated by the USEPA and the Vessel Incidental Discharge Act (VIDA), which establishes a new framework for the regulation of vessel incidental discharges under Section 312(p) of the CWA. The USEPA works with the International Maritime Organization to develop and implement legal standards that address vessel-source pollution and ocean dumping via the VIDA.

As mentioned previously, two regional offices issue NPDES general permits in the Gulf of America based on geographic location. Region 4 permits all CWA Gulf activities beyond the territorial seas of Mississippi, Alabama, and Florida, while Region 6 permits all CWA activities off the coast of Texas and those beyond the territorial seas of Louisiana (Figure 15). Each region issues general NPDES permits for discharges from new sources, existing sources, and new discharges in the Offshore and Coastal Subcategories of the Oil and Gas Extraction Point Source Category, as defined in EPA regulations at 40 C.F.R. Part 435, Subpart A.

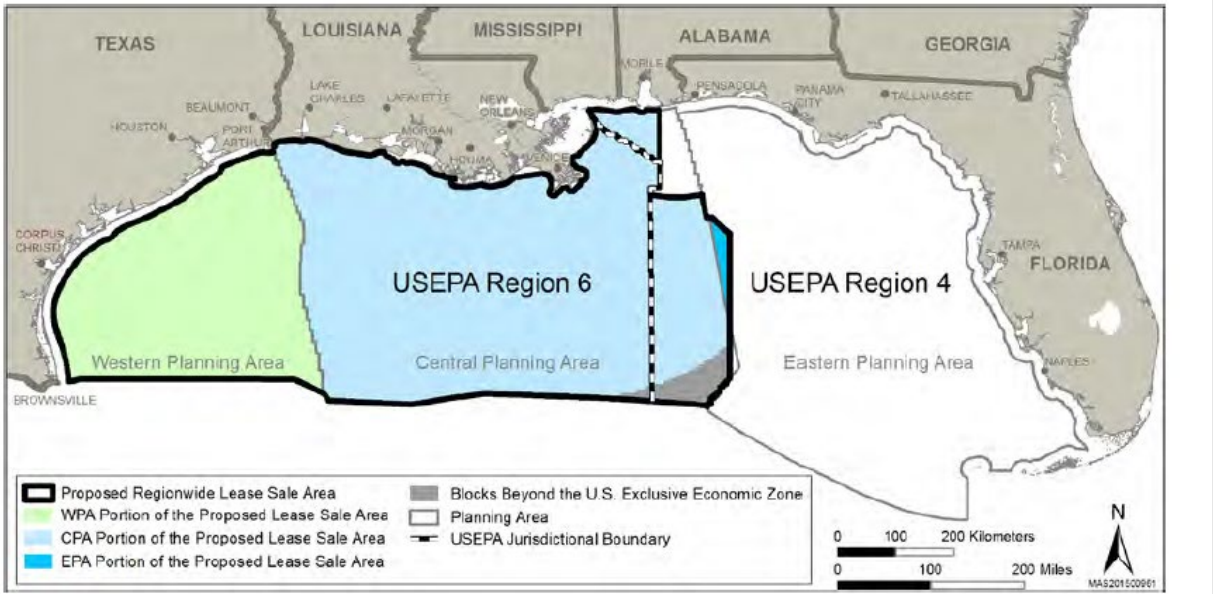


Figure 15. U.S. Environmental Protection Agency Jurisdictional Boundaries in the Gulf of America (Figure from the USEPA's Draft Environmental Assessment for the NPDES General Permit for Eastern GOM Offshore Oil and Gas Exploration, Development, and Production)

Permits issued under section 402 of the CWA for offshore activities must comply with any applicable water quality standards and/or federal water quality criteria as well as section 403 of the CWA. Water quality standards consist of the waterbody's designated uses, water quality criteria to protect those uses and to determine if they are being attained, and anti-degradation policies to help protect high-quality waterbodies. The general permits authorize discharges from exploration, development, and production facilities located in and discharging to Gulf of America waters.

General permits have been issued for oil and gas-related discharges into the Gulf of America that at a minimum incorporate the 1993 effluent guidelines and 2001 effluent guidelines for synthetic based fluid-wetted cuttings. The USEPA has issued general NPDES permits GMG290000 (Region 6 – Federal waters seaward of Texas and Louisiana), GEG460000 (Region 4 – Federal waters seaward of Texas and Louisiana) and GEG460000 (Region 4 – Federal waters seaward of the outer boundary of the territorial seas in water depths greater than 200 m offshore the coasts of Alabama and Florida in the Destin Dome lease block and in the Mobile and Visoca Knoll lease blocks seaward of the territorial seas offshore Mississippi and Alabama) for new and

existing sources in the Offshore Subcategory of the Oil and Gas Extraction Category located in the Gulf of America. NPDES permits can be found at https://www.epa.gov/npdes-permits. The permits allow the discharge of water-based drilling fluid, water- and synthetic-based drill cuttings, produced water, deck drainage, well treatment, completion, and workover fluids (usually brine), sanitary waste, domestic waste, and miscellaneous discharges. Each of these discharges is regulated by conditions outlined in the permit. The USEPA has established effluent limitations, toxicity testing requirements, and monitoring requirements for the various discharges that operators must comply with to ensure the health of waters, including in the Gulf of America (https://www.epa.gov/npdes/industrial-wastewater#oil).

Operators of facilities within the NPDES general permit coverage area must submit an NOI to the Regional Administrator, prior to discharge, that indicates they intend to be covered by the general permit. USEPA evaluates each NOI on a case-by-case basis. The NPDES general permit includes restrictions on the discharge of pollutants. Operators report discharge monitoring data into another USEPA electronic system. Failure to submit or falsification of information is considered a violation. Up to 50 production platforms and rigs per year have NPDES inspections performed by BSEE on behalf of the USEPA region 6 (region 4 has no installed structures), but those inspections do not include sampling.

USEPA ensures compliance through several enforcement actions: warning letter; administrative orders (smaller violations); penalty orders (large or continuous violations); or referrals the Department of Justice (e.g., if an operator does not have permit coverage). The USEPA may use documentation, information or pictures from BSEE, BOEM or USCG to support enforcement actions, which are publicly available on their online database at https://echo.epa.gov/.

3.2.2 Clean Air Act Responsibilities

The USEPA is also responsible for administering the CAA in areas of the Gulf of America not under the jurisdiction of BOEM. Under the 1990 CAA amendments, authority for regulating air emissions from sources subject to OSCLA was granted to the USEPA for areas of the OCS in the Gulf of America east of 87.5˚W longitude. Section 328(a)(1) of the CAA requires USEPA to establish air pollution control requirements for OCS sources under its jurisdiction, including that portion of the Gulf of America east of 87.5˚W, to ensure compliance with the NAAQS and the Prevention of Significant Deterioration (PSD) provisions under Title I, Part C of the CAA. These requirements are implemented through the OCS Air Regulations at 40 C.F.R. Part 55.

Applicants located within 25 nautical miles of a state seaward boundary must comply with the air quality requirements of the corresponding onshore area, including applicable federal, state, and local regulations and permitting programs, as required by 40 C.F.R. §55.3. Applicants operating beyond 25 nautical miles from the state seaward boundary are subject to federal requirements including the PSD preconstruction permit program (40 C.F.R. §52.21), Title V operating permit program requirements (40 C.F.R. Part 71), as well as applicable New Source

Performance Standards (NSPS) and National Emissions Standards for Hazardous Air Pollutants (NESHAP).

Under this program, USEPA will issue general permits, similar to those used by the NPDES program, or individual permits to operators working on the OCS east of longitude 87.5°W. The USEPA maintains a website that posts all of their OCS air permits for the southeastern U.S. at: https://www.epa.gov/caa-permitting/outer-continental-shelf-ocs-permit-activity-southeastern-us.

In a report to Congress, Ramseur (2012) identified differences between USEPA and BOEM/BSEE air permitting programs, particularly in how major source thresholds are applied. Under the CAA, USEPA defines a major source as any facility with cumulative emissions of regulated criteria pollutants equal or exceeding 250 tons per year (tpy). This total includes emissions from all oil and gas exploration and production onsite equipment, as well as support vessels operating within 25 mi of the facility. Individual units do not need to exceed the threshold on their own; it is the combined emissions from the entire facility that determine applicability. Once the major source threshold is exceeded, the facility must apply Best Available Control Technology (BACT) to all emissions units and undergo PSD permitting. In addition, air dispersion modelling is required if emissions of any single pollutant exceed the Significant Emissions Rates (SERs) established under C.F.R. §52.21. These SERs include 15 tpy for particulate matter (PM10), 10 typ for $PM_{2.5}$, 40 tpy for NOx, volatile organic compounds (VOCs), and SO_2, etc.). Modelling is used to demonstrate that the facility will not cause or contribute to a violation of the NAAQS or adversely affect nearby "Class I" areas. If modeling predicts potential impacts, the operator must implement mitigation or additional controls to reduce emissions. USEPA's permitting process also includes opportunities for public review and comment (Ramseur 2012). In 2020, BOEM updated its air quality regulations to better align with current standards and practices. The final rule, effective July 6, 2020, incorporated definitions for the NAAQS, updated significance levels based on EPA values, introduced requirements for $PM_{2.5}$ and PM10, and clarified emissions exemption thresholds for Development and Production Plans (DPPs) and Development Operations Coordination Documents (DOCDs). More recent studies such as Graham et al. (2016) provide updated assessments of cumulative emissions and onshore impacts and are used to inform both USEPA and BOEM decision-making.

BOEM does not use USEPA's major source thresholds. Instead BOEM's air quality regulations rely on exemption thresholds based on emissions and distance from the shore, originally developed from a 1980 study and Updated under BOEM's 2020 rule making (85 FR 81456). If projected emissions exceed these thresholds, additional modelling is required. However, if a plan falls below the thresholds, neither dispersion modeling nor control technology is required. During USEPA reviews of BOEM's NEPA air quality sections they have repeatedly commented that BOEM's approach may not ensure that onshore air quality, including within state tidelands, is adequately protected. USEPA staff have indicated that some OCS facilities regulated by BOEM could be contributing to NAAQS exceedances in neighboring states and have raised these concerns through interagency discussions and NEPA comment letters.

In 2024, USEPA finalized revisions to the NAAQS for fine particulate matter (PM2.5) and updated the Air Quality Index (AQI) and monitoring requirements. The final rule became effective March 4, 2024, with a technical correction issued December 19, 2024 (89 FR 243, Document Number 2024-29223).

USEPA Air Permitting Requirements

USEPA's OCS air quality regulations incorporate applicable requirements from the federal PSD and Title V operating permit programs, NSPS, and NESHAP as well as the applicable State Implementation Plan (SIP) and air quality regulations of the corresponding onshore area for OCS sources located within 25 miles of a state's seaward boundary.

40 C.F.R. Parts 328 and 55 distinguish between OCS sources located within 25 miles of a state's seaward boundary and those located beyond 25 miles of a state's seaward boundary (CAA §328(a)(1); 40 C.F.R. §§55.3(b) and (c)). Sources located within 25 miles must comply with both federal and corresponding state requirements, while sources located beyond 25 miles of a state's seaward boundary are only subject to federal requirements and are not subject to state's SIP. Below is brief summary of the applicable federal air quality programs under USEPA's jurisdiction for OCS sources under 40 C.F.R. Part 55:

- The PSD program, as set forth in 40 C.F.R. §52.21, is incorporated by reference into the OCS Air Regulations and is applicable to major OCS sources. The PSD program requires an assessment of air quality impacts from the proposed project on the NAAQS and PSD increments (PSD increment is the amount of pollution an area is allowed to increase) and the utilization of BACT. Under the PSD regulations, a stationary source is generally considered "major" if, among other things, it emits or has the potential to emit 250 tons per year or more of a "regulated New Source Review pollutant." Emissions from vessels servicing or associated with an OCS source that are within 25 miles of the OCS source are considered in determining the "potential emissions" for the purpose of applying the PSD regulations (see 40 C.F.R. §52.21(b) (70 FR 42508)).
- Title V: The requirements of the title V operating permit program, as set forth in 40 C.F.R. Parts 70 and 71, apply to major OCS sources. USEPA's OCS permits include conditions necessary to meet the requirements of the Title V operating permit program, as applicable. For example, permits include requirements for submittal of annual compliance certifications and annual fee payments (based on actual emissions), as well as monitoring, recordkeeping, and reporting requirements. OCS permits generally require the use of an approved continuous emission monitoring system, an approved parametric monitoring method, and/or stack testing of emissions units.
- A specific NSPS subpart applies to an OCS source based on equipment source category, equipment capacity, and the date equipment commences construction or modification. Potentially applicable NSPS include requirements for diesel engines, steam generating units (such as boilers or heaters), and petroleum storage tanks (see 40 C.F.R. §55.l3(c)).

- National Emission Standards for Hazardous Air Pollutants: Applicable NESHAP promulgated under section 112 of the CAA apply to OCS sources if rationally related to the attainment and maintenance of federal and state ambient air quality standards or the requirements of part C of Title I of the CAA (see 40 C.F.R. §55.13(e)). NESHAP regulations apply to an OCS source based on its source category listing. On the OCS, within EPA's jurisdiction, these standards control hazardous air pollutants from equipment such as diesel engines.

USEPA's OCS regulations also contain provisions for monitoring, reporting, inspection, compliance, and enforcement. Under 40 C.F.R. §§55.7–55.11; the USEPA Administrator may exempt an OCS source from a specific emissions control requirement if it is technically infeasible or would pose an unreasonable threat to health or safety, and they include provisions that allow USEPA's authority to be delegated to state or local air quality agencies (see 40 C.F.R. §§55.7, 55.8, 55.9, and 55.11).

The USEPA air quality requirements are incorporated into air construction and operating permits that are issued to the owner or operator of the OCS source. These permits may be issued for temporary, portable, or permanent OCS sources and for single operations or for multiple projects conducted over the life of the OCS source. Public notice and opportunity for public comment and hearing on USEPA's OCS permits are provided pursuant to the administrative procedures of 40 C.F.R. Parts 124 and 71.

3.3 NMFS Permits and Conservation Division Responsibilities under the Marine Mammal Protection Act

The MMPA of 1972 established a national policy to prevent marine mammal species and population stocks from declining beyond the point where they ceased to be significant functioning elements of the ecosystems of which they are a part. The MMPA established a moratorium on the taking of marine mammals in U.S. waters. It defines "take" to mean "to hunt, harass, capture, or kill" any marine mammal or attempt to do so (16 U.S.C. § 1362 (13)). NMFS Permits and Conservation Division can permit actions as exceptions to the moratorium for take incidental to commercial fishing and other non-fishing activities, for scientific research, and for public display at licensed institutions such as aquaria and science centers.

The Permits and Conservation Division's responsibilities under the MMPA includes rulemaking and issuance of LOAs and IHAs for oil and gas-related activities. For this consultation, the Permits and Conservation Division's action is the authorization of incidental take within the limits described and analyzed in this opinion and prescribing mitigation, monitoring and reporting requirements consistent with those analyzed in this opinion. The MMPA species in the Gulf of America listed under the ESA that are included in the MMPA action and considered in this opinion are the sperm whale and Rice's whale.

BOEM requested a rulemaking to authorize incidental take of marine mammals from oil and gas-related G&G activities in federal waters of the Gulf of America, except in those waters restricted

under the Presidential withdrawal. Under the regulation, available through the federal register and on the NMFS's website, individual industry companies may apply to the NMFS Permits and Conservation Division for LOAs for their proposed activities. Each LOA application will include the specific location and G&G survey details so that NMFS Permits and Conservation Division can make the determination if an LOA is warranted.

Each rule is valid for, and allows for authorization of incidental take of marine mammals from oil and gas-related G&G activities over five years, while this opinion is analyzing a 45-year period (since the 2020 opinion) for all oil and gas activities. Take that may be authorized under the rule includes Level A and/or Level B harassment (defined in the key assumptions Section 8.1) incidental to the use of active acoustic sound sources.

The final rule places requirements on lessees or operators for implementation to minimize potential adverse effects to marine mammals from sound sources used during geophysical surveys, including:

- standard detection-based mitigation measures, including the use of approved PSOs to conduct visual monitoring to detect marine mammals and acoustic monitoring during deep penetration surveys, and ramp up and shut down procedures for acoustic sources in certain circumstances during deep and shallow water penetration surveys;
- time-area restrictions designed to avoid effects to certain species of marine mammals in times and/or places believed to be of greatest importance;
- measures to reduce entanglement risk;
- vessel strike avoidance measures; and
- monitoring and reporting requirements for PSOs, equipment, and data collection.

The opinion and/or ITS may be amended to reflect changes to MMPA-based requirements for BOEM and its lessees and operators, if any, because of future rule making. The ITS in the 2020 opinion was amended following release of the 2021 final rule and again after the 2024 final rule. Future MMPA rule making may be subject to step-down review and, possibly, tiered consultation, depending on the scope and potential effects to ESA-listed species from future rule making. A new request for MMPA authorization was prepared and submitted by industry in March 2025.

3.3.1 Letters of Authorization

To incidentally take marine mammals pursuant to the applicable regulations, prospective LOA-holders must apply for and obtain a LOA. A LOA, unless suspended or revoked, may be effective for a period not to exceed the expiration date of these regulations. In the event of projected changes to the activity or to mitigation and monitoring measures required by a LOA, the LOA-holder must apply for and obtain a modification of the LOA as described in §217.187.

The LOA shall set forth:

- Permissible methods of incidental taking;
- Means of effecting the least practicable adverse impact (i.e., mitigation) on the species or stock and its habitat; and
- Requirements for monitoring and reporting, including annual reporting on activities conducted under the LOA with certification of information by the lead PSO and comprehensive reporting with information on injured or dead marine mammals, vessel strike, live stranding, and additional information, as requested, in the event of an investigation into live or dead stranded animals.

Issuance of the LOA shall be based on a determination that the level of taking will be consistent with the findings made for the total taking allowable under the applicable regulations and a determination that the amount of take authorized under the LOA is of no more than small numbers.

For LOA issuance where either: 1) the conclusions put forth in an application (e.g., take estimates) are based on analytical methods that differ substantively from those used in the development of the rule, or 2) the proposed activity or anticipated impacts vary substantively in scope or nature from those analyzed in the preamble to the rule, NMFS may publish a notice of proposed LOA in the Federal Register, including the associated analysis of the differences, and solicit public comment before making a decision regarding issuance of the LOA.

Notice of issuance or denial of a LOA shall be published in the Federal Register within 30 days of a determination.

3.3.1.1 Modifications of Letters of Authorization

A LOA issued under § 216.106 of this chapter and § 217.186 for the activity identified in § 217.180 shall be modified upon request by the applicant, provided that:

1. The proposed specified activity and mitigation, monitoring, and reporting measures, as well as the anticipated impacts, are the same as those described and analyzed for these regulations (excluding changes made pursuant to the adaptive management provision in paragraph (c)(1) of this section); and
2. NMFS determines that the mitigation, monitoring, and reporting measures required by the previous LOA under these regulations were implemented.

For LOA modification requests by the applicant that include changes to the activity or the mitigation, monitoring, or reporting (excluding changes made pursuant to the adaptive management provision in paragraph (c)(1) of this section) that result in more than a minor change in the total estimated number of takes (or distribution by species or years), NMFS may publish a notice of proposed LOA in the Federal Register, including the associated analysis of the change, and solicit public comment before issuing the LOA.

A LOA issued under § 216.106 of this chapter and § 217.186 for the activity identified in § 217.180 may be modified by NMFS under the following circumstances:

1) Adaptive Management – NMFS may modify (including augment) the existing mitigation, monitoring, or reporting measures (after consulting with the LOA-holder regarding the practicability of the modifications) if doing so is practicable and creates a reasonable likelihood of more effectively accomplishing the goals of the mitigation and monitoring set forth in the preamble for these regulations;
    a) Possible sources of data that could contribute to the decision to modify the mitigation, monitoring, or reporting measures in a LOA:
        i) Results from monitoring from previous years;
        ii) Results from other marine mammal and/or sound research or studies; and
        iii) Any information that reveals marine mammals may have been taken in a manner, extent or number not authorized by these regulations or subsequent LOAs.
    b) If, through adaptive management, the modifications to the mitigation, monitoring, or reporting measures are substantial, NMFS will publish a notice of proposed LOA in the Federal Register and solicit public comment.
2) Emergencies – If NMFS determines that an emergency exists that poses a significant risk to the well-being of the species or stocks of marine mammals specified in a LOA issued pursuant to § 216.106 of this chapter and § 217.186, a LOA may be modified without prior notice or opportunity for public comment. Notice would be published in the Federal Register within thirty days of the action.

3.3.2 Adaptive Management

The regulations governing the take of marine mammals incidental to geophysical survey activities contain an adaptive management component. The comprehensive reporting requirements associated with the rule are designed to provide NMFS Permits and Conservation Division with monitoring data from the previous year to allow consideration of whether any changes are appropriate. The use of adaptive management allows NMFS Permits and Conservation Division to consider new information from different sources to determine (with input from the LOA-holders regarding practicability) on an annual or biennial basis if mitigation or monitoring measures should be modified (including additions or deletions). Mitigation measures could be modified if new data suggest that such modifications would have a reasonable likelihood of reducing adverse effects to marine mammal species or stocks or their habitat and if the measures are practicable. The adaptive management process and associated reporting requirements serve as the basis for evaluating performance and compliance.

The following are some of the possible sources of applicable data to be considered through the adaptive management process: 1) results from monitoring reports, as required by MMPA authorizations; 2) results from general marine mammal and sound research; and 3) any

information which reveals that marine mammals may have been taken in a manner, extent, or number not authorized by these regulations or subsequent LOAs or that the specified activity may be having more than a negligible impact on affected stocks.

3.4 Step-Down Review

Many of the activities implemented under the Oil and Gas Program have a long regulatory history and a great deal of uniformity in how they are implemented. In addition, the anticipated effects of many of these activities often do not vary significantly from location to location. Thus, there is little uncertainty about the methods used to implement these activities under the program and their effects, so project-specific review of these activities is not conducted.

For other actions or activities, and their potential effects that occur in the conduct of the Gulf of America Oil and Gas Program, a project-specific step-down review may be required. Step-down review involves the action agency and/or NMFS conducting a project-specific review of an activity to determine whether it falls under or is consistent with this programmatic opinion. Consistency means that the methods and resultant effects from an action or activity that may not be explicitly described in this opinion are within the scope of the Oil and Gas Program and the range of effects analyzed in this opinion. The step-down review process begins with a consistency determination by the Bureaus. It is the responsibility of the Bureaus to make a consistency determination based on the details of the activity and confer with NMFS if they are unsure about whether an activity is consistent with the program. As part of a consistency determination, the Bureaus determine: 1) whether the effects of an action or activity are consistent with the effects analyzed in the programmatic opinion; 2) whether there are any different or new effects to ESA-listed species; and 3) whether or not the activity requires further consultation.

The need for step-down review varies depending on the level of uncertainty regarding aspects or potential effects of specific projects, approvals, or other actions. The greater the uncertainty, the greater the need for step-down review. Aspects of the step-down review process may be revised during annual program reviews, as necessary (e.g., phasing out of certain types of project-specific reviews, which has occurred since the 2020 opinion was implemented).

NMFS' review of the consistency determination assesses and confirms whether the anticipated effects of actions are consistent with and addressed by the programmatic effects analysis in this opinion. Where step-down review indicates activities may have adverse effects to listed species, NMFS may recommend additional avoidance or mitigation measures, or include requests for more information. In other instances, NMFS may determine that the action requires tiered consultation under the programmatic to analyze all the effects of the action. If an application for a permit or plan is outside the scope of the program, BOEM indicated the plan or permit is not likely to be approved until a stand-alone consultation is completed with NMFS.

A. Criteria for Actions and Activities that do not Require Step-Down Review by NMFS

Many of the activities that BOEM/BSEE approve for development and production are routine activities that have well understood effects that do not differ greatly depending on the timing or location of the activity. Activities that required step-down review under the 2020 opinion but because of the number of reviews completed, these activities are now well understood and NMFS can complete a thorough effects analysis for them are also included in this category. The activities included in this category have routine mitigation required under the BOEM/BSEE authorization and, in some cases, in the MMPA authorization.

Actions and activities carried out as described in this section of the programmatic biological opinion (Section 3, subsections 3.1 to 3.3.) not requiring step-down review include, but are not limited to, the following:

- Pipeline segment design, installation and maintenance not making landfall and reviewed by BSEE. This does not include in-place decommissioning of subsea equipment associated with pipelines, with the exception of decommissioning in-place of subsea tie-ins (SSTIs).
- Decommissioning activities submitted to BSEE via various forms listed in NTL 2010-G05 or NTL 2018-G03; and that go through BOEM/BSEE biological review to determine appropriate mitigations, or whether there is need for NMFS review.
- Vessel and helicopter operations that are associated with activities described in Section 3.1.4.8 and that abide by the requirements of this opinion.
- Development, construction and installation of structures that have no associated stressors as presented in the *Effects Analyses* Section 8 of this opinion and are not expected to result in effects to ESA-listed species or their designated critical habitats.
- Certain G&G modifications that are determined to neither alter the activity in a way that changes the modeled outcome and previous conclusion, nor the potential impacts to ESA-listed species or their designated critical habitats. For example, G&G OBN modifications where these conditions are met:
    - The proposed OBN type is the same as already permitted for use.
    - Any additional OBN(s) will be placed within the previously permitted OBN mapped polygon.
    - There are no changes to the permitted sound source and no new sound sources are proposed.

The revised Protocols that are part of the action have also removed the following actions and activities from requiring a step-down NMFS review, provided appropriate mitigations are assigned during permit issuance:

- Use of moon pools.

- Lines in the water.
- Use of geophysical equipment operating above 180 kHz.
- Coring activities.
- Abandonment in place of subsea tie-ins (SSTIs).

The requirement for step-down review under this consultation no longer applies to the following:

- G&G survey permit applications, including those using equipment operating below 180 kHz and the use of PIES with support structures other than tripod stands placed using an ROV, unless equipment to be used in the survey is of a type or used in a manner that is outside the scope of the equipment and associated effects evaluated in this opinion.
- Ancillary activities on the lease such as geophysical surveys associated with pipelines, liquid natural gas ports, or platform abandonment that go into an Ancillary Plan requiring BOEM review.
- New or revised NTLs, protocols or other guidance documents.

B. Criteria for Actions and Activities that Require Step-Down Review by NMFS

Types of actions that require step-down review are identified below.

- Actions or activities within the scope of the program described in Sections 3.1 to 3.3 of this opinion that differ from what is described, meaning the effects may have not been fully analyzed. These include, but are not limited to:
  - Activities that cannot be implemented as described in this opinion.
  - Activities for which the PDCs (i.e., NTLs, protected species stipulations, and/or other guidance [as appendices] in this opinion, or new or updated regulations) for a category of actions described in this opinion are proposed to be altered or eliminated.
- Certain pile driving-scenarios, specifically:
  - Any pile driving activity locations within the 100-400 m isobaths throughout the Gulf.
  - Vibratory pile driving activities planned anywhere within the action area.
- Use of NUTs
  - Any activity that may use emergent technologies or proposes use of equipment in a non-conventional way requires step-down review if the activity may affect ESA-listed species or their designated critical habitat. BOEM/BSEE should fully describe the new or unusual technology, consider all potential impacts to protected species, and provide clear effects determinations. New technologies

may be part of the program at any stage including, but not limited to, oil spill response, G&G, construction, development, drilling and production, pipelines, or other stages/activities described in Section 3.

- BOEM/BSEE Development and Production Activities
    - The cases that require step-down review for EPs, and DOCDs are:
        - Use of NUTs, which should be coordinated with NMFS as early in the process as possible.
    - Pipelines
        - Step-down review is required for any new pipelines expected to make landfall.
        - Decommissioning-in-place of subsea equipment other than pipelines and sub-sea tie-ins (SSTIs; i.e., manifolds, valves, pumps or other various equipment as described in 83 FR 67343).

3.4.1 Step-Down Review Procedures: BOEM and BSEE

If an activity falls into one of the categories identified in B, above, or the Bureaus determine, in coordination with NMFS, additional step-down review is required, then the BOEM or BSEE informs NMFS in writing of the activity details, the Bureau's determination, and the basis for the determination prior to taking the action or performing the activity. NMFS responds within the period referenced in the sections below for the actions and activities requiring step-down review. Below we describe the process and incorporate any changes made during the five years of implementation since issuance of the 2020 opinion.

3.4.1.1 Procedures for New and Unusual Technologies

Some new Oil and Gas Program technologies differ from established technologies in how they function or interface with the environment. These include equipment or procedures that have not been installed or used in the Gulf of America OCS waters. Having no operational history, they have not been assessed in BOEM/BSEE technical and environmental reviews. New technologies may be outside the framework established by OCSLA regulations and, thus, their performance (safety, environmental protection, efficiency, etc.) has not been analyzed by BOEM/BSEE. At the step-down review stage for an application or plan submitted via the online application system or email, BOEM/BSEE will identify any NUTs and conduct an internal review first according to their agency procedures (see Section 3.1.4.11):

1. Applicant presents materials for a NUT assessment. This should include a slide presentation and/or documentation that describes, at a minimum, the following:
    a. Source signal characteristics:
        i. Source levels (RMS SPL, PK SPL, SEL);

ii. Individual signal/pulse duration;

iii. Source spectrum;

iv. Impulsive or non-impulsive nature of the source;

v. Source directionality if significant; and

vi. If applicable, acoustic source modeling using a tool such as Gundalf or equivalent, to provide the metrics listed above.

b. Use characterization:

i. Usage environment (e.g. depth, locations);

ii. Duty cycle;

iii. Vessel speed;

iv. Approximate spacing between survey lines; and

v. Protraction area name.

c. Physical construction, description and configuration details; and

d. Specifics of any prior testing or measurements of new equipment (e.g., lake or quarry).

2. BOEM/BSEE NUT Review: BOEM/BSEE will complete a review on any NUTs proposed by lessees or operators to ensure the action is consistent with the program. BOEM/BSEE will make an initial determination as to whether: 1) the action can be implemented in accordance with the programmatic PDCs; and 2) is consistent with the effects addressed and analyzed in this opinion.

3. Request for step-down review: Upon completion of the NUT review, if BOEM/BSEE determines step-down review is needed, the agency will notify NMFS of its determinations and email the completed review to NMFS at nmfs.ser.gom.leases@noaa.gov with the subject header, "BOEM/BSEE NUT Review Request."

a. Content: BOEM review and any supporting documentation must be attached to the email, including the information provided by the applicant, an SEA, and other documentation, as relevant. The action agency should fully describe the NUT, consider all potential impacts to listed species and designated critical habitat, and provide clear supporting evidence for effect determinations.

4. NMFS Review and Response: If NMFS agrees with BOEM's determinations, we will notify BOEM via email within 30 days of receipt of the project-specific review request. If BOEM/BSEE does not receive a response within 30 days, NMFS and BOEM/BSEE will discuss and agree on appropriate future procedures. If NMFS' review reveals questions or

concerns, a meeting or conference call will be scheduled with BOEM/BSEE to resolve any protected species or critical habitat issues. If BOEM/BSEE determines the NUT may affect any listed species or designated critical habitat in a way that was not considered in this opinion, BOEM/BSEE shall coordinate with NMFS to discuss whether a separate, stand-alone consultation is required as part of approval of the permit or plan that includes the NUT.

3.4.1.2 Procedures for Development and Production Activities

Step-down reviews for DOCDs, APDs, EPs or other type activities identified above, and authorized by the Bureaus, will be conducted at a project-specific level as follows:

1. Upon completion of the BOEM or BSEE plan or permit review for consistency with the program, BOEM/BSEE will notify NMFS of the completed review by email to nmfs.ser.gom.leases@noaa.gov with the subject header, "BOEM/BSEE Project-Specific Review Request."
2. The appropriate plan or permit application must be attached to the email with any supporting LOA, EA, EIS, and other documentation, as relevant. At a minimum, the Bureaus must provide the following information regarding the plan:
    a. Duration of the Activity (number of activity days).
    b. Survey location and configuration (including line kilometers).
    c. Number of vessels involved.
    d. Energy source details – source type; number, size, and layout of arrays (number of airguns, configuration, and total volume); shot intervals; emitted frequencies and associated pressures of seismic sources; vessel speed; duration of a single shot; and source level (both peak to peak and root mean squared [rms] reported in dB re: 1 µPa @1 meter).
    e. Type and scale of receiving arrays (streamers, OBN, tethered OBN, etc.).
    f. Type of bathymetry, mapping or sampling equipment.
3. The body of the email must detail: (a) the activities in the permit or plan (b) location (block number) of those activities (c) a finding on whether the action will be implemented as described in the opinion (d) a statement whether the PDCs applicable to that type of action will be implemented, or are proposed to be altered or eliminated (e) findings as to whether the anticipated effects from the proposed project are consistent with those described in the programmatic biological opinion, and (f) a request for NMFS's review and agreement with BOEM/BSEE's determination.
4. NMFS Review and Response: NMFS will acknowledge receipt of the email submission through an auto reply email, will review the submitted materials and BOEM's or BSEE's findings, and respond within 30 days. NMFS' response will provide any additional

recommendations that may be appropriate to include in the specific plan or permit to avoid or minimize adverse effects to listed species or critical habitat, and provide confirmation or non-confirmation of BOEM/BSEE's determination. If BOEM/BSEE does not receive a response within the 30-day period, then NMFS and BOEM/BSEE will discuss and agree on appropriate future procedures. If NMFS disagrees with the action agency's determination the activity falls under the program and can proceed as planned, but it is determined that the effects are similar enough in scope to those analyzed in this opinion, a tiered consultation under the programmatic with NMFS on that activity will be required. Otherwise, if the activity or action is found to be completely beyond the scope of this opinion, a separate consultation must be requested.

3.4.2 Project-Specific Review Procedures: NMFS Permits and Conservation Division

The MMPA rulemaking evaluates the effects of expected marine mammal take (as defined under the MMPA) and imposes measures to mitigate effects from G&G sound for the five years covered by each rule, providing certainty regarding the expected effects of the MMPA action. Therefore, step-down reviews would not generally be required for the issuance of individual Letters of Authorization under any given MMPA rule. Future MMPA rulemaking actions may require step-down ESA review if there will be a change in the scope of activity with the outcome that effects to listed marine mammal species may be different or greater than those evaluated in this Opinion, or if one of the other reinitiation triggers are met (see Section 16). In these cases, the Permits and Conservation Division will provide the ESA Interagency Cooperation (via email to nmfs.ser.gom.leases@noaa.gov with the subject header, "Request for NMFS Permits and Conservation Division Review)" with a copy of the proposed rule attached.

3.4.3 Project-Specific Review Procedures: Environmental Protection Agency

The USEPA completed several ESA section 7 consultations with NMFS on NPDES general permits for discharges to the Gulf of America that all resulted in NMFS concurrence with a NLAA determination. The USEPA issues NPDES general permits that regulate the discharge of effluents from oil and gas-related activity in the Western, Central, or Eastern Planning Areas into marine waters of the OCS. NPDES permits are authorized for five years; however, terms may be administratively continued beyond five years based on the discretion of the Water Protection Division Director. Because the period of the program covered by this opinion exceeds the reissuance cycle, new NPDES general permits and occasionally individual permits will be issued during the course of the Oil and Gas Program. To assess any changes that may result from the reissuance of NPDES general permits or issuance of individual permits, a step-down review of the NPDES general permits or individual permits is required prior to their issuance for oil and gas-related activity. This step-down review allows NMFS to determine if the new NPDES general permits or site-specific permits are consistent with the programmatic opinion. Details for initiating step-down review include:

1. Request for Step-down Review: Prior to the expiration or reissuance of NPDES general permits or prior to site-specific permitting, the USEPA will notify NMFS via email at nmfs.ser.gom.leases@noaa.gov with the subject header, "Request for USEPA NPDES Review."
2. Content: The request will include any proposed changes from the previous NPDES general permit and information about effects of discharges permitted under the previous five-year permit, or new information regarding the project-specific permit, consider all potential effects to protected species, and provide clear effects determinations related to changes to the general permit or the new individual permit. The information will be reviewed to ensure: 1) permits can be implemented in accordance with the PDCs/effects minimization measures and reasonable and prudent measures of this programmatic opinion, and 2) the reissued permit, with any revisions clearly laid out, or new individual permit, is consistent with the effects analyzed in this programmatic opinion.
3. NMFS Review and Response: NMFS will provide a response via email within 60 days of receipt of the step-down request. If NMFS agrees with the action agency's determination that an activity is consistent with the activities and their effects described in this opinion, NMFS will notify USEPA that the new or changing information is consistent with this opinion. If this review results in questions or concerns by NMFS, an in-person meeting or conference call will be scheduled with the USEPA to resolve any protected species or critical habitat issues stemming from the proposed changes. If USEPA does not receive a response within 60 days, NMFS and USEPA will discuss and agree on appropriate future procedures. If NMFS disagrees with the action agency's determination, and it is determined that the impacts are similar enough in scope to those analyzed in this opinion, then the action agency may need to request a tiered consultation with NMFS on that activity. Otherwise, if the activity or action is found to be completely beyond the scope of this program, reinitiation of this consultation is required or a separate, stand-alone consultation must be requested.

3.5 Annual Activity Review

Action agencies will submit annual reviews, including summaries of the previous year's activity levels with the location and number of actions. The annual review covers all projects that occur within a calendar year (January 1 to December 31) and the report will be submitted within six months (by end of June) of the end of the calendar year with the exception of the year this opinion is issued where the report will cover May 21 through December 31, 2025. This review will provide a summary of annual aggregate activities and associated effects for the action agencies and NMFS to review and ensure that the activities remain within the scope of the opinion and/or so that adjustments to mitigation measures can be made, as necessary.

- The review process will include periodic meetings with the action agencies and NMFS' ESA Interagency Cooperation Division representative(s).

- For the first year following completion of this opinion, to ensure consistency with what is in this opinion, there may be more frequent calls/meetings so all agencies can be made aware of any issues that arise because of implementation of any new or revised conservation measures or ITS requirements.
- Program reviews will evaluate, among other things, whether the nature and scale of the assumptions and effects predicted for the entire Oil and Gas Program continue to be valid; whether the PDCs continue to be appropriate; whether RPMs and Terms and Conditions are ensuring take levels are not exceeded; and whether the step-down reviews and tiered consultation procedures are being complied with and are effective. Program-level reviews by themselves do not authorize any oil and gas leasing activities; however, programmatic planning documents should contain PDCs, revisions or amendments resulting from annual reviews, as well as any new information that should be considered in an ESA review, including programmatic NEPA documents.
- Annual reviews will be conducted by NMFS' ESA Interagency Cooperation Division with representatives from:
- BOEM/BSEE;
- NMFS' Permits and Conservation Division; and
- USEPA.

Annual activity reviews assist with streamlining step-down reviews and tiered consultations, allow for adaptive management, reduce the need for reinitiation, and ensure that NMFS retains a reasonable level of regulatory oversight for future activities proposed by the action agencies under the program and in stand-alone consultations.

The annual program reviews allows for adaptive management. There may be increased or reduced reporting requirements as program implementation continues based on the results of program reporting and the overall streamlining approach in the program.

3.5.1 BOEM/BSEE Annual Review

The process of G&G survey step-down review was found to be effective (i.e., individual permit applications are being appropriately reviewed by the Bureaus to determine consistency with the effects to ESA-listed species and their designated critical habitats analyzed in the biological opinion); therefore, in this opinion, G&G survey permits are now included in the annual reporting for G&G survey activities and the project-specific step-down review for G&G permits was eliminated.

- Information on number and location of activities, and activity details, PSO reports, number of takes reported for each activity identified as having the potential to result in take of an ESA-listed species, information regarding the

effectiveness of minimization measures, information on new developments in oil and gas activities including NUT evaluations, and recommendations for procedural changes to the program. For BOEM/BSEE, the annual reviews are generally organized around four topics: 1) G&G surveys; 2) construction and operations (covering all activities that are not in the other three reported areas); 3) oil spills and response planning; and 4) decommissioning.

- The Bureaus annual summary reporting includes the following:
  - All air quality reviews for program-related sources in the Gulf of America west of 87.5ºW longitude
  - Number of each type of permit/plan application reviewed and approved by BOEM/BSEE for each activity type;
  - Number of each type of permit/plan application flagged for anomalies necessitating further consideration or additional information from the applicants;
  - Number of each type of permit/plan application requiring BOEM/BSEE biologist review, and, of those, the number sent to NMFS for step-down review along with the rationale as to why each review was sent;
  - Proposed new or proposed revisions to NTLs, protocols, and other guidance documents with relevance to ESA-listed species and designated critical habitat;
  - Summary of mitigations implemented (number of activities, mitigations applied, description of interpreted effectiveness; i.e., instances in which mitigation led to identified effects to ESA listed species being reduced or avoided) with as much detail and quantitative description as possible;
  - The annual summary for explosive removal of offshore structures will include a summary of structure removal permits using explosives;
  - The annual summary for G&G survey activities will include a summary of the number of G&G permits and details of permitted activities;
  - The annual summary from the G&G PSO Program including, but not limited to, protected species sightings, the number and duration of sightings or adverse monitoring conditions leading to work stoppages or delays, a summary of PAM effort, any observed takes of each species, and any issues encountered (e.g., PAM equipment malfunctions);
  - Summary table(s) and/or reports for each of the specified permits and plans;
  - A summary of the aggregate effects evaluated by tallying the number of each occurring both annually and cumulatively:
    i. the number of animals observed in an exclusion zone, observed takes and estimated takes (e.g., sperm whale LOAs under the MMPA);
    ii. the number of actions for each activity type in the four broader categories (i.e., G&G, Development, Production, Decommissioning) in each Planning Area (note: if an activity plan or permit covers more than one

action, such as drilling multiple wells, that should be included but tallied separately from the total number of plans/permits);

iii. the number of permitted actions in the Mississippi and DeSoto Canyon Protraction areas; and

iv. the number and volume of program-related hydrocarbon spills occurring annually in each planning area in water depths less than 200 meters and greater than 200 m.

3.5.2 USEPA Annual Reviews

- Actions regulated under the NPDES General Permit and potential NPDES Individual Permits will be summarized.
- Region 6 will annually summarize number of activities reported under their electronic data submission system (https://echo.epa.gov/resources/echo-site-map).
- Region 6 will annually provide a summary report of all non-compliance events under the NPDES General Permit by lease holder or operator, as well as any penalties for violations of permit conditions. Data collection would begin at the time of the release of this opinion.
- Region 4 NPDES division will annually provide a summary report of all water quality permitting associated with oil and gas activities and make a determination whether or not they complied with the applicable general or individual permit.
- Region 4 will provide an annual summary of all site-specific air permits.
- There may be increased or reduced reporting requirements as the annual review process proceeds.

3.5.3 NMFS Permits and Conservation Division

NMFS Permits and Conservation Division provides shared documents for regular tracking of their activities and alignment with ESA section 7 reporting requirements. The annual review will cover all projects that occur within a given calendar year (January 1 through December 31), and the review will occur no later than the end of second quarter of the following year (i.e., by March 31). Reporting requirements may change over the program lifetime as the annual review process proceeds.

If the results of the annual review show that the anticipated impacts to listed species or critical habitat identified in this programmatic opinion have been exceeded or different/new impacts are expected, reinitiation of consultation may be required.

4 ACTION AREA

Action area means all areas affected directly, or indirectly, by the federal action, and not just the immediate area involved in the action (50 C.F.R. § 402.02).

The action area for this consultation includes the federal OCS waters in the Gulf of America, as well as coastal areas, ports, airspaces, and waterways used by transport vessels related to coastal infrastructure, fabrication sites, and pipelines connecting to the offshore pipeline system, and other estuarine and marine areas affected directly and indirectly by the action.

In the Gulf of America, the OCS refers to the offshore waters beginning 10 mi (16 km) offshore of Florida; 3.5 mi (5.6 km) offshore of Louisiana, Mississippi, and Alabama; and 10.3 mi (16.5 km) offshore of Texas; and extending seaward to the limits of the United States jurisdiction, the Exclusive Economic Zone (EEZ), to water depth of approximately 10,978 ft (3,346 m). Figure 16 displays the extent of BOEM's jurisdiction on the OCS divided into three planning areas.

The WPA covers approximately 28.58 million acres and is located 10.4 mi (16.7 km) offshore of Texas and extends seaward to the limits of the EEZ. It is bounded on the west and north by the federal-state boundary offshore of Texas. The eastern boundary begins at the offshore boundary between Texas and Louisiana and proceeds south-southeasterly. The WPA is bounded on the south by the maritime boundary with Mexico, as established by the "Treaty Between The Government Of The United States Of America And The Government Of The United Mexican States On The Delimitation Of The Continental Shelf In The Western Gulf Of Mexico Beyond 200 Nautical Miles," effective January 2001[7].

The CPA covers approximately 66.45 million acres and is located 3.5 miles (5.6 kilometers) offshore of Louisiana, Mississippi, and Alabama and extends seaward to the limits of the Federal jurisdiction. The eastern boundary begins at the Florida-Alabama border and proceeds southsoutheasterly.

[7] See https://www.boem.gov/sites/default/files/regulations/Treaties/US-Mexico-Delimitation-Treaty-9-June-2000.pdf

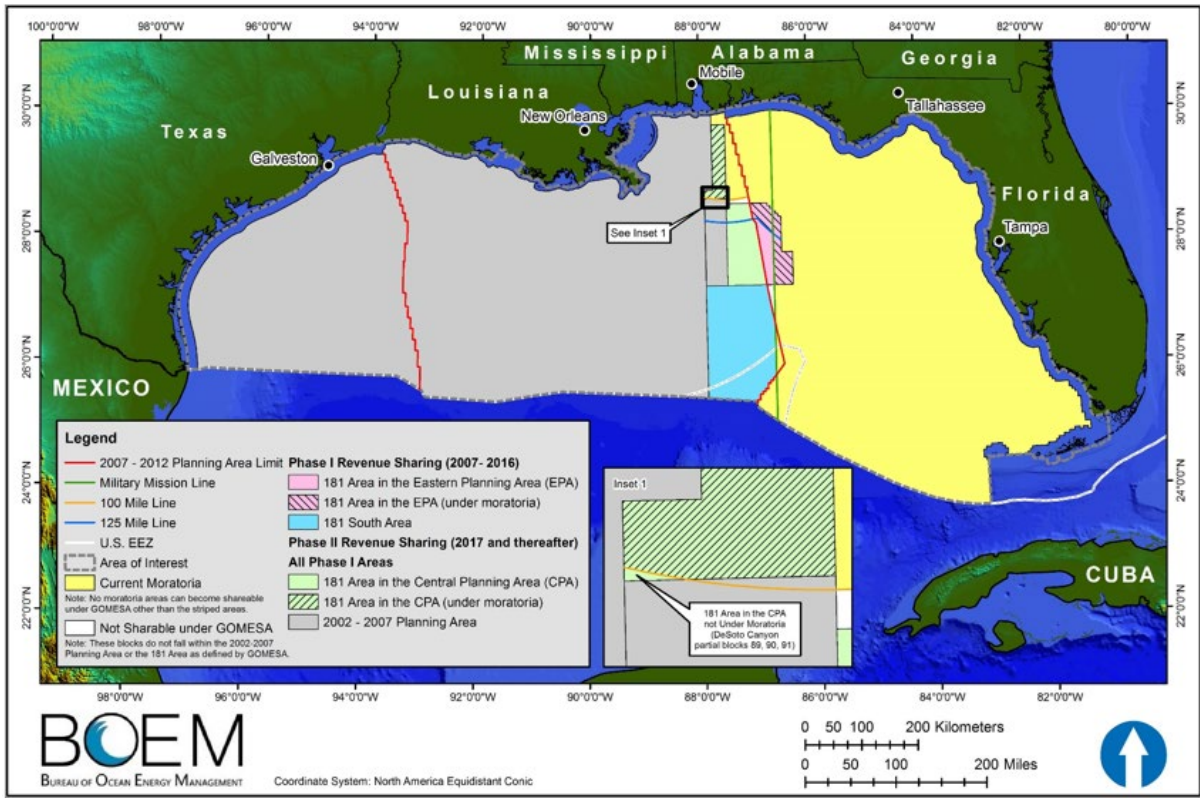


Figure 16. The action area for this consultation includes BOEM Gulf of America planning areas that extend into state coastal waters to shore and 55 km offshore beyond federal waters. The yellow area is under Presidential withdrawal until 2032 (BOEM 2017b).

The EPA, a large part of which is not included as part of BOEM's action, covers approximately 64.56 million acres and is located 10.4 mi (16.7 km) offshore of Florida extending westward to the boundary of the CPA. The portion of the EPA included as part of the action covers approximately 657,905 acres, bordered by the CPA boundary on the west. The area is located south of the Florida-Alabama border. The EPA withdrawal covers approximately 1.942 million acres. All areas under consideration for leasing are more than 125 mi (200 km) from Florida and the withdrawal area. Note that the area under Presidential withdrawal shown in Figure 16 (hatch-marked) is not included in BOEM's action for planning purposes because BOEM is not planning exploration or development activities within the area; however, there is vessel traffic associated with the oil and gas program that may transit across that area from Florida ports. Therefore, the area under withdrawal is part of the action area considered in this consultation.

The Presidential withdrawal of much of the EPA does not restrict geophysical surveys in the withdrawn area, but BOEM is not planning any geophysical survey activity in those areas for the period covered under this opinion, thus, G&G survey activities in the withdrawn area were not included in the consultation. Therefore, any BOEM- or BSEE-permitted oil and gas-related activities planned in the withdrawn portion of the EPA would need to undergo a separate consultation to be covered under the ESA.

5 STRESSORS CREATED BY THE ACTION

Stressors are any physical, chemical or biological agent, environmental condition, external stimulus or an event that may induce an adverse response in an ESA-listed species or their designated critical habitat. The Oil and Gas Program is very complex, consisting of multiple phases of oil and gas development from: 1) lease sales and exploration, 2) construction of facilities and oil and gas extraction, and 3) decommissioning and removal of facilities at the end of the lease term. Each of the activities can create stressors that may affect ESA-listed species or designated critical habitat. We deconstructed each phase of the action to identify stressors from each activity within each phase. As described in Section 3 the Federal action agencies have varied roles and responsibilities in each phase, and the stressors for each phase are displayed in each of the following tables:

Phase 1: Leasing and Exploration (Table 16)

- BOEM: Pre-lease Environmental Review; Geophysical Data Permit; Lease Sale; Exploration Plan; Administer air pollution control requirements for GOM OCS sources (west of 87.5˚W longitude)
- BSEE: Permit to Drill
- USEPA: NPDES Permits; Administer CAA air pollution control requirements for GOM OCS sources (east of 87.5˚W longitude)
- NMFS Permits and Conservation Division: MMPA LOA

Phase 2: Development and Production (Table 17)

- BOEM: Development Plan; Site-/Activity-specific Environmental Review; Administer air pollution control requirements for GOM OCS sources (west of 87.5˚W longitude)
- BSEE: Oil Spill Response Plan; Deepwater Operations Plan; Permit to Drill; Platform Approval/Verification; Pipeline Installation Permit; Production Safety System Permit; Production Measurement/Verification; Conservation of Resources
- USEPA: NPDES Permits; Administer CAA air pollution control requirements for GOM OCS sources (east of 87.5˚W longitude)

Phase 3: Decommissioning (Table 18)

- BOEM: Site-/Activity-specific Environmental Review; Administer air pollution control requirements for GOM OCS sources (west of 87.5˚W longitude)
- BSEE: Platform Removal Permit, Well Plugging and Abandonment (P&A) under an Application for Permit to Modify (APM)
- USEPA: NPDES Permits; Administer CAA air pollution control requirements for GOM OCS sources (east of 87.5˚W longitude)

The major categories of stressors are: vessel strike, sound from multiple sources (e.g., vessels, seismic airguns, drilling machines), emissions and discharges, entanglement and entrapment,

marine debris, and oil spills. All phases of the Oil and Gas Program (i.e., leasing and exploration, development and production, and decommissioning) involve stressor-causing activities.

While all of these stressors are reasonably certain to result from the action, oil spills are a stressor for which the level, location, duration, and other parameters are difficult to predict. Based on decades of experience with oil and gas exploration, leases, and extraction, we can reasonably assume oil spills will occur in the Gulf of America associated with this BOEM Oil and Gas Program over the next 45 years.

Table 16. Phase 1: Leasing and exploration activities and resulting stressors

Activity	Stressor
Deep penetration seismic surveys[2]	Sound (S)
HRG surveys[3]	Sound (S)
Deployment and retrieval of seismic survey equipment[4]	Entanglement in equipment (E), Increased turbidity (Z), Disturbance to ocean floor (Z), Marine debris entanglement (M)
Sediment sampling (box & piston cores)	Contaminants and toxins (D), Water quality degradation (D), Entanglement in equipment (E), Increased turbidity (Z), Disturbance to ocean floor (Z)
Service vessel operation	Vessel strike (V), Sound (S), Water quality degradation (D), Air pollution (D), Marine debris ingestion (M), Marine debris entanglement (M), Oil (O),
Geophysical survey vessel operation	Vessel strike (V), Sound (S), Water quality degradation (D), Air pollution (D), Marine debris ingestion (M), Marine debris entanglement (M), Oil (O),
Aircraft operation	Sound (S), Air pollution (D)
Drilling exploration & delineation wells	Sound (S), Contaminants and toxins (D), Water quality degradation (D), Increased turbidity (Z), Disturbance to ocean floor (Z), Oil (O)
Use of generators and engines	Sound (S), Air pollution (D), Oil (O)
Discharge of drilling fluids, drill cuttings, and produced water	Contaminants and toxins (D), Water quality degradation (D), Increased turbidity (Z)
Venting/Flaring to dispose of vapors or natural gas	Air pollution (D)
MODU operation[5]	Vessel strike (V), Sound (S), Water quality degradation (D), Air pollution (D), Increased turbidity (Z), Disturbance to ocean floor (Z), Marine debris ingestion (M), Marine debris entanglement (M), Oil (O)
Use of moon pools	Entrapment (E)

Table 17. Phase 2: Development and production activities and resulting stressors

Activity Producing Stressor[8]	Vessel strike (V)	Sound (S)	Underwater explosion (S)	Contaminants and toxins (D)	Water quality degradation (D)	Air pollution (D)	Entanglement in equipment (E)	Entrapment (E)	Capture in trawl gear (E)	Increased turbidity (Z)	Disturbance to ocean floor (Z)	Marine debris ingestion (M)	Marine debris entanglement (M)	Oil (O)
MODU operation[9]	X	X	--	--	X	X	--	--	--	X	X	X	X	X
Drilling development and production wells	--	X	--	X	X	--	--	--	--	X	X	--	--	X
Use of generators and engines	--	X	--	--	X	X	--	--	--	--	--	--	--	X
Use of moon pools	--	--	--	--	--	--	--	X	--	--	--	--	--	--
Discharge of drilling fluids, drill cuttings, and produced water	--	--	--	X	X	--	--	--	--	X	--	X	--	--
Discharge of waste products from offshore structures and support vessels[10]	--	--	--	--	X	--	--	--	--	--	--	X	--	--
Venting and flaring to dispose of hydrocarbon vapors or natural gas	--	--	--	--	--	X	--	--	--	--	--	--	--	--
Oil tanker and barge operation	X	X	--	--	X	X	--	--	--	--	--	--	--	X

[8] Stressor categories are identified as vessel strike (V); Sound (S); Emissions or Discharges (D); Entanglement and Entrapment (E); Marine Debris (M); Oil spills (O); and Other (Z), and the other category represent stressors that are represented in multiple categories.
[9] MODUs used include jack-up rigs, semi-submersible rigs, submersibles, platform rigs, and drill ships.
[10] Discharged wastes include treated sewage, treated wastewater, engine waste, biodegradable food waste, desalination brine, boiler blowdown fluids, blowout preventer fluids, excess cement slurry, subsea production fluids and uncontaminated freshwater and saltwater.

Activity Producing Stressor[8]	Vessel strike (V)	Sound (S)	Underwater explosion (S)	Contaminants and toxins (D)	Water quality degradation (D)	Air pollution (D)	Entanglement in equipment (E)	Entrapment (E)	Capture in trawl gear (E)	Increased turbidity (Z)	Disturbance to ocean floor (Z)	Marine debris ingestion (M)	Marine debris entanglement (M)	Oil (O)
Service vessel operation	X	X	--	--	X	X	--	--	--	--	--	--	--	X
Aircraft operation		X	--	--	--	X	--	--	--	--	--	--	--	
Shuttle tanker operation	X	X	--	--	X	X	--	--	--	--	--	--	--	X
Installation of fixed & floating platforms	--	X	--	--	--	--	--	--	--	X	X	--	--	--
Installation of caissons	--	X	--	--	--	--	--	--	--	X	X	--	--	--
Installation of well protectors	--	X	--	--	--	--	--	--	--	X	X	--	--	--
Installation of wellheads	--	X	--	--	--	--	--	--	--	X	X	--	--	X
Installation of casing conductors	--	X	--	--	--	--	--	--	--	X	X	--	--	--
Installation of pipelines	--	X	--	--	--	--	--	--	--	X	X	--	--	X
Installation of mooring buoys	--	--	--	--	--	--	X	--	--	--	X	--	X	--

Table 18. Phase 3: Decommissioning activities and resulting stressors

Activity Producing Stressor[11]	Vessel strike (V)	Sound (S)	Underwater explosion (S)	Contaminants and toxins (D)	Water quality degradation (D)	Air pollution (D)	Entanglement in equipment (E)	Entrapment (E)	Capture in trawl gear (E)	Increased turbidity (Z)	Disturbance to ocean floor (Z)	Marine debris ingestion (M)	Marine debris entanglement (M)	Oil (O)
Pipeline flushing	--	--	--	X	X	--	--	--	--	--	--	--	--	--
Tank and deck cleaning	--	--	--	X	X	--	--	--	--	--	--	X	--	--
Pile jetting	--	X	--	X	X	--	--	--	--	X	X	--	--	--
Structure severance using explosives (bulk, shaped and fracturing charges)[12]	--	X	X	--	--	--	--	--	--	X	X	X	X	--
Structure severance using non-explosive methods[13]	--	X	--	--	--	--	--	--	--	X	X	--	--	--
Site clearance trawling	--	--	--	--	--	--	X	--	X	X	X	--	--	--
Artificial reef creation	--	--	--	--	--	--	--	--	--	--	X	--	--	--
Removal of severed structure from seabed	--	--	--	--	--	--	--	--	--	X	X	--	--	--
Welders cut severed structure for lift vessel	--	--	--	X	--	--	--	--	--	--	--	--	--	--

[11] Stressor categories are identified as vessel strike (V); Sound (S); Emissions or Discharges (D); Entanglement and Entrapment (E); Marine Debris (M); Oil spills (O); and Other (Z), and the other category represent stressors that are represented in multiple categories.

[12] Target structures include wellheads and conductors, production devices, jacketed platforms, caissons, well protectors, pipelines, cement structures and foundations.

[13] Non-explosive methods include abrasive cutters (sand and abrasive-water jets), mechanical cutters (e.g., carbide or rotary), diamond wire cutting devices, and cutting facilitated by commercial divers using arc/gas torches.

Activity Producing Stressor[11]	Vessel strike (V)	Sound (S)	Underwater explosion (S)	Contaminants and toxins (D)	Water quality degradation (D)	Air pollution (D)	Entanglement in equipment (E)	Entrapment (E)	Capture in trawl gear (E)	Increased turbidity (Z)	Disturbance to ocean floor (Z)	Marine debris ingestion (M)	Marine debris entanglement (M)	Oil (O)
Transport of severed structures to service base or shore	X	X	--	--	X	X	--	--	--	--	--	X	--	X
Transport of topside equipment to shore	X	X	--	--	X	X	--	--	--	--	--	X	--	X
Lift and support vessel operation	X	X	--	--	X	X	----	--	--	--	--	X	--	X
Load barge operation	X	X	--	--	X	X		--	--	--	--	--	--	--
Aircraft operation	--	X	--	--		X	--	--	--	--	--	--	--	--

6 SPECIES AND CRITICAL HABITAT IN THE ACTION AREA

The ESA and its implementing regulations (50 CFR Part 402) allows for three general determinations for listed species and critical habitat: 1) no effect, 2) may affect, not likely to adversely affect (NLAA), and 3) may affect, likely to adversely affect (LAA). Action agencies, prior to requesting ESA consultation, determine whether their proposed action may affect ESA-listed species or their designated critical habitat. Generally, a "no effect" determination means there is no plausible exposure or response to stressors generated by the proposed action for any ESA-listed species or designated critical habitat. A "no effect" determination does not require consultation. Any scenario where there is a plausible exposure to stressors generated by the action, no matter how unlikely, is considered "may affect." For any action that "may affect" an ESA-listed species or its designated critical habitat, the action agency shall consult with the Services under section 7(a)(2) of the ESA.

Once we have determined the action may affect ESA-listed species or their designated critical habitat, the next step is differentiating between stressors that are NLAA and LAA for each listed species and critical habitat in the action area. An action warrants a NLAA finding when its effects are completely beneficial, discountable, or insignificant. Completely beneficial effects have an immediate positive effect without any adverse effects to the species or habitat. Completely beneficial effects are usually discussed when the project has a clear link to the ESA-listed species or its specific habitat needs and consultation is required because the species may be affected, albeit positively. Discountable effects are those that could occur while an ESA-listed species is in the action area but, because of the intensity, magnitude, frequency, duration, or timing of the stressor, exposure to the stressor is extremely unlikely to occur. Insignificant effects relate to the response of exposed individuals where the response, in terms of an individual's growth, survival, or reproduction, would be immeasurable or undetectable, or an impact to the conservation value of a PBF would be immeasurable or undetectable. For stressors that meet these criteria for completely beneficial, discountable, or insignificant, the appropriate conclusion is NLAA.

6.1 May Affect, Not Likely to Adversely Affect

BOEM/BSEE did not make effects determinations for blue, sei, and North Atlantic right whales, and fin whales (*Balaenoptera physalus*) were not discussed by the Bureaus. BOEM revised their effect determinations for Nassau grouper and smalltooth sawfish to "no effect" in 2024 because they concluded the species are not in the action area and are not likely to be exposed to oil and gas-related activity. However, we assessed the potential for exposure and response of these species and critical habitats to the stressors from activities conducted under the Oil and Gas Program, as discussed below.

6.1.1 Whales

Blue whale (*Balaenoptera musculus*), sei whale (*Balaenoptera borealis*), and North Atlantic right whale (*Eubalaena glacialis*) have been reported in the Gulf of America on rare occasions.

These whale species are very rare in the action area and are considered extralimital in the Gulf of America and are not documented as inhabitants of the Gulf of America in NMFS' stock assessment reports (Waring 2016). Therefore, we consider the risk of overlap of these species with the Oil and Gas Program activities to be extremely unlikely to occur and find the risk to these species to be discountable. For this reason, NMFS concludes that the Oil and Gas Program is not likely to adversely affect blue, sei, or North Atlantic right whales.

Fin whales are very rare in the action area and are considered extralimital in the Gulf of America. The species is not documented as inhabiting the Gulf of America in NMFS' stock assessment reports (Hayes et al. 2022), and we consider the risk of overlap of this species with the oil and gas program activities to be extremely unlikely to occur. Therefore, we find the risk to this species to be discountable. For this reason, NMFS concludes that the Oil and Gas Program is not likely to adversely affect fin whales.

6.1.2 ESA-listed Fish

ESA-listed smalltooth sawfish (*Pristis pectinata*) are rare in the action area and their designated critical habitat is outside the action area. Small, juvenile smalltooth sawfish are generally restricted to estuarine waters of peninsular Florida, whereas larger adults have a broader distribution and could be found in the southeastern Gulf of America, although this is generally outside of the action area.

Decades of oil and gas activities have not documented any interactions, such as through entanglement/entrapment or oil spill response, with smalltooth sawfish. The sound stressors from the action are not likely to occur at levels to create a risk to smalltooth sawfish because the sounds would occur in deepwater areas away from sawfish preferred habitats. Marine debris from the action is expected to occur in deep water areas of the Gulf of America. BOEM's oil spill risk analysis (Section 8.8) concluded that there is little to no risk of oil making contact with southern Florida coastal waters where smalltooth sawfish reside. Based on the above we find the risk of smalltooth sawfish interacting with the stressors of vessel strike, sound, emissions/discharges, entanglement/entrapment, marine debris, and oil spill is extremely unlikely to occur and therefore discountable. We determined that smalltooth sawfish and their designated critical habitat are not likely to be adversely affected by the Oil and Gas Program.

BOEM determined that their activities will have no effect on Nassau grouper. Nassau grouper (*Epinephelus striatus*) may occur in southeastern portion of BOEM's EPA, which is currently located far from any oil and gas activities due to the moratorium on the majority of this area. The moratorium originally banned oil and gas development until June 30, 2022, but, on September 8, 2020, the ban was extended through a Presidential withdrawal to June 30, 2032. As noted previously, BOEM and BSEE do not project any leases in the EPA after the withdrawal expires. If new leases are offered in the EPA during the timeframe of this opinion, reinitiation of consultation or a stand-alone consultation would be required because effects of oil and gas development and production in that area are not considered in this opinion.

Nassau grouper may be exposed to and detect sound generated by oil and gas activities, specifically from Oil and Gas Program-associated vessel traffic that passes through the Florida Straights but, because their range is separated from the majority of sound-producing activities, we expect effects from sound on these fish to be insignificant.

The risk of a vessel strike resulting from the action is considered discountable because vessel strikes of marine fish offshore are rare events in general and are not considered a threat to Nassau grouper. While it is possible that the presence of vessels or aircraft used for oil and gas activities may result in a short-term behavioral response from this species (e.g., startle), the effects are not expected to result in any measurable response by individuals that may be exposed to stressors from vessel or aircraft operation (i.e., insignificant). Because their range is a great distance from where the oil and gas activities will occur, we do not expect Nassau grouper will be affected by any of the following activities or associated stressors (i.e., no effect): marine debris, G&G sediment sampling, entanglement, entrainment or entrapment in equipment, emissions and discharges, offshore infrastructure/construction, and decommissioning and structure removal.

Oil spill risk analyses have shown low to zero risk in the areas where Nassau grouper occur in the action area. Given the low to zero risk of an oil spill affecting this species because a spill is unlikely to occur where Nassau grouper are present, exposure of Nassau grouper to oil spill response activities, including the use of dispersants and in-situ burning, is also extremely unlikely to occur (i.e., discountable). Because pipeline construction is also unlikely to occur in the portions of the action area that overlap with the ranges of Nassau grouper, we consider the effects of this activity to be discountable. In addition, any new pipelines expected to make landfall in areas where Nassau grouper may be present would require step-down review under this programmatic consultation (Section 3.4). In summary, we conclude that any effects to Nassau grouper resulting from activities conducted as part of the action will be either discountable or insignificant.

Therefore, we determined that the Nassau grouper is not likely to be adversely affected by the Oil and Gas Program.

In the Western Atlantic, oceanic whitetips occur from Maine to Argentina, including the Gulf of America. The oceanic whitetip shark can be found at the ocean surface to at least 152 m deep, but most frequently stay between 25.5 and 50 m from the ocean surface (Carlson and Gulak 2012; Young 2016), with changes in vertical movements above and below 50 m occurring when sea surface temperatures were around 28 ºC (82.4ºF) (Andrzejaczek et al. 2018) Three tagging studies conducted on oceanic whitetip sharks in the Atlantic found young oceanic whitetip sharks offshore along the southeastern coast of the U.S., suggesting there may be a nursery over the OCS (Compagno 1984) (Bonfil et al. 2008). In the southwestern Atlantic, the prevalence of immature sharks, both female and male, in fisheries catch data suggests this area may serve as potential nursery habitat for the oceanic whitetip shark (Coelho et al. 2009; Frédou et al. 2015; Tambourgi et al. 2013; Tolotti et al. 2015). The oceanic whitetip shark was described historically

as widespread, abundant, and the most common pelagic shark in the warm parts of the North Atlantic (Backus et al. 1956), but recent information suggests the species is now relatively rare, largely due to bycatch in fisheries (Young et al. 2018).

In the Atlantic Ocean, giant manta rays have been observed as far north as New Jersey and are widespread in the Gulf of America. The giant manta ray can exhibit diel patterns in habitat use, moving inshore during the day to clean and socialize in shallow waters (10-20 m), and then moving offshore at night to feed to depths of 1,000 m (Burgess et al. 2016; Hearn et al. 2014). Farmer et al. (2022a) utilized sightings and survey effort data from numerous sources and decades of sampling across a broad geographic range to create a species distribution model of giant manta ray occurrence. The most sightings and largest groups reported in the Gulf were near the mouth of the Mississippi River and the east coast of Florida with peak manta ray use concentrated near the Mississippi River delta during the spring (April to June) and fall (October to November). Manta rays were more dispersed and farther offshore during the remainder of the year. The Flower Garden Banks National Marine Sanctuary (FGBNMS) is an important nursery habitat for juvenile manta rays in the Gulf of America (Stewart et al. 2018), and the only abundance data for the species in the Gulf is from the FGBNMS with more than 70 individuals (Miller 2016).

Giant manta rays and oceanic whitetip sharks could potentially overlap with sound producing activities from the Oil and Gas Program. Because these species are considered very rare within the action area, the number of individuals exposed to sounds from the action is expected to be extremely small. The effects associated with a rare encounter of a manta ray or oceanic whitetip shark with a source vessel would be minimal because of the implementation of required minimization measures. We could not find any information suggesting that sounds produced by G&G surveys (i.e., seismic airguns, HRG, CSEM, or other sources) will result in measurable effects to individual manta rays or oceanic whitetip sharks. We could not find any information suggesting that sounds produced by oil and gas construction and operations will result in measurable effects to individual manta rays or oceanic whitetip sharks. In addition, large pelagic species such as these would be expected to avoid areas where construction operations are underway. The effects of sound on individual fish that may be exposed to G&G survey and oils and gas construction and operation sound sources, other than pile driving, are expected to be too small to measure and, thus, insignificant for these species, in part because they lack swim bladders.

There is little available information on the effects of pile driving on marine fish. Pile driving can potentially result in mortality or injury to fish that are sufficiently close to the source (Popper and Hastings 2009b). Given the low numbers of giant manta rays and oceanic whitetip sharks within the action area, it is highly unlikely that these species would be found close enough to pile driving activities to experience injury or mortality. Because exposure of giant manta ray and oceanic whitetip shark to pile driving sounds at levels that could cause injury or mortality is

extremely unlikely to occur, we believe the effects of pile driving on these two species will be discountable.

There is considerable variability in the effects of explosive blasts on fish species. Studies suggest there is far more damage to fish species with swim bladders than to species, such as giant manta rays and oceanic whitetip sharks, which lack such air chambers (Hastings and Popper 2005a). We could not find any information suggesting that sounds from explosive severance and other decommissioning activities will result in measurable effects to individual manta rays or oceanic whitetip sharks. Given the low numbers of giant manta rays and oceanic whitetip sharks within the action area, exposure of these species to explosives that could lead to injury or mortality is extremely unlikely to occur, and thus the effects will be discountable.

Giant manta rays and oceanic whitetip sharks may be able to hear the sound of passing vessels, but they are not expected to be adversely affected by the sound. Behavioral responses, which may include startle, avoidance, and diving, are expected to be short-term and minor, if they occur at all. The sound produced by passing vessels would be brief, and the received sound levels by these species would result in effects that are too small to measure in individual fish. We conclude that vessel sound associated with the Oil and Gas Program will have only insignificant effects.

Vessel strikes of elasmobranch species, in general, are extremely rare. The small number of giant manta rays and oceanic whitetip sharks within the action area contributes to the low likelihood of a vessel strike to one of these species. We are not aware of any previous reports of a vessel strike in the Gulf of America involving a giant manta ray or oceanic whitetip shark. Giant manta rays are found in open water, feeding over reefs, or visiting shallow water cleaning stations in certain areas. Oceanic whitetips tend to prefer the deeper ocean waters where there is no likelihood of vessel strike. Although oceanic whitetips have been observed in waters as shallow as 120 ft and along coastlines, they tend to only hunt in these waters if they are near a continental shelf where they still have access to deeper waters. Based on the best available information, we find that a vessel strike of a giant manta ray or oceanic whitetip shark is extremely unlikely to occur due to their rarity in the action area and their lack of surface-oriented behavior. Therefore, we find the effects to giant manta rays and oceanic whitetip sharks from vessel strikes to be discountable.

There have been several documented entanglement events including a sea turtle, manta ray and a dolphin. Because of the prior occurrences of entanglement, BOEM, in consultation with NMFS, implemented measures, such as removing use of certain types of lines or requiring the use of a heavy coated fiber line to prevent coiling or slack lines, to reduce the chance of such entanglements occurring. Data on giant manta ray are uncertain, but these two species are expected to be sparsely encountered in the Gulf of America with the only known larger concentration of giant manta ray being in the FGBNMS where Oil and Gas Program activities are not expected. Entanglement of animals in gear and lines associated with the program are rare, isolated events and BOEM implemented measures to reduce the potential for gear interactions in response. Therefore, we believe entanglement of giant manta rays in OBN lines is extremely unlikely to occur and, thus, discountable.

We expect similar effects of oil on oceanic whitetip sharks and giant manta rays because they are both elasmobranchs with similar physiology. These species are free-swimming, and often occur in deeper, pelagic waters. The species could aspirate oil dispersed in the water column through their gill filaments, ingest oil in contaminated prey, or come into contact with oil beneath the water surface or if these animals breach the surface, potentially affecting their skin. Giant manta rays are found at FGBNMS and occasionally in shallower waters in the action area, where no or limited Oil and Gas Program activities occur, although the species is pelagic. There are no known breeding aggregations of manta ray in the Gulf of America and, when evaluating general encounter data from scientists searching specifically for this species, individuals appear to be relatively sparse (pers. Comm. K. Hull, Mote Marine Laboratory, October 6, 2017). The abundance of oceanic whitetip shark has declined significantly, and the species is rare in the action area. Therefore, the likelihood of an individual of either species being in the area of a spill large enough for oil to remain in the water column over an extended period is very small, although any individuals in the footprint of a spill would be affected. We expect that exposure of giant manta ray and oceanic whitetip shark to oil spills associated with the Oil and Gas Program is extremely unlikely and the effects are, thus, discountable.

Therefore, we determined that giant manta ray and oceanic whitetip shark are not likely to be adversely affected by the Oil and Gas Program.

6.1.3 Designated Northwest Atlantic DPS Loggerhead Sea Turtle Critical Habitat

Critical habitat for the Northwest Atlantic DPS of loggerhead includes six nearshore reproductive habitat units within the action area that extend from the shore to 1.6 km seaward, and a *Sargassum* critical habitat unit that covers a large portion of the Northern Gulf of America. The PBFs associated with nearshore reproductive habitat that may be affected by stressors from the Oil and Gas Program are:

- Waters directly off the highest density nesting beaches to one mile offshore,
- Waters sufficiently free of obstructions or artificial lighting to allow transit through the surf zone, and
- Waters with minimal man-made structures that could promote predators, disrupt wave patterns necessary for orientation, and/or create excessive longshore currents.

The PBFs associated with loggerhead *Sargassum* critical habitat that may be affected by stressors from the Oil and Gas Program are:

- Convergence zones, surface-water downwelling areas, and other locations where there are concentrated components of the *Sargassum* community in water temperatures suitable for the optimal growth of *Sargassum* and inhabitance of loggerheads,
- *Sargassum* in concentrations that support adequate prey abundance and cover, and

- Available prey and other material associated with *Sargassum* habitat such as, but not limited to, plants and cyanobacteria and animals endemic to the *Sargassum* community such as hydroids and copepods.

While loggerhead Northwest Atlantic DPS nearshore reproductive habitat units are outside of BOEM's jurisdiction for leasing and geophysical activities, vessels (and their artificial lighting) associated with the Oil and Gas Program may transit through nearshore reproductive habitat and present temporary obstructions. Any effects to PBFs from temporary obstructions are expected to be temporary and localized with no lasting, measurable effects. Therefore, effects of vessel activity on loggerhead nearshore reproductive critical habitat as part of the Oil and Gas Program are insignificant.

Vessel activity associated with the Oil and Gas Program will overlap with the loggerhead *Sargassum* designated critical habitat unit in the Gulf of America. We anticipate vessel operators will actively avoid *Sargassum* patches within the action area because coming near or in contact with *Sargassum* mats may have detrimental impacts to vessel operation (e.g., slow or jam propellers or clog engine cooling water intakes). Some vessels may still come in direct contact with *Sargassum,* temporarily disturbing the biotic community (including available prey for oceanic juvenile loggerheads) and other materials associated with this habitat. However, such disturbance is likely to be very brief, cover a relatively small area, and result in no lasting measurable effect on the affected *Sargassum* community. Any effects of vessel activity on loggerhead *Sargassum* designated critical habitat associated with the Oil and Gas Program are, thus, insignificant.

The action includes HRG surveys using sound sources such as sub-bottom profilers (at 2.5-7 kHz), echosounders (single-beam at 12-240 kHz; multibeam at 50-400 kHz), CHIRP sub-bottom profiler (at 4-24 kHz), pingers (at 2 kHz), and side-scan sonars (16-1,500 kHz). Similar sound sources are present on AUVs. These devices are "deep-towed" just above the seafloor, and attached to cables up to 7 km long. Because of the sound source characteristics of these devices (e.g., narrow beamwidth, source level, frequency), the area ensonified is much smaller than that for airguns, so we do not expect the sound to extend out great distances. HRG surveys using these sound sources may operate in or near *Sargassum* patches, potentially affecting the essential feature of prey abundance if prey temporarily leave the area because of their response to exposure to sounds from these surveys. However, these surveys will not occur within the nearshore reproductive habitat and devices like those in the Oil and Gas Program (e.g., multibeam echosounders) have been used to conduct abundance and density surveys of eusphausiids and copepods with no observed detrimental effects (Atkins et al. 2001; Korneliussen et al. 2009). Based on this information, we believe invertebrate prey species exposed to the high frequency surveying devices used in the Oil and Gas Program will be similarly unaffected. Because of the low likelihood of exposure to the sound sources used during high-resolution geophysical surveys, and the expected low likelihood of measurable effects

should exposure occur, we find the effects to the PBF of prey abundance in *Sargassum* patches to be insignificant.

Seismic surveys conducted as part of Oil and Gas Program activities use multiple types of sound sources, primarily airguns, and boomers or sparkers that operate at different frequencies. These differences mean seismic sources are used in various settings to achieve specific surveying goals. Thus, there may be varying degrees of effects in different areas of loggerhead *Sargassum* critical habitat exposed to the seismic surveys. Broadly, we expect a higher degree of impact from large airgun arrays than boomers or sparkers, because airguns use a higher source level. Seismic surveys conducted as part of the Oil and Gas Program will not overlap spatially with loggerhead nearshore reproductive critical habitat (i.e., within 1.6 km of shore). Most of the nearshore reproductive critical habitat in the Gulf is along the coast of Florida, in the EPA, where seismic survey activity will be largely absent (89 FR 31488). The BOEM modeling area denoted as Zone 2 is closest to the nearshore reproductive areas in Mississippi and Alabama, and there will be large array, 3-D seismic activity using airguns in Zone 2. If an airgun seismic survey of sufficient size occurred close to the nearshore reproductive critical habitat, the noise could potentially create a temporary obstruction. The OCS off Mississippi and Alabama begins 5.6 km offshore, meaning airgun surveys would not occur closer than this. While we do not know where specifically seismic surveys will occur in Zone 2, we do know that the main type of survey activity in that zone will be 3-D surveys (Table 1; 89 FR 31488) which are for surveying large areas using airgun arrays capable of creating a large ensonified area. Seismic survey vessels are mobile, and any survey that creates a sound field that reaches the nearshore reproductive critical habitat would be temporary. Because any seismic activity will be in deep water at such a distance that any sound from the survey will diminish before reaching the nearshore reproductive critical habitat, and the sound will be temporary, the effects from sound on nearshore reproductive critical habitat are so small they cannot be meaningfully measured. Therefore, we determine the effects to the nearshore reproductive habitat segment of the Northwest Atlantic Ocean DPS of loggerhead designated critical habitat from seismic surveys associated with the Oil and Gas Program are insignificant.

Seismic survey activity associated with the Oil and Gas Program overlaps spatially with loggerhead sea turtle Northwest Atlantic Ocean DPS *Sargassum* designated critical habitat. A study suggests that seismic airguns may lead to significant mortality of zooplankton, including copepods (McCauley et al. 2017), which can affect the *Sargassum* prey community that juvenile loggerheads rely on. Considering that copepod prey are a PBF of *Sargassum* critical habitat, seismic surveys associated with the Oil and Gas Program may affect this critical habitat unit. We anticipate that seismic survey operators will actively avoid *Sargassum* patches within the action area because coming near or in contact with *Sargassum* may destroy the towed seismic equipment causing a loss of data. Avoidance of *Sargassum* patches will not entirely eliminate the potential effects of seismic activity on loggerhead prey within this critical habitat PBF because effects to zooplankton have been observed out to 1.2 km from shore (McCauley et al. 2017). Avoidance will reduce those effects to some extent. While the seismic surveys associated with

the Oil and Gas Program may temporarily alter copepod abundance in designated loggerhead *Sargassum* critical habitat, we expect such effects to be short-term given the high turnover rate of zooplankton, and spatially limited area affected compared to the size of *Sargassum* habitat available to oceanic juvenile sea turtles in the Gulf of America. Thus, the effects from seismic survey sound on *Sargassum* critical habitat are so small they cannot be meaningfully measured. Therefore, we determine that effects to the *Sargassum* habitat segment of the Northwest Atlantic Ocean DPS of loggerhead designated critical habitat from seismic surveys associated with the Oil and Gas Program are insignificant.

Nearshore reproductive habitat waters do not overlap areas affected by offshore water discharges from the Oil and Gas Program. Discharges from offshore oil and gas structures are expected to dissipate and/or sink to the bottom and be extremely unlikely to reach nearshore waters. Therefore, we determine that effects of water discharges to loggerhead nearshore reproductive habitat are extremely unlikely to occur and, thus, discountable.

We find that the effects of NPDES CWA-regulated discharges on the PBFs of *Sargassum* habitat will be insignificant for the following reasons. All discharges must meet permit requirements for toxicity levels and other restrictions set forth in the permit intended to protect all aquatic life. Such treated discharges quickly dilute and disperse in the vast receiving waters at discharge points. As part of standard procedures, there are restrictions that limit many chemicals and nutrients from entering the receiving waters (i.e., no free oil, no floating solids, no garbage, no foam, phosphate-free soap and detergents, sanitary waste treated with chlorine). On offshore structures, there is also the standard use of curbs, drip pans, and other pollution prevention equipment. Toxicity limits are required for facilities intending to discharge drilling fluids, drill cuttings, and/or produced waters to the sea. USEPA regulations prevent unreasonable degradation of the marine environment. Based on information from the USEPA and BOEM, and bioaccumulation studies cited previously, there have been no reported measurable adverse environmental impacts from the types of discharges from oil or gas platforms within the action area, and no reported adverse effects to any NMFS' protected resources.

While releases of trash and debris are not lawful activities and, therefore, not part of the action, we include an analysis of their effects because releases are reasonably certain to occur and would not occur but for Oil and Gas Program activities. There are a number of anticipated types of debris accidentally lost offshore (e.g., paper, plastic, wood, glass and metal) as part of oil and gas activities. Heavier debris (glass, metal) will sink, and paper debris will break up and disintegrate before reaching loggerhead nearshore reproductive critical habitat. Other types of debris like wood and plastic float but will most likely be transported into current convergence zones and remain in deeper water. Given the size of the action area, we believe it is extremely unlikely these items will be transported to the loggerhead nearshore reproductive critical habitat. Because it is extremely unlikely that marine debris from Oil and Gas Program activities will be transported to coastal areas, the effects of marine debris on loggerhead nearshore reproductive critical habitat are discountable.

One study indicated that the majority of marine debris items originating from the oil and gas industry consisted of wood (Miller and Jones 2003). Plastics used by industry can persist in the environment for years, and plastic debris (large pieces and microplastics) have been found in *Sargassum* patches. It is possible for floating marine debris (e.g., plastic and wood) from oil and gas operations to entangle in *Sargassum* patches. However, any effects of marine debris on the PBFs of loggerhead *Sargassum* critical habitat, including available loggerhead prey, and given the size of the available *Sargassum* critical habitat, are expected to be so minimal as to be unmeasurable and, thus, insignificant.

Much of the loggerhead *Sargassum* critical habitat within the northwestern portion of the action area is at risk of oil exposure considering (1) the large spatial overlap between *Sargassum* critical habitat and oil and gas leasing areas, and (2) the physical processes bringing both surface oil and *Sargassum* together. Powers et al. (2013) found three pathways to oil spill-related injuries in *Sargassum*-dependent communities: (1) *Sargassum* accumulated oil on the surface exposing animals to high concentrations of contaminants; (2) application of dispersant sinking *Sargassum*, removing the habitat and potentially transporting oil and dispersant vertically; and (3) low oxygen surrounding the habitat potentially stressing animals that reside in the alga. Removal of large numbers of individual clumps, patches, or lines of *Sargassum* through sinking could reduce concentrations of this habitat supporting adequate prey abundance and cover for animals dependent on *Sargassum* for feeding, such as oceanic juvenile loggerhead sea turtles.

To assess the effects of oil spills on the PBFs of loggerhead *Sargassum* critical habitat, we consider aspects of the macroalgae's life cycle, including seasonal movements and drift rate within the action area, growth rate, longevity, and resiliency to environmental disturbances. Unlike more fixed types of critical habitat (e.g., river stretches, or nesting beaches), *Sargassum* is a highly mobile habitat. The movement of *Sargassum* over many months is consistent from year to year, and can be explained by prevailing surface currents and winds. Satellite data indicate *Sargassum* starts growing each year in the Gulf of America around March, and dies about a year later in the Atlantic in the area northeast of the Bahamas (Gower and King 2011). The rapid increase in the amount of *Sargassum* in the northwest Gulf each year from March to July strongly suggests that the Gulf of America is the dominant source of new *Sargassum* growth, which occurs cyclically. Satellite data clearly indicate strong growth early in the year in the Gulf of America, with *Sargassum* advected by the Loop Current and Gulf Stream into the Atlantic each year in July and August (Gower and King 2011). *Sargassum* species in the northern Gulf of America grow at an estimated rate of 4% per day (Lapointe 1986).

Exposed patches are expected to recover quickly, usually in less than one day for most small spills. In small spills, oil typically spreads on the water surface and results in a thin sheen, which persists for a period of time and then dilutes. The amount of *Sargassum* exposed to an oil spill within the action area will depend largely on the time of year given the seasonality and cyclical movement of *Sargassum* in the northern Gulf of America. Continuous exposure of a particular *Sargassum* patch to oil could last days, weeks, or months depending on the size and location of

the spill and other factors (e.g., wind speed and direction, season, and type of oil). Given its fast growth rate, continuous motion, and somewhat ephemeral nature, we expect a relatively high turnover rate for *Sargassum* patches under normal conditions. *Sargassum* habitat lost because of an oil spill will likely be replaced over time by the combination of movement of unexposed (or lightly exposed) existing patches into the area and new growth. Although nearly one-quarter of all *Sargassum* habitat in the northern Gulf of America was heavily exposed to oil after the 2010 DWH spill, follow-up aerial surveys in 2011 and 2012 documented a four-fold increase in *Sargassum* abundance since DWH. These results suggest that *Sargassum* can repopulate in the Gulf of America within a year or two of an extremely large oil spill, which is not the spill volume we expect to be reasonably certain to occur over the period considered in this opinion, particularly given the regulatory measures BOEM requires since DWH.

In summary, we anticipate that numerous small-scale oil spills will occur because of Oil and Gas Program activities but the ephemeral nature and annual cycle of rapid growth, movement, and subsequent die-off will allow *Sargassum* to repopulate quickly if patches are exposed to oil. Because of this, and because extremely large spills are not reasonably certain to occur, we believe effects to the PBFs of *Sargassum* critical habitat, including prey, will be temporary in any patches exposed to oil and too small to measure on the scale of this PBF in the Gulf. Therefore, the effects of oil spills of the size likely to occur over the period of the Oil and Gas Program considered in this opinion are insignificant.

Therefore, we determined that Northwest Atlantic DPS loggerhead sea turtle designated critical habitat is not likely to be adversely affected by the Oil and Gas Program.

6.1.4 ESA-Listed Corals and Designated Coral Critical Habitat

Four coral species listed under the ESA occur in the action area boulder star coral (*Orbicella franksi*), elkhorn coral (*Acropora palmata*), lobed star coral (*Orbicella annularis*), mountainous star coral (*Orbicella faveolta*). These species occur in the FGBNMS. No federally managed oil and gas activities are proposed in these coral locations; however, some activities may be approved by FGBNMS on a case-by-case basis, which would require a separate ESA section 7 consultation with NMFS (Figure 17 and Figure 18).

FGBNMS has monitored the abundance of corals in the Sanctuary since 1989. FGBNMS has some of the highest percent coral cover in the United States, and unlike other areas, coral cover still dominates benthic communities. In 2016, mean coral cover based on random transects was 49.92% within the East Flower Garden Bank (EFGB) study site and 58.54% within the West Flower Garden Bank (WFGB) study site (Johnston et al. 2017). Boulder star coral (*Orbicella franksi*) was the principal component of mean percent coral cover within the EFGB study site (20.38%) and the WFGB study site (29.29%). When Johnston et al. (2017) combined the *Orbicella* species complex, it made up 50.99% of the observed coral species within EFGB study sites and 61.67% of the observed coral species within WFGB study sites. Boulder star coral covered the greatest total area (58,615,875 cm^3) within EFGB study site surveys and

mountainous star coral (*Orbicella faveolata)* covered the greatest total area within WFGB (36,290,058 cm^3) study site surveys (Johnston et al. 2017).

Coral communities have been characterized on less than 2% of oilrigs in the Gulf of America. Of the nine hermatypic (requiring light) coral species known to occur on surveyed oilrigs, none are listed under the ESA (Sammarco et al. 2013).

On August 9, 2023, 28 mostly overlapping specific occupied areas containing PBFs essential to the conservation of five species of ESA-listed corals (lobed star coral, mountainous star coral, boulder star coral, pillar coral, and rough cactus coral) were designated as critical habitat. Boulder star coral, lobed star coral, and mountainous star coral are present in the FGBNMS and areas containing the PBFs of critical habitat for these corals is also present in this area. The critical habitat for boulder star, lobed star, and mountainous star corals overlaps with designated critical habitat for elkhorn coral in the FGBNMS. The PBFs for elkhorn coral are substrate of suitable quality and quantity (defined as low sediment and algal cover) for coral settlement and growth.

Within the geographic area occupied by the four ESA-listed coral species in the FGBNMS portion of the action area, newly designated critical habitat for three of these species consists of specific areas where the PBFs essential to the conservation of each species are found. The PBFs essential to the conservation of these three ESA-listed corals (boulder star coral, lobed star coral, and mountainous star coral) are reproductive, recruitment, growth, and maturation habitat found in the Gulf of America. Sites that support the normal function of all life stages of these three threatened coral species are natural, consolidated hard substrate or dead coral skeleton, which is free of algae and sediment at the appropriate scale at the point of larval settlement or fragment reattachment, and the associated water column. Several attributes of these sites determine the quality of the area and influence the value of the associated feature to the conservation of the species:

1. Substrate with the presence of crevices and holes that provide cryptic habitat, the presence of microbial biofilms, or the presence of crustose coralline algae;
2. Reefscape with no more than a thin veneer of sediment and low occupancy by fleshy and turf macroalgae;
3. Marine water with levels of temperature, aragonite saturation, nutrients, and water clarity that have been observed to support any demographic function; and
4. Marine water with levels of anthropogenically introduced (from humans) chemical contaminants that do not preclude or inhibit any demographic function.

In terms of stressors from program activities, we believe it is highly unlikely that the types of marine debris originating from this industry will ultimately reach and smother corals or their designated critical habitat in the FGBNMS. As previously mentioned, oil and gas-related activities are prohibited within FGBNMS. Plastic and wood materials from oilrigs will generally

float on the surface while any tools or heavier objects will sink directly below the rigs where they are lost. Because these rigs will not be located directly above sensitive areas such as coral reefs, it is extremely unlikely that exposure of corals or the PBFs of coral designated critical habitat to marine debris will occur, thus, impacts are discountable. Therefore, we find marine debris from the Oil and Gas Program is not likely to adversely affect ESA-listed corals or their designated critical habitat.

Corals are benthic and less susceptible to oiling than animals that utilize the water column and surface for feeding, breathing, and swimming. Listed coral species and their designated critical habitat only occur in the action area within the FGBNMS. Due to the depth of corals and their designated critical habitat in the Flower Gardens Banks (from 55 ft [17 m] to about 160 ft [49 m]), the likelihood of coral being oiled is least of all the listed species in the action area.

Coral exposure to oil via the water column is the more likely route of contact. Because much of the constituent material in oil has a relatively low solubility in water, in general coral may be protected from exposure by overlying waters. Rough seas and dispersants may result in a greater solubility and dispersion of oil into the water column where it can come into contact with and be taken in by corals. For most spills, the absolute levels of exposure would be expected to be low, because only a small fraction of the total oil can mix into the water column in solution or physically suspended. If a large spill was able to be transported by currents to coral habitat, exposure to higher oil concentrations that could be acutely toxic could occur. Oil that becomes weathered and/or mixes with sediment material can sink and affect corals and their designated critical habitat. Although acute toxicity characteristics of weathered oil mats and tarballs would be expected to be low, the potential for smothering and impacts to the PBFs of critical habitat is greatly increased.

In a review of oil spill effects on coral prepared for oil spill planning and response purposes (NOAA 2010), some key findings were made regarding the toxicity of oil to corals:

- Spill impacts vary in severity with the specific conditions at a given spill, including oil type and quantity, species composition, and the nature of oil exposure.
- Oil can kill corals, depending on species and exposure.
- Longer exposure to lower levels of oil may kill corals as well as shorter exposure to higher concentrations.
- Chronic oil toxicity impedes coral reproduction, growth, behavior, and development.
- The time of year when a spill happens is critical, since coral reproduction and early life stages are particularly sensitive to oil.
- Branching corals (e.g., elkhorn coral) are more sensitive to oil impacts than are massive or plate-like corals.

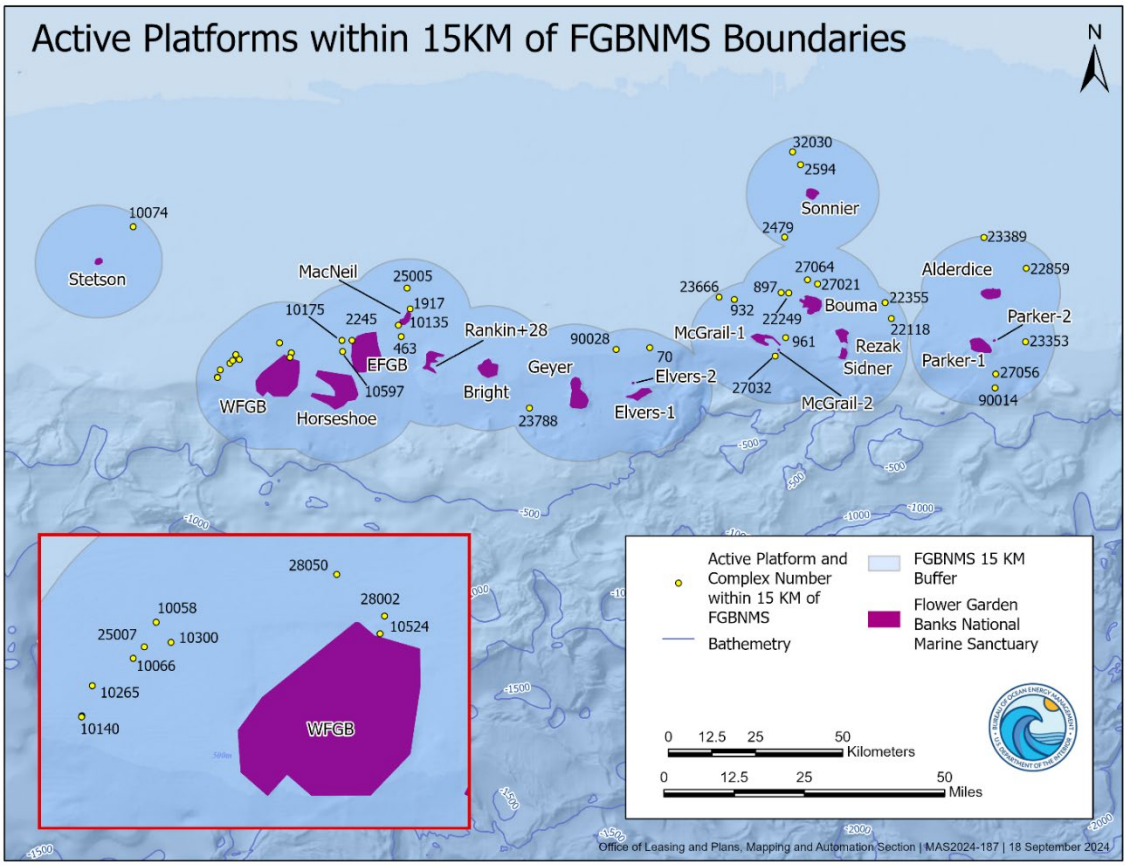


Figure 17. The location of active platforms within 15 km of the FGBNMS (provided by Bureaus April 2025)

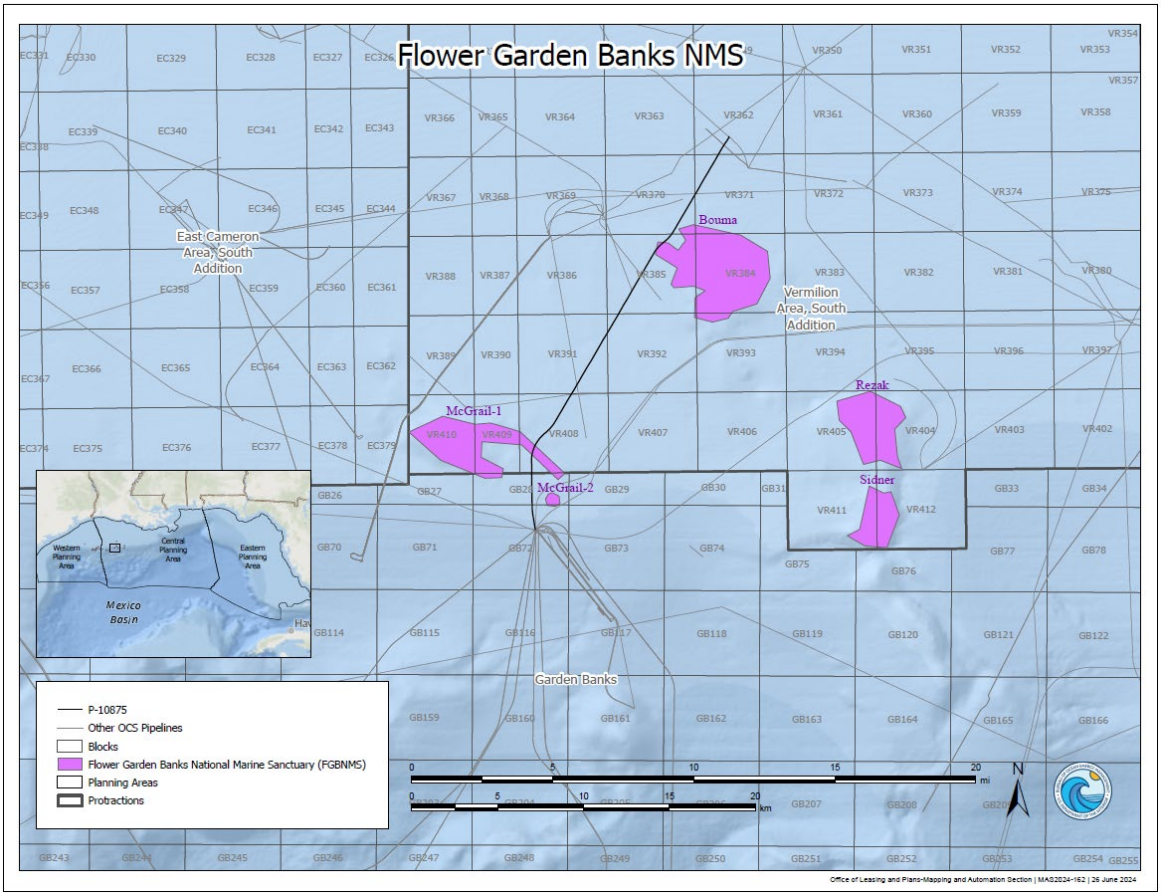


Figure 18. Active pipeline (segment number P-10875) in the FGBNMS (provided by Bureaus April 2025)

Direct oiling would mostly occur in the intertidal zone, which is not a concern for corals or their designated critical habitat found in the FGBNMS given that this area is not within this zone. Laboratory studies of oil impacts on corals have had varied results, and the applicability of laboratory study methods to exposure under natural conditions have been treated with caution. One of the best examples of a field study of oil exposure under natural conditions occurred during the 1986 Bahía Las Minas crude oil spill in Panama. An extensive series of studies documented both short-term mortality of corals and long-term, sublethal impacts to reproduction and growth lasting five years or longer. A comparison of the cover of common coral species at six reefs before 1985 and three months after the oil spill at Bahía Las Minas showed that, at one heavily oiled reef, total coral cover decreased by 56% in the greater than 3-6 m range and decreased with moderately oiled reefs. The branching corals on the reef appeared to be much more susceptible to oiling due to their morphology. Elkhorn coral nearly disappeared at the heavily oiled site in this study.

A laboratory study showed that low-level exposures almost completely disintegrated coral tissues after 48 hours (hrs) suggesting that longer exposure periods to low concentrations of oil may be just as lethal as exposure to higher concentrations for brief periods (Harrison et al. 1986) and could also degrade the substrate of critical habitat.

Studies have found enhanced phototoxicity from short-term and very low exposures to fluoranthene (a polynuclear aromatic hydrocarbon in oil) under outdoor light conditions (thus including ultraviolet radiation during the day) with the coral *Porites* (Martínez et al. 2007; Peachey and Crosby 1995; Tarrant et al. 2014). The upper sides of the coral fragments exposed to outdoor light exhibited bleaching and mortality within three to six days; however, the under sides of the corals were normal. Because corals grow in shallow, clear water with good light penetration, photo-enhanced toxicity is likely to be a significant mechanism, making corals more sensitive to oil impacts than previously understood.

NOAA (2010) concluded the long-standing notion that coral reefs do not suffer acute toxicity effects from oil floating over them is probably incorrect. Direct coating increases the severity of impact, but high oil concentrations in the water column during a spill may also kill some species. Oil quickly and readily bioaccumulates in coral tissues and is slow to leave the body. Uptake into the symbiotic zooxanthellae also occurs and can impair the photosynthetic relation between corals and symbiotic algae. Chronic effects of oil exposure have been consistently noted in corals and, ultimately, can kill the entire colony. A summary of the reported impacts to coral are: tissue death, impaired feeding response, impaired polyp retraction, impaired ability to clear sediment, increased mucus production, change in calcification rate, gonadal damage, premature extrusion of planulae, larval death, impaired larval settlement, expulsion of zooxanthellae, change in zooxanthellae photosynthesis, and muscle atrophy.

Corals reproduce annually during spawning events that are synchronized by seawater temperature changes, lunar cycle, and time of day. Broadcast spawning events in the FGBNMS occur when corals release gametes over the course of a few nights. This occurs every year seven to ten days after the full moon in August. Because eggs are generally lipid-rich and positively buoyant, whole slicks of gametes are often seen at the surface during and after spawning events. This life stage is particularly sensitive to surface oils occurring in the FGBNMS area at the time of a broadcast spawning event. Impacts could include gamete death, failure to reproduce, and decreased recruitment of new corals into the population.

A study by Goodbody-Gringley et al. (2013) examined the potential effects of oil spill and dispersant-oil exposure on coral larvae in the Florida Keys. Larvae of the brooding coral, *Porites astreoides*, and the broadcast spawning coral, *Montastraea faveolata* (now reclassified as *Orbicella faveolta* and listed as threatened), were exposed to multiple concentrations of DWH source oil (crude, weathered and soluble oil), oil in combination with the dispersant CorexitH 9500, and dispersant alone, and analyzed for behavior, settlement, and survival (Goodbody-Gringley et al. 2013). Settlement and survival of *P. astreoides* and *O. faveolata* larvae decreased with increasing concentrations of soluble oil, Corexit H 9500, and dispersant-oil mixture; however, the degree of the response varied by species and solution. *P. astreoides* larvae experienced decreased settlement and survival following exposure to 0.62 parts per million (ppm) source oil, while *O. faveolata* larvae were negatively impacted by 0.65, 1.34, and 1.5 ppm, suggesting that *O. faveolata* larvae are more sensitive to soluble oil than *P. astreoides* larvae.

Exposure to medium and high concentrations of dispersant-oil mixture and CorexitH 9500, significantly decreased larval settlement and survival for both species. Furthermore, exposure to CorexitH 9500 resulted in settlement failure and complete larval mortality after exposure to 50 and 100 ppm for *O. faveolata* (Goodbody-Gringley et al. 2013). These results indicate that exposure of coral larvae to oil spill chemicals, particularly the dispersant Corexit H 9500, has the potential to negatively impact coral settlement and survival, thereby affecting the resilience and recovery of coral reefs following exposure to oil and dispersants.

Dispersed oil rapidly dilutes into the water and a plume of dispersed oil is transported away from the treated site. The subsurface plume may move in a different direction and speed than the untreated surface slick. Dispersed oil is more available to biodegradation by naturally occurring bacteria, but it is also available to smaller animals and filter feeders such as corals. There have not been any documented impacts to listed corals in the FGBNMS from oil. The distance of the reefs from shore and the depth of corals in the FGBNMS mean there is no risk of coral or coral critical habitat exposure to surface oil, or oil mixed in the upper water column by wind and wave action. The likelihood of listed coral spawning events for such a small number of corals happening at the same time and place that a large spill would occur is so low as to be extremely unlikely to occur. Exposure of the FGBNMS reefs to submerged or dispersed oil is possible under the right conditions, but it has never been documented and is expected to be an extremely unlikely event. The effects of oil on listed species of coral and their designated critical habitat in the action area are expected to be discountable. Therefore, we conclude that listed corals are not likely to be adversely affected by oil spills that result from the Oil and Gas Program.

Because the listed corals and their designated critical habitat in the action area are located in the FGBNMS, it is anticipated that NOAA will coordinate with a responsible party to take preventative measures to avoid impacts to coral resources in the National Marine Sanctuary from oil-spill response activities, should they occur. Section 304(d) of the National Marine Sanctuaries Act requires interagency consultation between NOAA and federal agencies taking actions, including authorization of private activities, “likely to destroy, cause the loss of, or injure a sanctuary resource” and emergency consultation under section 7 of the ESA can also be undertaken by the federal agency responsible for oil spill response.

6.1.5 Queen Conch

The queen conch (*Alger gigas,* formerly known as *Strombus gigas*) was listed as a threatened species under the ESA (89 FR 11208), effective March 15, 2024. The queen conch is a large gastropod mollusk that is slow growing and late to mature, reaching up to 12 in in length and living up to 30 years. They are benthic-grazing herbivores that feed on diatoms, seagrass detritus, and various types of algae and epiphytes. Adult queen conch prefer sandy algal flats, but are also found on gravel, coral rubble, smooth hard coral, and beach rock bottom, while juveniles are primarily associated with seagrass beds.

The queen conch occurs in the Gulf of America, Florida Keys, around Bermuda, and throughout the Caribbean Sea (Figure 19). Queen conch use different habitat types including seagrass beds, sand flats, algal beds, and rubble areas from a few centimeters deep to approximately 30 m. Adult distributions are heavily influenced by food availability and fishing pressure; in unexploited areas, they are most common in shallow marine waters less than 30 m depth.

Within the Gulf of America, the queen conch occurs within the FGBNMS. No federally managed oil and gas activities are proposed in this area, although some activities may be approved by FGBNMS on a case-by-case basis and require separate ESA section 7 consultation. As for corals, queen conch could be exposed to oil if a spill were to occur but because of the location of the FGBNMS in relation to Oil and Gas Program activities, effects from the program to queen conch are extremely unlikely to occur. Given the lack of activities in this area, the likelihood of effects is discountable and, therefore, the Oil and Gas Program is not likely to adversely affect the queen conch.

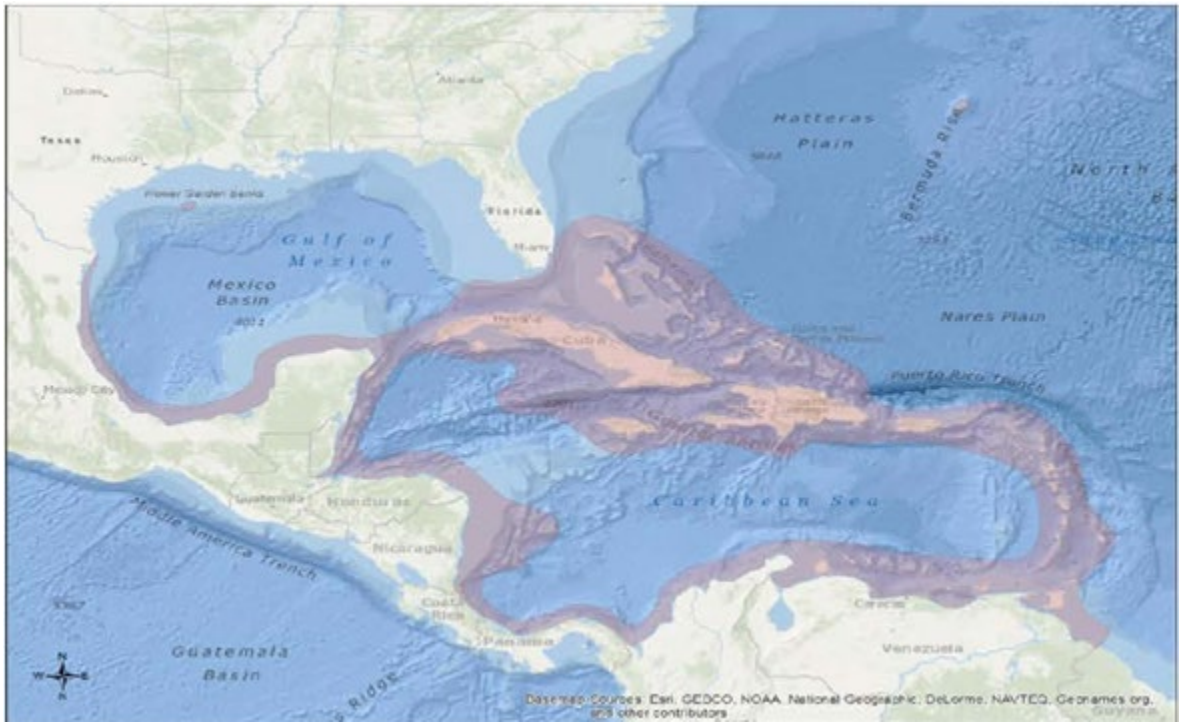


Figure 19. Queen conch geographic range (Horn et al. 2022)

6.2 Status of Species and Critical Habitat in the Action Area Likely to be Adversely Affected

During consultation, we reviewed the status of each species that is likely to be adversely affected by the Oil and Gas Program. The status is determined based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. The species status section helps to inform the description of the species' current "reproduction, numbers, or distribution" as described in 50 CFR § 402.02. This section also examines the condition of critical habitat throughout the designated area (such as various watersheds and coastal and

marine environments that make up the designated area), and discusses the condition and current function of designated critical habitat, including the PBFs that contribute to that conservation value of the critical habitat. More detailed information on the status and trends of these ESA-listed species, and their biology and ecology can be found in the listing regulations and critical habitat designations published in the Federal Register, status reviews, recovery plans, and on NMFS' Web site: http://www.nmfs.noaa.gov/pr/species/esa/listed.htm.

Rice's whales, sperm whales, green sea turtles (North Atlantic DPS), Kemp's ridley sea turtles, hawksbill sea turtles, leatherback sea turtles, loggerhead sea turtles (Northwest Atlantic Ocean DPS), and Gulf sturgeon are all likely to be adversely affected by the action (Table 19). The sea turtle species and sperm whales use Gulf waters extensively, while Rice's whales mainly inhabit the northeastern Gulf, although it is possible that they were historically more widespread and there are confirmed sightings of Rice's whales outside of this area. These species will be exposed to a variety of stressors from oil and gas program operations. While many specific oil and gas activities are not likely to adversely affect these species, several activities present stressors that may lead to harassment, injury, or death. These stressors include vessel strikes, ingestion of or entanglement in marine debris, impacts from sound and explosives, and oil spills. Gulf sturgeon use nearshore coastal waters in the Gulf of America and could be affected by oil spills stemming from the action. In addition, designated critical habitat for Gulf sturgeon and proposed critical habitat for Rice's whale and green sea turtle North Atlantic DPS may be adversely affected by the action (Table 20).

Table 19. ESA-listed species that may be adversely affected by the action

Species	ESA Status	Recovery Plan
Gulf Bryde's Whale (Balaenoptera edeni; re-classified as the Rice's Whale, Balaenoptera ricei in 2021)	E – 84 FR 15446	Recovery Outline
Sperm Whale (*Physeter macrocephalus*)	E – 35 FR 18319	75 FR 81584
Green Sea Turtle (*Chelonia mydas*) – North Atlantic DPS	T – 81 FR 20057	10/1991
Hawksbill Sea Turtle (*Eretmochelys imbricata)*	E – 35 FR 8491	63 FR 28359 and 57 FR 38818
Kemp's Ridley Sea Turtle (*Lepidochelys kempii*)	E – 35 FR 18319	9/2011
Leatherback Sea Turtle (*Dermochelys coriacea*)	E – 35 FR 8491	63 FR 28359 and 10/1991
Loggerhead Sea Turtle (*Caretta caretta*) – Northwest Atlantic Ocean DPS	T – 76 FR 58868	74 FR 2995
Gulf Sturgeon (*Acipenser oxyrinchus desotoi*)	T – 56 FR 49653	09/1995

Table 20. Designated and Proposed Critical Habitat that may be adversely affected by the action

Designated and Proposed Critical Habitat	Federal Register Notice	Unit
Gulf Sturgeon (*Acipenser oxyrinchus desotoi*)	68 FR 13370	Units 8-14
Rice's Whale (Balaenoptera ricei)	88 FR 47453	--
Green Turtle (*Chelonia mydas*) – North Atlantic DPS	88 FR 46572	FL01, TX01, NA01 (Sargassum)

6.2.1 Whales

6.2.1.1 Threats to Sperm and Rice's Whales

Large whales considered in this opinion include sperm whale and Rice's whale. Both species are threatened by vessel strikes, entanglement, oil spills, pollution, loss of prey and habitat, and sound. In this section, we discuss general threats and, in Sections 6.2.2 and 6.2.3, we discuss species-specific threats.

Vessel Strike

Various types and sizes of vessels have been involved in ship strikes with large whales, including container/cargo ships/freighters, tankers, military vessels, cruise ships, ferries, recreational vessels, research vessels, fishing vessels, whale-watching vessels, and other vessels (Jensen and Silber 2004). The majority of vessel strikes of large whales occur when vessels are traveling at speeds greater than approximately ten knots, with faster vessels, especially large vessels (80 m or greater), being more likely to cause serious injury or death (Conn and Silber 2013; Jensen and Silber 2004; Laist et al. 2001; Vanderlaan and Taggart 2007a). Injury is generally caused by the rotating propeller blades, but blunt injury from direct impact with the hull also occurs. Injuries to whales killed by vessel strikes include huge slashes, cuts, broken vertebrae, decapitation, and animals cut in half (Carillo and Ritter 2010).

Entanglement

Entanglement in fishing gear or other marine debris represents an important source of injury and mortality in marine mammals. Fisheries interactions are likely to have significant demographic effects on many populations of marine mammals (Read et al. 2006). Bycatch mortality is estimated globally to exceed hundreds of thousands of marine mammals each year (Read et al. 2006). Many marine mammals that die from entanglement in commercial fishing gear tend to sink rather than strand ashore, thus making it difficult to fully assess the magnitude of this threat. When not immediately fatal, entanglement or ingestion of fishing gear can impede the ability of marine mammals to feed and can cause injuries that eventually lead to infection and death (Cassoff et al. 2011; Moore and Van der Hoop 2012; Wells et al. 2008). Other sublethal effects of entanglement include increased vulnerability to additional threats, such as predation and ship strikes, by restricting agility and swimming speed. There are also costs likely to be associated

with nonlethal entanglements in terms of energy and stress (Moore and Van der Hoop 2012). There is a strong spatial component to bycatch of marine mammals, with 'hotspots' influenced by marine mammal density and fishing intensity (Lewison et al. 2014).

Pollution

Pollution from noise and oil spills are threats to whales. Sound from constant, chronic sources such as vessel traffic and other construction noises can mask sound of whales trying to communicate, navigate, reproduce, or feed. These topics are also discussed in Sections 7 and 8.

6.2.2 Sperm Whale

Sperm whales were first listed under the precursor to the ESA, the Endangered Species Conservation Act of 1969, and remained on the list of threatened and endangered species after the passage of the ESA in 1973. The sperm whale is endangered as a result of past commercial whaling. The IWC estimates that nearly 250,000 sperm whales were killed worldwide in whaling activities between 1800 and 1900. From 1910 to 1982, nearly 700,000 sperm whales were killed worldwide by whaling activities (Whitehead and Shin 2022). A compilation of all whaling catches in the North Atlantic north of 20ºN from 1905 onward gave totals of 28,728 males and 9,507 females (NMFS 2010a). Sperm whales are protected under the MMPA and listed in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), meaning that commercial trade in products of sperm whales is prohibited.

6.2.2.1 Species Description and Distribution

The sperm whale occurs in all oceans of the world. Sperm whales are perhaps the most widely distributed mammal on earth. It is the largest of the toothed whales, reaching a length of 60 ft (18.3 m) in males and 40 ft (12.2 m) in females (Odell 1992). Sperm whales are distributed throughout most oceanic areas, but are found in deeper waters seaward of the continental shelf. Deep water is required so they can make prolonged, deep dives to locate prey, breed, and nurse their young. In general, females and immature sperm whales appear to be restricted in range, whereas males are found over a wider range and do make occasional movements across and between ocean basins (Dufault et al. 1999). Stable, long-term associations among related and unrelated females form the core units of sperm whale societies (Christal and Whitehead 1998). Females and juveniles form groups that are generally distributed within tropical and temperate latitudes between 50°N and 50°S, while the solitary adult males can be found at higher latitudes between 75ºN and 75ºS (Reeves and Whitehead 1997). The home ranges of individual females seem to span distances of approximately 1,000 km (Best 1979; Dufault and Whitehead 1995). Although there is strong evidence for geographic, matrilineal structuring in sperm whales, there is no evidence the management stocks presented in the following paragraph represent distinct populations of whales.

The Recovery Plan (NMFS 2010a) identifies recovery criteria geographically across three ocean basins: the Atlantic Ocean/Mediterranean Sea, the Pacific Ocean, and the Indian Ocean. This geographic division by basin is due to the wide distribution of sperm whales and presumably

little movement of whales between ocean basins. For management purposes under the MMPA, sperm whales inhabiting U.S. waters have been divided into five stocks: 1) the California-Oregon-Washington Stock, 2) the North Pacific (Alaska) Stock, 3) the Hawaii Stock, 4) the Northern Gulf Stock, and 5) the North Atlantic Stock. In the Gulf of America, sperm whales are the most common large cetacean seaward of the continental shelf (Davis et al. 1998; Jefferson and Schiro 1997; Mullin et al. 1991; Mullin and Fulling 2004; Mullin et al. 1994; Weller et al. 2000; Wursig et al. 2000). Sperm whales in the Gulf of America are not evenly distributed, showing greater densities in areas associated with oceanic features that provide the best foraging opportunities (Figure 20 and Figure 21).

Updated spatial density models based on line-transect and aerial surveys conducted in U.S. waters of the Gulf of America during the "Gulf of Mexico Marine Assessment Program for Protected Species" (GoMMAPPS) project show highest sperm whale densities occurring throughout the Gulf during the months of July (Figure 20) and August and lower densities during the months of January (Figure 21), February, and March (Rappucci et al. 2023).

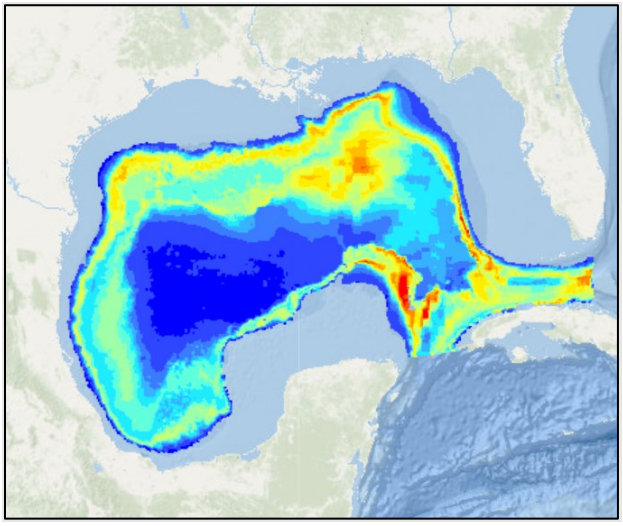


Figure 20. Density map of relative sperm whale abundance in the Gulf in July (Rappucci et al. 2023).

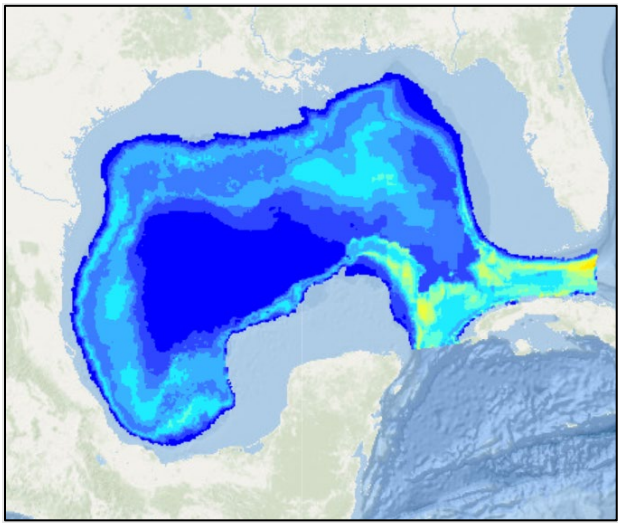


Figure 21. Density map of relative sperm whale abundance in the Gulf in January (Rappucci et al. 2023).

6.2.2.2 Life History Information

The social organization of sperm whales, as with most other mammals, is characterized by females remaining in the geographic area in which they were born and males dispersing more broadly. Females group together and raise young. For female sperm whales, remaining in the region of birth can include very large oceanic ranges the whales need to successfully forage and nurse young whales. Male sperm whales are mostly solitary, disperse more widely and can mate with multiple female populations throughout a lifetime.

Female and immature sperm whales of both sexes are found in more temperate and tropical waters throughout the year. Maturing males will leave the female groups and form loose aggregations of bachelor schools. As the males grow older, they separate from the bachelor schools and remain solitary most of the year (Best 1979). Adult males visit female groups of whales only to breed. Large males have been sighted on occasion and are believed to enter the Gulf of America for short periods to breed. Therefore, the Gulf population is comprised of the year-round presence of females, calves, and juvenile whales. The proportion of females to males in the Gulf is 72:28 (Engelhaupt et al. 2009). Calves make up about 11% of the population in the Gulf of America (Jochens et al. 2008).

Female sperm whales attain sexual maturity at a mean age of eight or nine years. Mature females ovulate April through August in the Northern Hemisphere. Maturation in males usually begins in this same age interval as females, but males have a prolonged puberty and attain sexual maturity at between age 12 and 20. Males may require another 10 years to become large enough to successfully compete for breeding rights (Kasuya 1991). During this season of ovulating females, one or more large mature bulls temporarily join each breeding school. In the North Atlantic Ocean, the peak breeding season for sperm whales occurs during the spring (March/April to June), although some mating activity continues throughout the summer (NMFS 2015c). In the South Atlantic Ocean, the peak breeding season is presumed to occur in the austral

spring. During mating seasons, mature males in their late twenties and older rove among groups of females. Because females within a group often become reproductively active at the same time, the male need not remain with them for an entire season to achieve maximal breeding success (Best and Butterworth 1980) and their association with a female group can be as brief as several hours. Gestation lasts well over a year, with credible estimates of the normal duration ranging from 15 months to over 18 months. A single calf is born at a length of about 13 ft (four m). Female sperm whales rarely become pregnant after the age of 40 (Whitehead and Mesnick 2003). It is thought that females assist each other in the care of offspring, guarding of young at the surface while mothers dive (Whitehead 1996). Females even have been observed nursing calves other than their own (Reeves and Whitehead 1997). Calves are nursed for two to three years (in some cases, up to 13 years), and the calving interval is estimated to be about four to seven years (Kasuya 1991).

The age distribution of the sperm whale population is unknown, but they are believed to live at least 60 years (Rice 1989). Potential sources of natural mortality in sperm whales include killer whale predation and disease (Lambertsen 1997; Whitt et al. 2015). Sperm whales may also be "harassed" by pilot whales (*Globicephala* spp.) and false killer whales (*Pseudorca crassidens*), but most "attacks" by these species are probably unsuccessful (Palacios and Mate 1996; Weller et al. 1996). Very little is known about the role of disease in the natural mortality of sperm whales (Lambertsen 1997). Several naturally occurring diseases that are likely to be lethal have been identified in sperm whales: myocardial infarction associated with coronary atherosclerosis, gastric ulceration associated with parasitic nematode infection**,** the papilloma virus (Lambertsen 1997) and *Brucella* and *Morbillivirus* (West et al. 2015). There were 37 individual sperm whale strandings reported in the Gulf of America from 2000-2016 in Texas, Louisiana, Alabama and Florida (NOAA National Marine Mammal Health and Stranding Response Database, accessed October 1, 2022). At least seven of those reported were calves. Using data from 2003-2007, Williams et al. (2011) suggested that the rate of recovery of sperm whale carcasses in the Gulf of America was 3.4%.

Cephalopods (i.e., squid, octopi, cuttlefishes, and nautili) are the main component of sperm whale diets. The ommastrephids, onychoteuthids, cranchids, and enoploteuthids are the cephalopod families that are numerically important in the diet of sperm whales in the Gulf of America (Davis et al. 2002). Other populations, especially mature males in higher latitudes, are known to feed on significant quantities of large demersal and mesopelagic sharks, skates, and bony fishes (Clarke 1962; Clarke 1979). Sperm whales consume about 3.0 to 3.5% of their body weight per day (Lockyer 1981). Sperm whales undergo deep foraging dives to find prey, spending approximately 75% of their day in the foraging dive cycle (Watwood et al. 2006). Descent rates are approximately 1.7 meters per second (m/sec) and nearly vertical (Goold and Jones 1995). Dive depth may be dependent upon temporal variations in prey location in the water column. Typical foraging dives last 40 minutes to depths of about 1,300 ft (400 m), followed by approximately eight minutes of resting at the surface (Gordon 1987; Papastavrou et al. 1989).

Nonetheless, dives of over two hours and deeper than 2 m (3.3 km) have been recorded (Clarke 1976); individuals may spend extended periods at the surface to recover.

The highly asymmetrical, disproportionately large head of the sperm whale is an adaptation to produce acoustic signals (Cranford 1992; Norris et al. 1972). Recordings of sperm whale vocalizations reveal that they produce a variety of sounds, such as clicks, gunshots, chirps, creaks, short trumpets, pips, squeals, and clangs (Goold 1999). Sperm whales locate prey by echolocation clicks while in a deep dive pattern, and produce vocalizations while resting at the surface. The function of vocalizations is relatively well studied (Goold and Jones 1995; Weilgart and Whitehead 1997). Long series of monotonous, regularly spaced clicks and closely spaced clicks are produced for echolocation and are associated with feeding and prey capture (Goold and Jones 1995; Weilgart and Whitehead 1993; Weilgart and Whitehead 1997). However, clicks are also used in short patterns (codas) during social behavior and intragroup interactions (Gero et al. 2015; Gero et al. 2016; Weilgart and Whitehead 1993). Sperm whales show regional differences in coda patterns (Gero et al. 2016; Weilgart and Whitehead 1997). Clicks may also aid in intra-specific communication. Clicks are heard most frequently when sperm whales are engaged in diving and foraging behavior (Miller et al. 2004; Whitehead and Weilgart 1991). Creaks (rapid sets of clicks) are heard most frequently when sperm whales are foraging and engaged in the deepest portion of their dives, with inter-click intervals and source levels being altered during these behaviors (Laplanche et al. 2005; Miller et al. 2004). When sperm whales are socializing, they tend to repeat series of group-distinctive clicks (codas), which follow a precise rhythm and may last for hours (Watkins and Schevill 1977). Codas are shared between individuals in a social unit and are considered to be primarily for intragroup communication (Rendell and Whitehead 2004; Weilgart and Whitehead 1997). Recent research in the South Pacific Ocean suggests that in breeding areas the majority of codas are produced by mature females (Marcoux et al. 2006). Coda repertoires have been found to vary geographically and are categorized as dialects, similar to those of killer whales (Pavan et al. 2000; Weilgart and Whitehead 1997). For example, significant differences in coda repertoire have been observed between sperm whales in the Caribbean Sea and those in the Pacific Ocean (Weilgart and Whitehead 1997). Three coda types used by male sperm whales have recently been described from data collected over multiple years: these codas associated with dive cycles, socializing, and alarm (Frantzis and Alexiadou 2008).

Our understanding of sperm whale hearing stems largely from the sounds they produce. The only direct measures of sperm whale hearing were conducted on a stranded neonate using the auditory brainstem response technique: the whale showed responses to pulses ranging from 2.5 to 60 kHz and highest sensitivity to frequencies between five to 20 kHz (Ridgway and Carder 2001). Other hearing information consists of indirect data. For example, the anatomy of the sperm whale's inner and middle ear indicates an ability to hear high frequency to ultrasonic best (Ketten 1992). The sperm whale may also possess better low frequency than other odontocetes, although not as low as many baleen whales (Ketten 1992). Reactions to anthropogenic sounds can provide indirect evidence of hearing capability, and several studies have made note of changes seen in

sperm whale behavior in conjunction with these sounds. For example, sperm whales have been observed to frequently stop echolocating in the presence of underwater pulses made by echo sounders and submarine sonar (Watkins et al. 1985; Watkins and Schevill 1975). In the Caribbean, Watkins et al. (1985) observed that sperm whales exposed to 3.25 to 8.4 kHz pulses (presumed to be from submarine sonar) interrupted their activities and left the area. Similar reactions were observed from artificial sound generated by banging on a boat hull (Watkins et al. 1985). André et al. (1997) reported that foraging whales exposed to a 10 kHz pulsed signals did not ultimately exhibit any general avoidance reactions: when resting at the surface in a compact group, sperm whales initially reacted strongly, and then ignored the signal completely (André et al. 1997). Thode et al. (2007) observed that the acoustic signal from the cavitation of a fishing vessel's propeller (110 dB re: 1 μPa^2 between 250 Hz and 1 kHz) interrupted sperm whale acoustic activity and resulted in the animals converging on the vessel.

A sperm whale was tagged for a controlled exposure experiment during a behavioral response study in southern California and did not appear to demonstrate obvious behavioral changes in dive pattern or production of clicks (Miller et al. 2012; Sivle et al. 2012; Southall et al. 2011).

Clicks produced by sperm whales (and presumably heard by them) are in the range of about 0.1 to 20 kHz (Goold and Jones 1995; Watkins 1977; Weilgart and Whitehead 1993; Weilgart and Whitehead 1997), up to 30 kHz, often with most of the energy in the two to four kHz range (Watkins 1980). Clicks have source levels estimated at 171 dB re: 1 µPa (Levenson 1974). The clicks of neonate sperm whales are very different from typical clicks of adults in that they are of low directionality, long duration, and low frequency (between 300 Hz and 1.7 kHz) with estimated source levels between 140 to 162 dB re: 1 µPa at 1 m (rms) (Madsen et al. 2003).

Sound production and reception by sperm whales are better understood than in most cetaceans. Sperm whales produce broadband clicks in the frequency range of 100 Hz to 20 kHz that can be extremely loud for a biological source (200 to 236 dB re: 1 µPa at 1 m [rms]), although lower source level energy has been suggested at around 171 dB re: 1 µPa at 1 m (rms) (Goold and Jones 1995; Møhl et al. 2003; Weilgart and Whitehead 1993; Weilgart and Whitehead 1997). Another class of sound, "squeals," are produced with frequencies of 100 Hz to 20 kHz (e.g., Weir et al. 2007).

6.2.2.3 Status and Population Dynamics

The best estimate of the current worldwide abundance of sperm whale is estimated to be 844,761 individuals (Whitehead and Shin 2022). Estimates are available for two of three U.S. stocks in the Atlantic Ocean, the Northern Gulf stock, estimated to consist of 1,180 individuals (N_{min}=983)(Hayes et al. 2021) and the North Atlantic stock, estimated to consist of 5,895 individuals (N_{min}=4,639)(Hayes et al. 2023).

On a global scale, no genetic differences have been found in the nuclear DNA (nDNA) (bi-parentally inherited) between individuals sampled in different ocean basins with some differences found in mitochondrial DNA (mtDNA) (maternally inherited) sequences (Lyrholm et

al. 1999). In general, results tend to find low genetic differentiation of nDNA among sperm whales in different ocean basins and little differentiation of mtDNA within ocean basin stocks, with the exception of some semi-enclosed basins such as the Mediterranean Sea and Gulf (Bond 1999; Engelhaupt 2004; Lyrholm and Gyllensten 1998; Lyrholm et al. 1999; Mesnick et al. 1999; Richard et al. 1996). Based on over 2,473 tissue samples and 1,038 mtDNA sequences from a global consortium of investigators, 28 haplotypes have been identified worldwide, defined by 24 variable sites (Mesnick et al. 2005). Three common haplotypes dominated the sequencing and made up 82% of the total. This dominance by a few haplotypes indicates broad reproductive mixing of genetic material. Mitochondrial DNA evidence in the Gulf of America suggests population structuring based on genetic material inherited from mothers. Regional structuring is also supported by satellite tracking data suggesting that most females establish home ranges within the Gulf of America basin, and their site fidelity has resulted in maternally related groups of females and young whales in this region.

6.2.2.4 Threats

Continued threats to sperm whale populations include vessel strikes, entanglement in fishing gear, competition for resources due to overfishing, pollution, loss of prey and habitat, and sound. NMFS' Recovery Plan for Sperm Whales (NMFS 2010b) identified four main categories of threats to the recovery of sperm whales in the Atlantic Ocean: (1) vessel interactions, (2) incidental capture in fishing gear, (3) habitat degradation, and (4) military operations. Loss of habitat can occur from multiple stressors including, changing environmental conditions, contaminant pollution and sound (Waring et al. 2016). Sound threats can include seismic surveys or propeller cavitation from large vessels, and this is heightened in areas of oil and gas activities or where shipping activity is high.

Vessels affect sperm whales via collisions and vessel sound. Sperm whales have been recorded spending periods of up to ten minutes "rafting" at the surface between deep dives (Watwood et al. 2006). This could make them exceptionally vulnerable to ship strikes. There was a reported and investigated vessel strike of a juvenile sperm whale in December 2020 from an off-bow contact of a major, 350-ft/6,500 ton OSV (*M/V Olympic Challenger*), which is one of the largest classes of OSVs in use in the Gulf of America, while the vessel was returning to the Port of Galveston. Studies on the behavior of sperm whales around whale watching boats suggest sperm whales change their diving and acoustic behavior in response to boats, but following frequent exposure, they become increasingly tolerant or habituated to the presence of vessels (Gordon et al. 1992; Markowitz et al. 2011).

Incidental entrapment and entanglement in fishing gear, especially gillnets set in deep water for pelagic fish (e.g., sharks, billfish, tuna), is of potential concern. In U.S. East coast waters, two incidents involving sperm whales were reported between 1990 and 1995, both on Georges Bank. In 1990, a whale was found entangled and was released in "injured" condition. In 1995, another was found, also injured, and released while still carrying gear (Waring et al. 1997). Based on observer data, mortality of sperm whales from the drift gillnet fishery between 1989 and 1995

ranged from zero to 4.4 (CV 1.77) per year (Waring et al. 1997). A single nonlethal interaction between sperm whales and the longline fishery has been recorded in the Gulf of America. A stranded sperm whale has been documented with signs of human interaction (NOAA National Marine Mammal Health and Stranding database unpublished data 2002-2012).

The accumulation of stable pollutants (e.g. heavy metals, polycholorobiphenyls [PCBs], chlorinated pesticides [DDT, DDE, etc.], and polycyclic aromatic hydrocarbons [PAHs]) is of concern for sperm whales. The potential impact of coastal pollution may be an issue for this species in portions of its habitat, though little is known regarding the effect pollutants may have on individuals. Because sperm whales feed at high trophic levels and store the chemicals in their blubber, they are susceptible to chemical pollution. Sperm whales could potentially pass these chemicals to their offspring in their milk (Whitehead 2003). A population sensitivity analysis for the Gulf sperm whales showed that if toxins, such as those found in oil spills, reduce the survivorship rate of the mature female sperm whales by as little as 2.2%, or the survivorship rate of mothers by 4.8%, the growth rate of the population would drop to a level that would result in a decline in the size of that population (Chiquet et al. 2013). The DWH oil spill and response impacted the Gulf sperm whale population. The effects on sperm whales are described in greater detail in Section 8.8, as well as in the Final PDARP. Oil spills and response activities continue to threaten sperm whales.

Marine debris may be ingested by sperm whales, as is the case with many marine animals. Debris entrained in the deep scattering layer where sperm whales feed could be mistaken for prey and incidentally ingested. Manmade sound and offshore energy development may also be adversely affecting habitat quality. Because of their apparent role as important predators of mesopelagic squid and fish, changing the abundance of sperm whales should affect the distribution and abundance of other marine species. Conversely, changes in the abundance of mesopelagic squid and fish from recently developed targeted fisheries could affect the distribution of sperm whales.

Sperm whales may be affected by military operations in a number of ways. Whales can be struck by vessels and disturbed by sonar and other anthropogenic sounds. Sperm whales have been observed to frequently stop echolocating in the presence of underwater pulses made by echosounders and submarine sonar (Watkins 1985; Watkins and Schevill 1975). They also stop vocalizing for brief periods when codas are being produced by other individuals, perhaps because they can hear better when not vocalizing themselves (Goold and Jones 1995).

Morano et al. (2020) performed a large-scale passive acoustic survey of sperm whales along the eastern Gulf of America continental shelf following the Deepwater Horizon oil spill. Sperm whales were shown to exhibit a seasonal occurrence pattern in the region, with seasonal movements to other regions, which are likely not directly influenced by the oil spill. Seasonal occurrence was shown to be highest during summer and lowest during winter. Results suggested other factors, such as oceanographic or ecological processes, may have a stronger influence on sperm whale occurrence than an oil spill. However, the authors acknowledged that not enough

baseline data on sperm whale occurrence existed prior to the Deepwater Horizon spill to compare with the post-spill data. Therefore, inferring spill-related sperm whale occurrence was difficult.

However, Marques et al. (2023b) looked at cetacean density surface models from Roberts et al. (2016b) and data on surface oil coverage and thickness from Macdonald et al. (2015) to determine impacts from the Deepwater Horizon oil spill on cetacean populations. The authors estimated that the sperm whale population trajectory in the Gulf of America required approximately 11 years to return to 95% of the baseline population trajectory.

Li et al. (2021b) analyzed passive acoustic datasets in the northern Gulf of America from approximately 16, 40, and 80 kilometers away from the DWH oil spill site. Data were collected in 2007, 2010, 2015, 2016, and 2017. A comparison between the abundances of sperm whales before and after the oil spill was completed. The results show that sperm whales were present in the region throughout the entire monitoring period. The results also indicated that the density of sperm whales at the site closest to the spill showed recovery from 2010 to 2015, thus, animals increased the site occupancy, probably due to prey field recovery.

There have been no updates to the sperm whale recovery plan since 2010. A five-year review was conducted in 2015 and concluded that no changes to the status of the species were warranted.

6.2.3 Rice's Whale

At the time of issuance of the 2020 biological opinion, Rice's whales in the Gulf of America were classified as a Gulf subspecies of the Bryde's whales (*Balaenoptera edeni)* because of their genetic distinctiveness from other Bryde's whales worldwide (including the subspecies of *B. e. edeni* and *B. e. brydei*). Gulf Bryde's whales were listed as endangered under the ESA on April 15, 2019. On August 23, 2021, the common and scientific name of the former Gulf of Mexico Bryde's whale was revised via rulemaking to Rice's whale (*Balaenoptera ricei)* to reflect the scientifically accepted taxonomy and nomenclature of the whale as a separate species (86 FR 47022).

6.2.3.1 Species Description and Distribution

The Rice's whale is the only known baleen whale to inhabit the Gulf of America year-round. These whales are consistently found in the northeastern Gulf of America in the De Soto Canyon area between the 100 m and 400 m depth contours. Whaling records indicate the historical distribution of Rice's whales in the Gulf was likely much broader, and included the north-central and southern Gulf.

Rice's whales are baleen whales that typically grow to lengths of 40 to 55 ft (13 to 16.5 m). To date, the largest verified Rice's whale to strand was a lactating female about 1,265 cm long; the largest male was 1,126 cm (Rosel et al. 2021). The species has a large, falcate dorsal fin, a streamlined body shape, and a pointed, flat rostrum. There are three ridges on the dorsal surface of the rostrum that distinguish it from other similar-looking species, such as the sei whale (Rosel

2016). Rice's whales have a counter-shaded color that is fairly uniformly-dark dorsally and light to pinkish ventrally.

Historically, there has been less survey effort in known Rice's whale habitat than in other areas of the Gulf of America. The area where Rice's whales are expected to be found and their density based on best available information is shown in Figure 22, Figure 23, and Figure 24. Most sightings have occurred off the northwest coast of Florida in waters near the continental shelf break (bottom depths ranging between 100-400m, (Garrison et al. 2024). Sightings in this area have been observed year-round, and the same individual animals, identified by dorsal fin and body markings, have been seen in this region over many years. However, in recent years, there have been visually and genetically confirmed observations of Rice's whales off the coast of Texas and south of Louisiana. There have been historical sightings of unidentified baleen whales outside the eastern Gulf, and there have also been six confirmed visual sightings of Rice's whales outside of the eastern Gulf (Garrison et al. 2024). Notably, there was a confirmed Rice's whale sighting in the western Gulf of America off the central Texas coast in waters 225 m deep during the 2017 GoMAPPS survey effort (NMFS 2018b).

Rosel et al. (2021) reported that, based on a compilation of sighting and stranding data from 1992 to 2019, the primary habitat of the Rice's whale is the northeastern Gulf of America, particularly the De Soto Canyon area (Figure 22). Rice's whale habitat is considered to be within the depth range of 100 to 400 m in this part of the Gulf (NMFS 2020; Rosel 2016; Rosel et al. 2021). Two Bryde's-like whales were sighted during a NMFS survey in the western Gulf in the early 1990s (Rosel et al. 2021) and there was a confirmed Rice's whale sighting in the western Gulf of America off the central Texas coast in waters 225 m deep (NMFS 2018a). Data from passive acoustic monitoring revealed long-moan whale calls along the northwestern Gulf of America shelf break that were determined to share distinctive and similar features with Rice's whale calls in the eastern Gulf of America, which provides evidence for the occurrence of Rice's whales over a broader distribution in the Gulf of America than previously understood (Debich et al. 2025a; Debich et al. 2025b; Debich et al. 2025c; Soldevilla et al. 2022a; Soldevilla et al. 2024; Soldevilla et al. 2022b).

Updated spatial density models based on line-transect and aerial surveys conducted in U.S. waters of the Gulf during the GoMMAPPS project show highest Rice's whales occurring throughout their northeastern Gulf habitat and the 100 to 400-m isobaths throughout the entire year (Figure 23 and Figure 24; (Rappucci et al. 2023)). Rice's whale habitat is characterized by bottom depths between 100-400m, cool near-bottom water temperatures, and surface waters rich with algae (Garrison et al. 2024). These features support the concentration of schooling fish near the bottom, which make up their primary prey (Kiszka et al. 2023). Rice's whales feed near the bottom, diving consistently during daylight hours to feed on fish. They spend more time near the surface at night with less active foraging (Kok et al. 2023; Soldevilla et al. 2017).

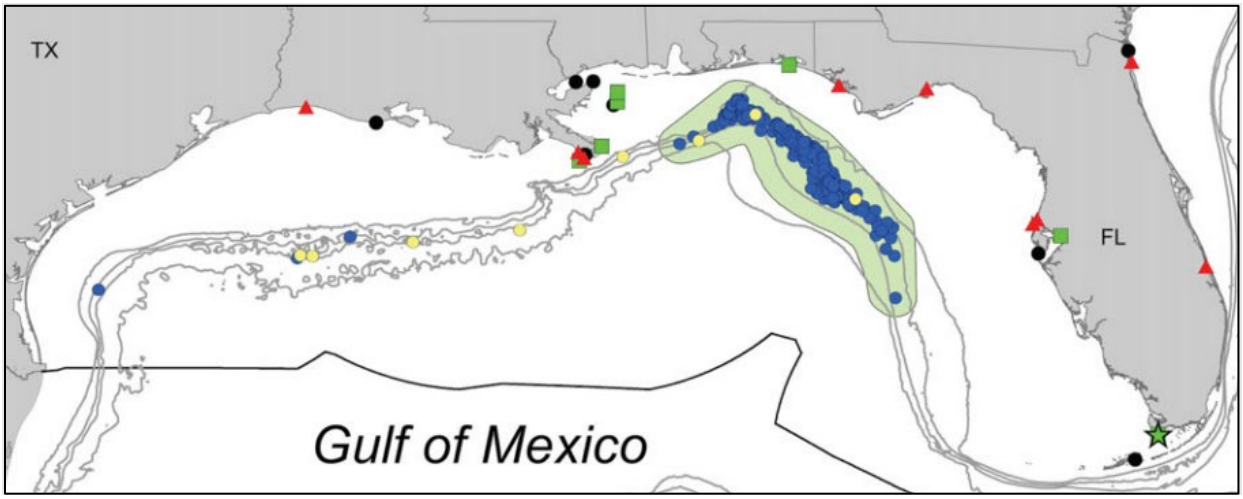


Figure 22. Distribution of sightings and strandings of Bryde's-like whales in the Gulf and Atlantic U.S. EEZ from 1992 to 2019. Green area: Rice's whale primary habitat area. Blue circles: visual survey sightings, yellow circles: sightings recorded by protected species observers (PSOs), red triangles: strandings recorded as "Bryde's whales", black circles: strandings recorded as unconfirmed Bryde's-like whale, green squares: strandings confirmed as Gulf Bryde's-like whale (Rosel et al. 2021).

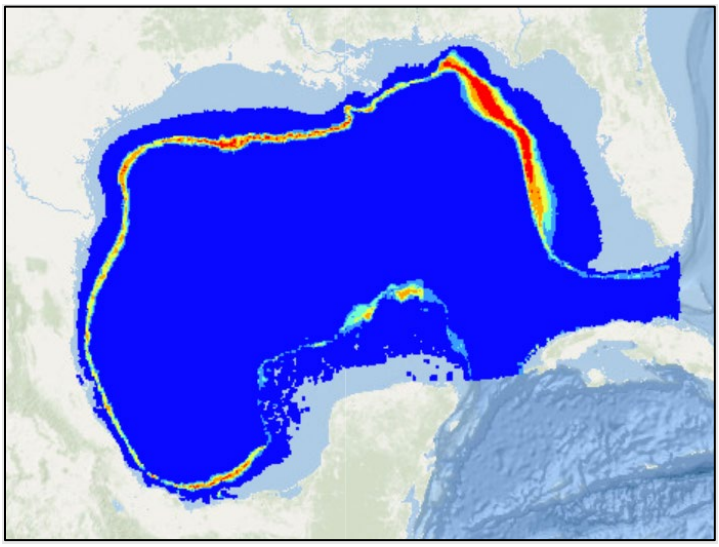


Figure 23. Density map of relative Rice's whale abundance in the Gulf in January (Rappucci et al. 2023).

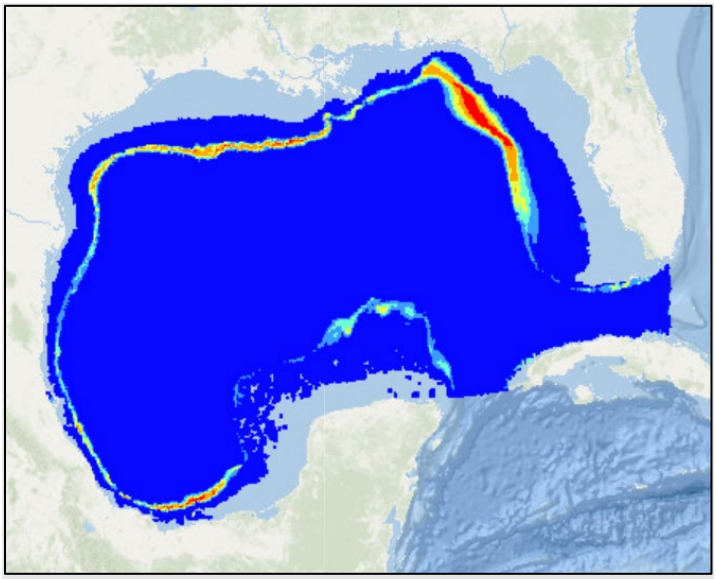


Figure 24. Density map of relative Rice's whale abundance in the Gulf in July (Rappucci et al. 2023)

Vessel and aerial surveys during 2023 and 2024 have added to the available sightings of Rice's whales in the Gulf of America in addition to the data summarized in Garrison et al. 2024. During April 2024, an aerial survey was conducted off the coast of Texas over water depths between 100-400m. Two whales identified visually as Rice's whales were observed and photographed. The locations of the sightings were close to where a Rice's whale had been observed in the summer of 2017 and the locations where Rice's whales have been detected acoustically (Debich et al. 2025a; Debich et al. 2025b; Debich et al. 2025c; Soldevilla et al. 2024). Large vessel surveys were conducted in the summers of 2023 and 2024 to assess marine mammal abundance and spatial distribution. These surveys included sightings of Rice's whales in the northeastern Gulf habitat along with a sighting of a probable Rice's whale (Summer 2023), three visually identified individuals south of Louisiana (Summer 2024), and an individual off the coast of Texas. The locations of these sightings are shown in Figure 25. The locations where these sightings occurred are consistent with both the predicted habitat and previous passive acoustic detections.

Passive acoustic data has been used to improve our understanding of where Rice's whales may occur throughout the Gulf. Studies conducted in 2018 and 2019 verified that Rice's whales have unique calls (Soldevilla et al. 2022a; Soldevilla et al. 2022b) that can be used to determine when they are present using PAM. Data from PAM units in the central and western Gulf of America have demonstrated regular presence of Rice's whales year-round (Debich et al. 2025a; Debich et al. 2025b; Debich et al. 2025c; Soldevilla et al. 2022a; Soldevilla et al. 2024), consistent with the recent visual observations in these areas (Figure 24). These detections are within the described habitat between the 100-400m water depths, and PAM units deployed in deeper waters have not detected Rice's whales. A PAM unit moored in waters off the northeastern coast of Mexico also detected Rice's whale vocalizations (Soldevilla et al. 2024), indicating for the first time that their range includes Mexican waters and validated habitat predictions from Garrison et al. (2024).

Ongoing PAM studies include the deployment of units in potential Rice's whale habitats more broadly in Mexican waters to determine the extent of Rice's whale habitat.

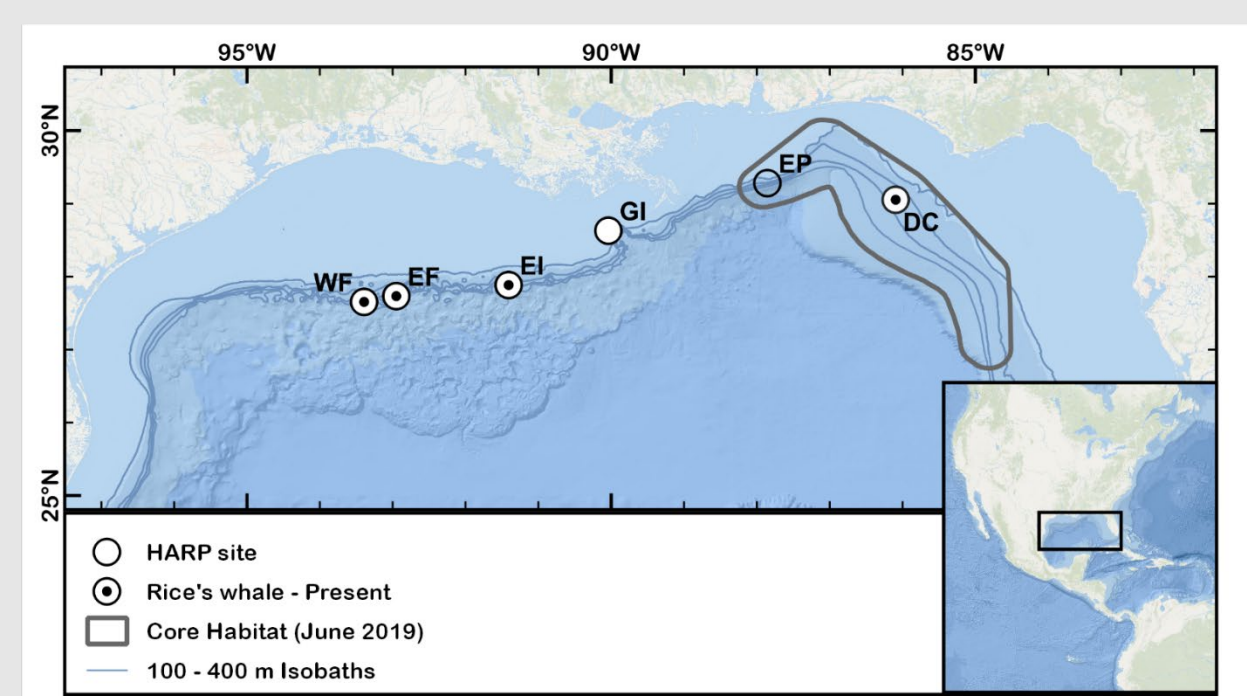


Figure 25. Passive Acoustic Monitoring Sites where Rice's whale calls were detected (Soldevilla et al. 2022)

Information available from the status review (Rosel 2016), the proposed listing, and available literature was used to summarize the life history, population dynamics, and status of the species as follows.

6.2.3.2 Life History Information

Little is known about the Rice's whale's life history compared to Bryde's whales more generally and worldwide. For the purposes of this opinion, we use relevant information gathered about Bryde's whales more generally and worldwide because they are a close relative to Rice's whale (reference). The life expectancy of Rice's whales is unknown. Bryde's whale have a gestation period of 11 to 12 months, and give birth to a single calf, which is nursed for six to 12 months. Age of sexual maturity is not known for Rice's whales specifically, but Rice's whales are thought to be sexually mature at eight to 13 years. Peak breeding and calving probably occurs in the fall. Females breed every second year. Rice's whales exhibit a typical diel dive pattern, with deep dives in the daytime, and shallow dives at night. Rice's whales generally feed on schooling fishes (e.g., anchovy, sardine, mackerel, and herring) and small crustaceans (Rosel 2016).

Rice's whales are year-round residents in the Gulf of America. Bryde's whales are known to dive to over 200 m depth to feed on small fish or crustaceans and their occurrence is thought to be determined by prey abundance (Kerosky et al. 2012). Bryde's whales are observed in small groups, pairs or solitary and reportedly seem curious about ships (Lodi et al. 2015; Rosel 2016; Tershy 1992).

According to Rice (1998), adult *B. e. edeni* rarely exceed 37 ft (11.5 m) total length and adult *B. e. brydei* reach approximately 46 to 49 ft (14 to15 m). Rosel and Wilcox (2014) summarized body length information in the Gulf of America from strandings and concluded that they may have a size range intermediate to the currently recognized subspecies. This is similar to Bryde's whales off the coast of South Africa where inshore males are estimated to attain maturity at 40 to 41 ft (12.2 to 12.5 m) compared to 42 to 45 ft (12.8 to 13.7 m) for offshore males, while inshore females reach sexual maturity at 39 to 41 ft (11.9 to 12.5 m) compared to 42 to 43 ft (12.8 to 13.1 m) for offshore females (Best 2001).

Like other balaenopterids, Rice's whales have distinctive calls depending on geographic regions that may be useful for delineating subspecies or populations (Figueiredo 2014; Rosel 2016; Širović et al. 2014). Based on data presented in Širović et al. (2014) and Rice et al. (2014), the calls by the Rice's whale are consistent with, but different from those previously reported for Bryde's whales worldwide. These unique acoustic signatures support the genetic analyses identifying the Rice's whale as an evolutionary distinct species from Bryde's whales (Rosel and Wilcox 2014). While no data exist on the hearing abilities of Rice's whale, as with other marine mammals we assume they hear best in the frequency range in which they produce calls.

Based on trawl surveys, Kiszka et al. (2023) inferred that prey items most readily available included Atlantic pearlside (*Maurolicus weitzmani*), silver-rag driftfish (*Ariomma bondi*), Dumeril's lanternfish (*Diaphus dumerilii*), and longfin inshore squid (*Doryteuthis pealeii*). However, stable isotope analysis from biopsy samples indicated that silver-rag driftfish were the primary prey item for Rice's whales, despite the lower relative abundance of this prey species compared to others. Silver-rag driftfish were found to have a higher energy content than the other prey species analyzed. These results suggest that prey energy content rather than prey abundance may be the primary driver behind prey selection by Rice's whales.

A study by (Soldevilla et al. 2022a) used sonobuoys and passive acoustic tagging to validate the source of potential call types and to characterize Rice's whale calls. During concurrent visual and acoustic surveys, acoustic-directed approaches were conducted to obtain visual verifications of sources of localized sounds. Of 28 acoustic-directed approaches, 79% led to sightings of balaenopterid whales, of which 10 could be positively identified to species as Rice's whales. Long-moan calls, downsweep sequences, and tonal-sequences are attributed to Rice's whales based on these matches. A potential new call type, the low-frequency downsweep sequence, is characterized from tagged Rice's whale recordings.

6.2.3.3 Status and Population Dynamics

The Rice's whale population is very small; data from aerial and vessel-based line-transect surveys conducted in the northern Gulf of America have been used to estimate their abundance. Abundance estimates made between 1991 and 2009 range between zero and 44 individuals (Rosel 2016). A second habitat-based density estimate by Roberts et al. (2016a) that incorporated visual survey data from 1992 to 2009 estimated 44 individuals (Rosel 2016), was used in the 2020 biological opinion. The current best abundance estimate for the Rice's whale is

51 animals (Hayes et al. 2023; NMFS 2021). This estimate incorporates the most recent data available on the species, including the best data available on post-DWH abundance, and was derived from vessel survey data from 2017 and 2018 in the eastern Gulf. However, given increasing evidence that Rice's whales regularly occur outside the eastern Gulf and have been confirmed in Mexican waters, this may be an under estimate. Rappucci et al. (2023) estimate the population may be larger, with an abundance estimate of 121 animals derived from a species distribution model that covers a broader area, including Mexican waters (Figure 23 and Figure 24). There is insufficient information available to properly examine population trends for the Rice's whale.

Genetic diversity within the Rice's whale population is very low. Genetic analysis of Rice's whale samples from the Gulf of America found only two mitochondrial DNA control region haplotypes in the first 375 base pairs of the control region (compared to five haplotypes for North Atlantic right whales and 51 in fin whales across the same control region sequence) (Rosel and Wilcox 2014). Examination of 42 nuclear microsatellite loci found that 25 (60%) were monomorphic, meaning no genetic variability was seen for the 21 Rice's whales sampled (Rosel 2016).

Phylogenetic reconstruction using the control region and all published Bryde's whale sequences reveal that the Rice's whale's haplotypes are evolutionarily distinct from the other two recognized subspecies of Bryde's whale as the two subspecies are from each other. In addition, the Rice's whale is more genetically differentiated from the two recognized subspecies than is the sei whale, which is an entirely different species (Rosel and Wilcox 2014; Rosel et al. 2021).

6.2.3.4 Threats

Historically, some commercial whaling targeting sperm whales occurred in the Gulf of America and, while Rice's whales were not specifically targeted by whalers, "finback whales" caught between the mid-1700s and late 1800s were likely Rice's whales (Reeves et al. 2011). Since then, there has not been whaling in the Gulf of America. Sound from shipping traffic and seismic surveys in the region can affect Rice's whales' ability to communicate. Vessel traffic, such as from commercial shipping and the oil and gas industry, poses a risk of vessel strike for Rice's whales. Of the six reported Rice's whale strandings on the Gulf Coasts of Louisiana and Florida since 2005, at least one was attributed to blunt force trauma by ship strike (NOAA National Marine Mammal Health and Stranding Response Database unpublished data). Further, carcass-recovery rates are low for cetaceans in the Gulf of America (Williams et al. 2011). Entanglement from fishing gear is also a threat, and several fisheries operate within the range of the species. The DWH oil spill and response heavily affected the Rice's whale population (Trustees 2016). Oil spills and response to spills continue to be a serious threat, though there has been regulatory reform and drilling safety improvements (see Section 8.8). Because the Rice's whale population is small and has low levels of genetic diversity, it is highly susceptible to further perturbations.

The Rice's whale status review identified 27 possible threats to Rice's whales, with the following four being the most significant: (1) sound, (2) vessel collisions; (3) energy exploration; (4) oil spills and oil spill response (Figure 26).

1. Sound from shipping traffic and oil and gas exploration and development activities are of particular concern since they produce a large amount of low frequency sound (less than 100 Hz) that falls within the hearing range of the species. Similar to other baleen whales, it is likely that Rice's whales rely on their hearing to perform critical life functions (i.e., communication, navigation, mate finding, food location, predator avoidance, etc.).
2. The northern Gulf of America is an area with considerably high amount of ship traffic, which increases the risk of vessel-whale collisions. Vessel traffic from commercial shipping lanes cuts through known Rice's whale habitat. The Rice's whale's dive behavior contributes to their risk of collision. Tracking information indicates they spend the majority of the night within 15 m of the surface. The risk of vessel strike is significant, given the location of commercial shipping lanes, the difficulty of sighting a whale at the surface at night, and, currently, the low ability of large ships to change course quickly enough to avoid a whale.
3. The Gulf of America is highly industrialized due to expansive energy exploration and production that requires drilling rigs, platforms, cables, pipelines, and ship support. Habitat in the north-central and western Gulf of America, which includes the Rice's whale's historical range, has been significantly modified by the presence of thousands of oil and gas platforms. The September 8, 2020 Presidential Memorandum on Withdrawal of Certain Areas of the United States Outer Continental Shelf from Leasing Disposition prohibits lease sales through June 30, 2032, in the EPA, which overlaps with the area where Rice's whales are found. BOEM has not projected any new lease sales in the EPA in their projection of activities to be covered by this opinion. However, if new leases are offered after the Presidential withdrawal expires, Rice's whales could be exposed to increased threats associated with energy exploration and development.
4. Exposure to spilled oil and dispersants used for oil spill response can result in lethal or sub-lethal effects to baleen whales. The DWH oil spill, considered a low-probability catastrophic spill (which is not reasonably certain to occur), is an example of the significant impacts a spill can have on the Rice's whale. Although the DWH platform was not located within the Rice's whale northeastern Gulf habitat, the Rice's whales were still significantly impacted by the spill, with an estimated 17% of the population killed, 22% of females exhibiting reproductive failure, and 18% of the population suffering adverse health effects (Trustees 2016).

NMFS is developing a recovery plan for this species. In the interim, NMFS has developed a recovery outline to provide a preliminary strategy for conservation of the Rice's whale (https://www.fisheries.noaa.gov/resource/document/rices-whale-recovery-outline).

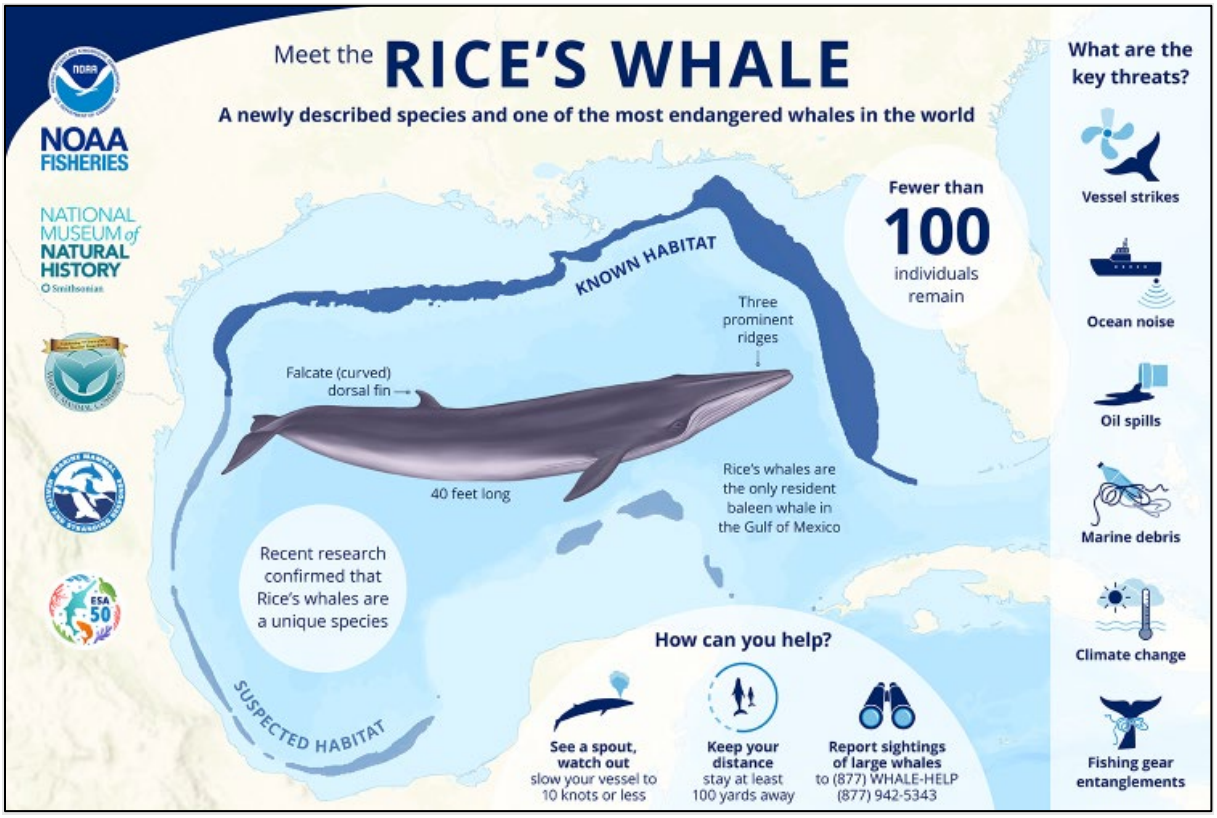


Figure 26. Summary illustration for Rice's whale (NMFS webpage accessed March 12, 2025)

6.2.4 Proposed Critical Habitat for Rice's Whale

NMFS proposed to designate critical habitat for the Rice's whale on July 24, 2023. Proposed Rice's whale critical habitat includes the area ranging from the 100-m isobath to the 400-m isobath in U.S. waters in the Gulf of America (Figure 27). This includes primary Rice's whale habitat in the De Soto Canyon in the northeastern Gulf of America described in Section 6.2.3.

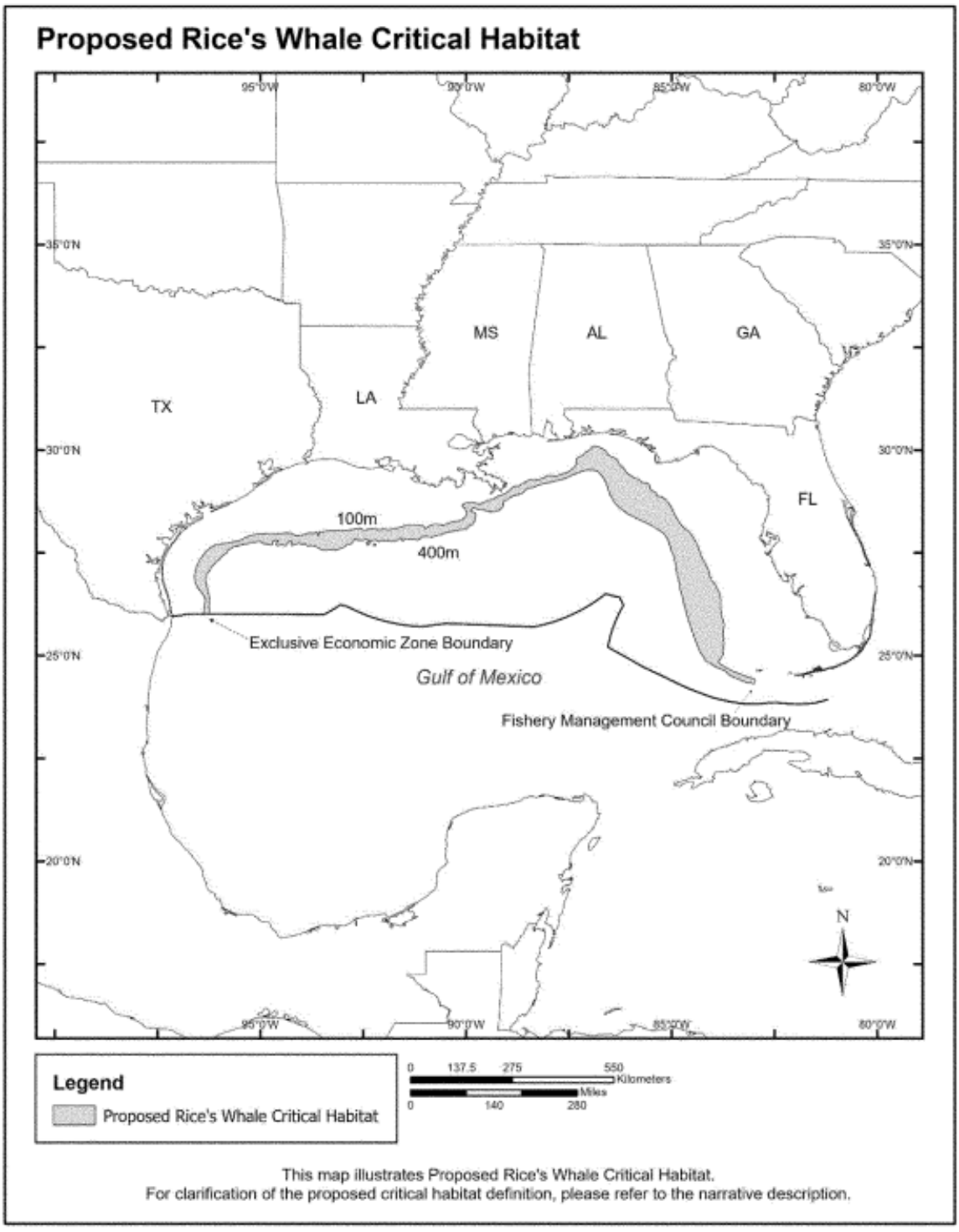


Figure 27. Area of proposed critical habitat for the Rice's whale in the Gulf of America

Essential Features of Critical Habitat

Essential features are the PBFs of the habitat that are essential for the conservation of the species. The Proposed Rice's Whale Critical Habitat Rule identifies Gulf of America continental

shelf and slope associated waters between the 100 and 400 m isobaths that support individual growth, reproduction, and development, social behavior, and overall population growth as an essential feature for Rice's whale conservation. Key attributes of this feature include sufficient density, quality, abundance, and accessibility of small demersal and vertically migrating prey species, including scombriformes, stomiiformes, myctophiformes, and myopsida; marine water with elevated productivity, bottom temperatures of 10 to 19 °C (50 to 66 °F), and levels of pollutants that do not preclude or inhibit any demographic function; and sufficiently quiet conditions for normal use and occupancy, including intraspecific communication, navigation, and detection of prey, predators, and other threats.

6.2.5 Sea Turtles

6.2.5.1 Threats to Sea Turtles

The five species of sea turtles that may be adversely affected by the Oil and Gas Program (North Atlantic DPS green, hawksbill, Kemp's ridley, leatherback, and Northwest Atlantic DPS loggerhead) travel widely throughout the South Atlantic, Gulf of America and the Caribbean. These species are highly migratory and could occur within the action area. This section discusses threats to all species of sea turtles followed by information on the status and unique threats for each species.

Fisheries

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

In addition to domestic fisheries, sea turtles are subject to direct as well as incidental capture in numerous foreign fisheries, further impeding the ability of sea turtles to survive and recover on a global scale. For example, oceanic-stage sea turtles, especially loggerheads and leatherbacks, that circumnavigate the Atlantic are susceptible to international longline fisheries including the Azorean, Spanish, and various other fleets (Aguilar et al. 1994; Bolten et al. 1994; Crouse 1999). Bottom longlines and gillnet fishing is known to occur in many foreign waters, including (but not limited to) the northwest Atlantic, western Mediterranean, South America, West Africa, Central

America, and the Caribbean. Shrimp trawl fisheries are also occurring off the shores of numerous foreign countries and pose a significant threat to sea turtles similar to the impacts seen in U.S. waters. Many unreported takes or incomplete records by foreign fleets make it difficult to characterize the total impact that international fishing pressure is having on listed sea turtles. Nevertheless, international fisheries represent a continuing threat to sea turtle survival and recovery throughout their respective ranges.

Non-Fishery In-Water Activities

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

Vessel Strikes

Where there is overlap between vessel traffic and sea turtle habitat, there is threat of vessel strike to sea turtles. High levels of vessel traffic in nearshore areas along the U.S. Atlantic and Gulf of America coasts result in frequent injury and mortality of sea turtles. From 1997 to 2005, nearly 15% of all stranded loggerheads in this region were documented as having sustained some type of propeller or collision injury, although it is not known what proportion of these injuries were sustained ante-mortem versus post mortem. According to Reneker et al. (2017), examination of stranded turtles from Mississippi in 2017 showed trauma, primarily from vessel strikes, to be the second largest factor for mortality. In one study from Virginia, Barco et al. (2016) found that all 15 dead loggerhead turtles encountered with signs of acute vessel interaction were apparently normal and healthy prior to human-induced mortality. The incidence of propeller wounds of stranded turtles from the U.S. Atlantic and Gulf of America doubled from about 10% in the late 1980s to about 20% in 2004. Singel et al. (2007) reported a tripling of boat strike injuries in Florida from the 1980's to 2005. Over this time period, in Florida alone over 4,000 (~500 live; ~3500 dead) sea turtle strandings were documented with propeller wounds, which represents 30% of all sea turtle strandings for the state (Singel et al. 2007). These studies suggest that the threat of vessel strikes to sea turtles may be increasing over time as vessel traffic continues to increase in the southeastern U.S. and throughout the world.

Coastal Development

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 shoreline erosion control structures such as breakwaters, groins, and jetties can impact nesting females and hatchling as they approach and leave the surf zone or head out to sea by creating physical blockage, concentrating predators, creating longshore currents, and disruption 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], PCBs, and perfluorinated chemicals [PFCs]), 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 ingestion of 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. Oil spills and spill response activities continue to be a threat to sea turtle populations in the Gulf of America.

Juvenile sea turtles include oceanic juveniles (younger juveniles using surface-pelagic habitats) and nearshore benthic-stage juveniles (neritic stage defined by older juveniles using nearshore benthic habitats). Most reports of oiled juveniles are oceanic stage juveniles from convergence zones, ocean areas where currents meet to form collection points for material at or near the surface of the water. These oceanic juveniles spend a greater proportion of their time at the surface than adults do; thus, their risk of exposure to floating oil slicks would be increased. In convergence zones off the east coast of Florida, tar was found in the mouths, esophagi, or stomachs of 65 out of 103 post-hatchling loggerheads (Loehefener et al. 1989). In another study (Witherington 1994), 34% of post-hatchlings at "weed lines" off the Florida coast had tar in their mouths or esophagi, and over half had tar caked in their jaws. Lutz and Lutcavage (1989)reported that hatchlings have been found apparently starved to death, their beaks and esophagi blocked with tarballs.

The April 20, 2010, explosion of the DWH oilrig affected sea turtles in the Gulf of America. There is an on-going assessment of the long-term effects of the spill on Gulf of America marine life, including sea turtle populations. 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 Trustees involved with the Natural Resources Damage Assessment conducted a thorough assessment of the effects of the spill and response activities on sea turtles. Assessment activities included boat-based rescues, veterinary assessments, aerial surveys, satellite tracking of live sea turtles, recovery of stranded sea turtles, and movements and/or monitoring of sea turtle nests and nesting females. Oil collected from the rescued turtles was confirmed as DWH oil. They concluded that sea turtles were adversely effected by exposure to DWH oil and response activities (Trustees 2016).

"The Trustees estimated that between 4,900 and up to 7,600 large juvenile and adult sea turtles (Kemp's ridleys, loggerheads, and hardshelled sea turtles not identified to species), and between 55,000 and 160,000 small juvenile sea turtles (Kemp's ridleys, green turtles, loggerheads, hawksbills, and hardshelled sea turtles not identified to species) were killed by the DWH oil spill. Nearly 35,000 hatchling sea turtles (loggerheads, Kemp's ridleys, and green turtles) were also injured by response activities" (Trustees 2016)

The DWH event affected sea turtles at the population level and shifted the baseline for sea turtles. To read more on the full assessment and the nature and magnitude of effects from the DWH oil spill, refer to the PDARP and Final PEIS at http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan. Oil spills and spill response activities continue to be a threat to sea turtle populations in the Gulf of America.

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).

Other Threats

There is a large and growing body of literature on past, present, and future impacts of changing global environmental conditions, 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. One of NOAA's information portals provides basic background information on these and other measured or anticipated effects (see http://www.climate.gov). We discuss changing environmental conditions and associated effects on the species and critical habitat in the action area in detail in the Environmental Baseline (Section7).

Predation by various land predators is a threat to developing nests and emerging hatchlings. The major 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 predation, direct harvest of eggs and adults from beaches in foreign countries continues to be a problem for various sea turtle species throughout their ranges (NMFS and USFWS 2008b).

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

6.2.6 North Atlantic Distinct Population Segment Green Sea Turtle

The green sea turtle was 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. Of the 11 green sea turtle DPSs that were listed on May 6, 2016, only the North Atlantic DPS occur within the action area. Three of the green sea turtle DPSs were listed as endangered and the other eight including the North Atlantic DPS, which was listed as threatened. We included the South Atlantic DPS in the 2020 biological opinion, but newer science on green turtle stocks suggests that the South Atlantic DPS is not genetically present at a level to represent that DPS in the US EEZ portion of the Gulf (Shamblin et al. 2023). Hence, we are not including the South Atlantic DPS in our green turtle analysis.

6.2.6.1 Species Description and Distribution

The green sea turtle is the largest of the hardshell marine turtles, growing to a weight of 350 lb (159 kg) and a straight carapace length of greater than 3.3 ft (one m). Green sea turtles have a smooth carapace with four 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 and USFWS 1997). The two largest nesting populations are found at Tortuguero, on the Caribbean coast of Costa Rica, and Raine Island, on the Pacific coast of Australia along the Great Barrier Reef.

Differences in mitochondrial DNA properties of green sea turtles from different nesting regions indicate there are genetic subpopulations (Bowen et al. 1992; Fitzsimmons et al. 2006). Despite the genetic differences, sea turtles from separate nesting origins are commonly found mixed together on foraging grounds throughout the species' range. Within U.S. waters individuals from both the North Atlantic and South Atlantic DPSs can be found on foraging grounds. While there are currently no in-depth studies available to determine the percent of North Atlantic and South Atlantic 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 America) found approximately 4% of individuals came from nesting stocks in the South Atlantic DPS (specifically Suriname, Aves Island, Brazil, Ascension Island, and Guinea Bissau) (Foley et al. 2007). On the Atlantic coast of Florida, a study on the foraging grounds off Hutchinson Island found that approximately 5% of the turtles sampled came from the Aves Island/Suriname nesting assemblage, which is part of the South Atlantic DPS (Bass and Witzell 2000). 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 North Atlantic DPS, the U.S. Caribbean nesting assemblages are split between the North and South Atlantic DPSs. Nesters in Puerto Rico are part of the North Atlantic DPS, while those in the U.S. Virgin Islands are part of the South Atlantic DPS. We do not currently have information on what percent of individuals on the U.S. Caribbean foraging grounds come from which DPS.

In U.S. Atlantic and Gulf waters, green sea turtles are distributed throughout inshore and nearshore waters from Texas to Massachusetts. Principal benthic foraging areas in the southeastern United States include Aransas Bay, Matagorda Bay, Laguna Madre, and the Gulf inlets of Texas (Doughty 1984; Hildebrand 1982; Shaver 1994), the Gulf of America off Florida from Yankeetown to Tarpon Springs (Caldwell and Carr 1957; Carr 1984), 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.

Metz et al. (2020) analyzed juvenile green sea turtle movements in the northwestern Gulf of America and found that tracked green turtles exhibited strong seasonal fidelity to their original capture locations. Metz et al. (2020) tracked turtles initially captured in coastal bays in Texas and Mexico (Matagorda Bay, Texas, Aransas Bay, Texas, Launa Madre, Texas, and Laguna Madre, Mexico) to follow their seasonal movements and habitat use. The turtles generally utilized coastal Texas inland bays in the Fall and Summer before moving south to the coastal bays at the Mexico-Texas border and into Laguna Madre, Mexico. All turtles displayed residency in Texas bays during summer months (March - November) while five of the 15 individuals exhibited seasonal migrations into Mexican waters following passage of strong cold fronts in December

and January. Winter (e.g., Mexico) and summer (e.g., Texas) core areas were not significantly different.

During a study by Sloan et al. (2022), 10 green sea turtles were tagged along the southwest coast of Florida. Based on switching state space modeling of the tracking data, an area off of Cape Sable (Everglades), Florida Bay, and the Marquesas Keys are important foraging areas that support individuals that nest on southwest Florida mainland beaches.

Updated spatial density models based on line-transect and aerial surveys conducted in U.S. waters of the Gulf of America during the GoMMAPPS project show highest green turtle densities occurring off the East and Southeast coast of Florida and along the northern gulf during the months of July (Figure 28) and August and lower densities during the month of January (Figure 29; (Rappucci et al. 2023).

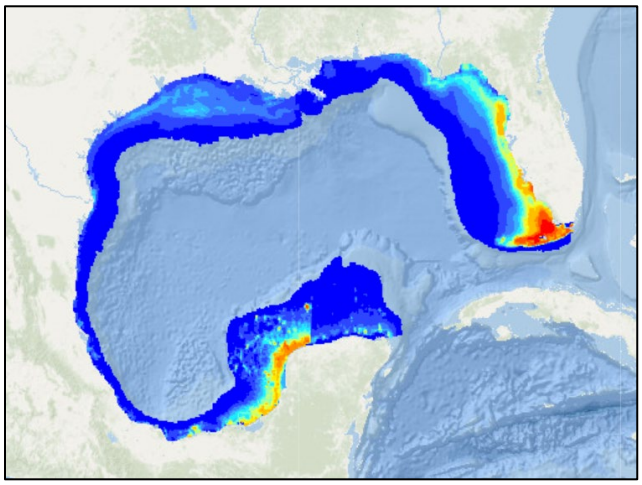


Figure 28. Density map of relative green turtle abundance in the Gulf in July (Rappucci et al. 2023)

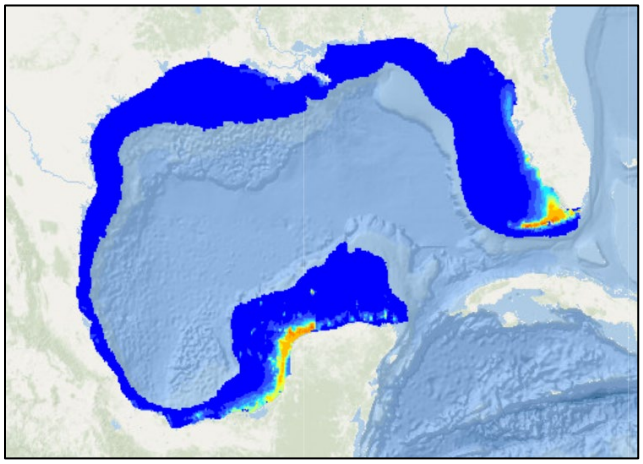


Figure 29. Density map of relative green turtle abundance in the Gulf in January (Rappucci et al. 2023)

6.2.6.2 Life History Information

Green sea turtles reproduce sexually, and mating occurs in the waters off nesting beaches. 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 two to four years while males are known to reproduce every year (Balazs 1983). In the southeastern United States, females generally nest between June and September, and peak nesting occurs in June and July (Witherington and Ehrhart 1989). During the nesting season, females nest at approximately two-week intervals, laying an average of three to four clutches (Johnson and Ehrhart 1996). Clutch size often varies among subpopulations, but mean clutch size is approximately 110 to 115 eggs. In Florida, green sea turtle nests contain an average of 136 eggs (Witherington and Ehrhart 1989). Eggs incubate for approximately two months before hatching. Hatchling green sea turtles are approximately two in (five cm) in length and weigh approximately 0.9 ounces (oz; 25 g). Survivorship at any particular nesting site is greatly influenced by the level of anthropogenic 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. his early oceanic phase remains one of the most poorly understood aspects of green sea turtle life history (NMFS and USFWS 2007b). Green sea turtles exhibit particularly slow growth rates of about 0.4 to 2 in (1-5 cm) per year (Green 1993; McDonald-Dutton and Dutton 1998), which may be attributed to their largely herbivorous, low-net energy diet (Bjorndal 1982). At approximately eight to 10 in (20 to 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 five to six 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 to 50 years to reach sexual maturity (Chaloupka and Musick 1997; Hirth and USFWS 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 (Hart et al. 2013; 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 reside in nearshore foraging areas throughout the Florida Keys and in the waters southwest of Cape Sable, with some post-nesting turtles also residing in Bahamian waters as well (Hart et al. 2013; NMFS and USFWS 2007b).

Howell and Shaver (2021) conducted a gut content analysis of the dietary composition of all size ranges of green turtles stranded on the Texas coast. Green turtles consumed 73 unique species,

comprised of five seagrasses, 33 red algae, 12 green algae, eight brown algae, and 15 animals. Food items were classified into six major diet groups based on an overall frequency of occurrence greater than 25%: seagrasses, animal matter, anthropogenic debris, red, green, and brown macroalgae. Previous diet studies in Texas showed seagrass was not present in turtles less than 20 cm maximum straight carapace length (SCLmax; (Howell 2012; Howell et al. 2016); however, in this study, seagrass was found in the diet of turtles with an SCLmx greater than 16.2 cm to 20 cm (frequency of occurrence = 20.0%). Thus, demonstrating recruitment of individuals less than 20 cm SCLmax to Texas' nearshore waters. The authors recommend that juvenile green turtles foraging in Texas be described as omnivores. Seagrass collectively dominated the diet of turtles greater than 30 cm SCLmax.

In a study by Roche et al. (2021), isotope samples were collected from 151 green sea turtles in the Dry Tortugas from May to August from 2008 to 2015. A pattern was found with stable carbon isotope values indicative of an ontogenetic change from an omnivorous diet in smaller turtles to a seagrass-based diet in larger turtles. Specifically, turtles with a carapace length greater than 65 cm had similar stable carbon isotope values to the seagrass species present in the area.

6.2.6.3 Status and Population Dynamics

Worldwide, nesting data at 464 sites indicate that 563,826 to 564,464 females nest each year (Seminoff et al. 2015). Compared to other DPSs, the North Atlantic DPS exhibits the highest nester abundance, with approximately 167,424 females at 73 nesting sites (Figure 30 and Figure 31), and available data indicate an increasing trend in nesting. The largest nesting site in the North Atlantic DPS is in Tortuguero, Costa Rica, which hosts 79% of nesting females for the DPS (Seminoff et al. 2015).

For the North Atlantic DPS, the available data indicate an increasing trend in nesting. There are no reliable estimates of population growth rate for the DPS as a whole, but estimates have been developed at a localized level. Modeling by Chaloupka et al. (2008) using data sets of 25 years or more show the Florida nesting stock at the Archie Carr National Wildlife Refuge growing at an annual rate of 13.9%, and the Tortuguero, Costa Rica, population growing at 4.9%.

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

The green turtle has a circumglobal distribution, occurring throughout nearshore tropical, subtropical and, to a lesser extent, temperate waters. Green turtles from the North Atlantic DPS originate from the boundary of South and Central America (7.5°N, 77°W) in the south, throughout the Caribbean, the Gulf, and the U.S. Atlantic coast to New Brunswick, Canada (48°N, 77°W) in the north. The range of the DPS then extends due east along latitudes 48°N and

19°N to the western coasts of Europe and Africa. Nesting occurs primarily in Costa Rica, Mexico, Florida and Cuba.

In the continental United States, green sea turtle nesting occurs along the Atlantic coast, primarily along the central and southeast coast of Florida where an estimated 200-1,100 females nest each year (Meylan et al. 1994; Weishampel et al. 2003). Occasional nesting has also been documented along the Gulf Coast of Florida (Meylan et al. 1995); in Texas, Georgia, South Carolina, and North Carolina (www.seaturtle.org accessed on March 20, 2025).

The number of green turtle nests in the southern Gulf has increased in most of their known nesting sites since 1990. However, no significant temporal trend in annual female size, clutch size, hatching, and emergence success has been observed (Lopez-Castro et al. 2022). 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 ten years of regular monitoring (Figure 30). According to data collected from Florida's index nesting beach survey from 1989 to 2016, green sea turtle nest counts across Florida have increased approximately 150-fold from a low of 267 in the early 1990s to a high of just under 41,000 in 2019. The 2021 nest count did not set another record and was only slightly higher than the 2020 nest count, an unusually high "low year."

Historically, there have been few green sea turtle nests in Texas relative to other nesting beaches in the Gulf. However, the number of nests found at South Padre Island National Seashore has increased since 2011 (Figure 31). In 2017, 28 nests were found at the Seashore, while in 2020, 35 nests were found. Most nesting activity occurred on federally protected land and were shown to have higher success rates than nests not located on federally protected lands (NPS 2023).

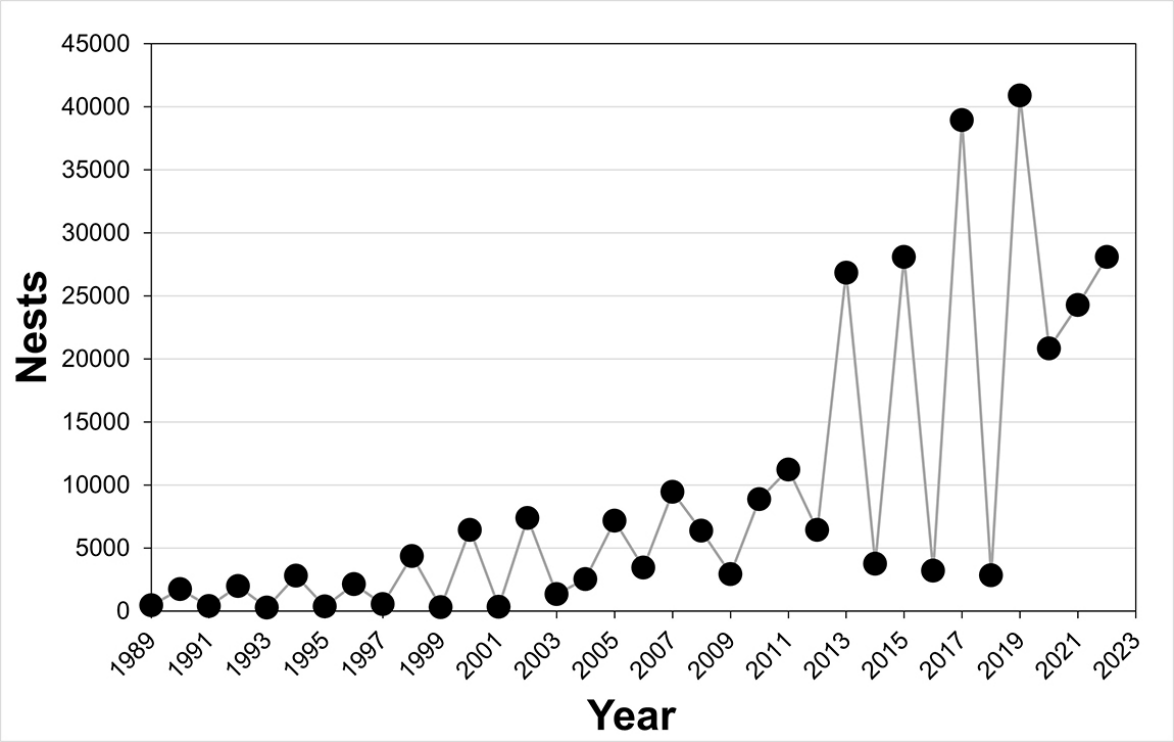


Figure 30. Green sea turtle nesting at Florida index beaches since 1989. (Figure from https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/, Accessed June 16, 2023)

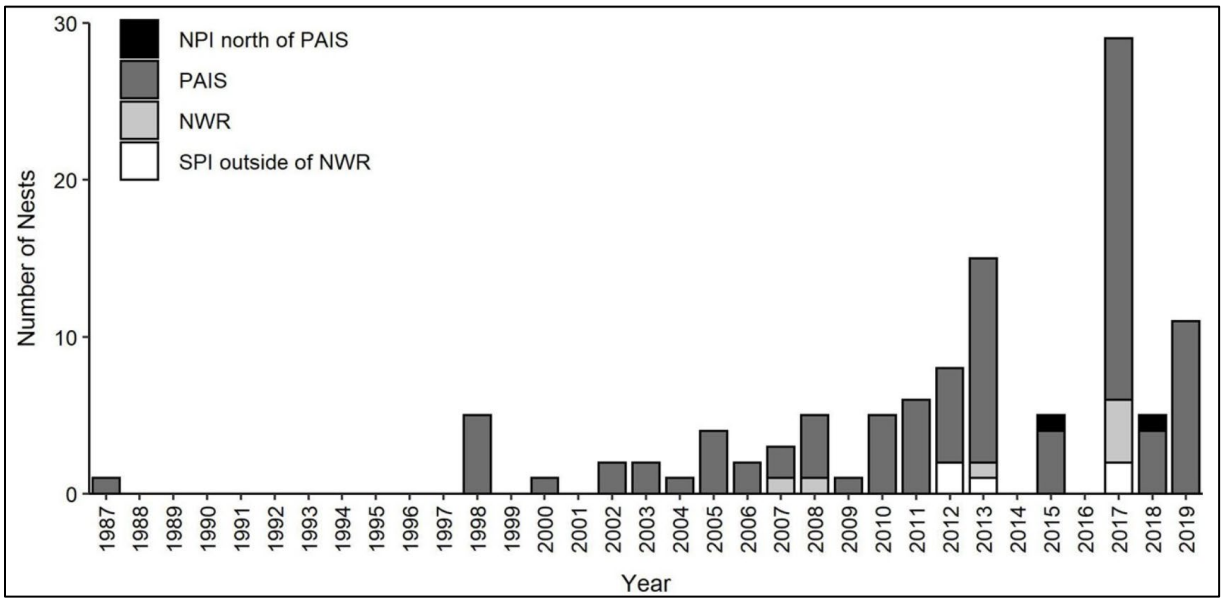


Figure 31. Green sea turtle nesting at Texas beaches from 1987 to 2019. NPI: North Padre Island outside of PAIS, PAIS: Padre Island National Seashore, NWR: Laguna Atascosa and Lower Rio Grande National Wildlife Refuges, SPI: South Padre Island outside of a National Wildlife Refuge

6.2.6.4 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. While the threats of pollution, habitat loss through coastal development or stabilization, destruction of nesting habitat from storm events, beachfront lighting, poaching, changing global environmental conditions, fisheries interactions, natural predation, disease, and fisheries bycatch continue, the green turtle appears to be somewhat resilient to future perturbations. We discussed some of these in section 5 as relevant to all sea turtle species, and will discuss the species-specific threats below.

In addition to anthropogenic 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; Jones et al. 2015). Presently, 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 and 50°F (8 and 10°C) turtles may lose their ability to swim and dive, often floating to the surface. The rate of cooling that precipitates cold-stunning appears to be the primary threat, rather than the water temperature itself (Milton and Lutz 2003). Sea turtles that overwinter in inshore waters are most susceptible to cold-stunning because temperature changes are most rapid in shallow water (Witherington and Ehrhart 1989). During January 2010, an unusually large cold-stunning event in the southeastern United States resulted in around 4,600 sea turtles, mostly greens, found cold-stunned, with hundreds found dead or dying (Avens et al. 2012). Several large cold-stunning events occurred in the western Gulf of America in early 2010, early 2011, late 2013 to early 2014, and late 2014 to early 2015 resulting in 464, 1,683, 1,300, and nearly 700 green sea turtles found cold-stunned in Texas, respectively. Some were found dead or died after stranding, while approximately two-thirds were rehabilitated and released (Shaver et al. 2015).

Whereas oil spill impacts are discussed generally for all species, 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) (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 America, they have a widespread distribution throughout the entire Gulf, Caribbean, and Atlantic, and the proportion of the population using the northern Gulf of America at any given time is relatively low. Although it is known that adverse impacts occurred and numbers of animals in the Gulf of America were reduced as a result of the 2010 DWH oil spill, 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 America 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 (Trustees 2016).

A study by Choi et al. (2021) evaluated plastic ingestion by incidentally captured or stranded green turtles over 33 years (1987 to 2002) along the coast of Texas. Debris ingestion was recorded for 238 out of 464 turtles (48.7%). The most common plastic category was sheets (37.8%), followed by fragments (27.1%) and threads (22.9%). By mass, fragments were the most common (40.2%), followed by sheets (26.1%). By color, clear and white items were most common. Pelagic-stage turtles (i.e., juveniles and post-hatchlings) ingested plastic most frequently. Choi et al. (2021) concluded that the plastic ingestion did not relate to mortality and that the rates of ingestion off Texas are lower than globally noted. Thus, there is a low overall severity of plastic ingestion by green turtles off Texas compared to other regions. Indirect effects, such as dietary dilution or chemical absorption, may be of greater conservation concern.

Perrault et al. (2021) performed a study assessing the effects of FP, a herpesvirus, on green sea turtles that results in skin lesions, benign tumors, and reduced immune function. Results suggest that green turtles can produce sufficient immune responses following tumor development, at least until FP becomes severe. Immunosuppression was found to occur after the onset of FP.

6.2.7 Proposed Critical Habitat Green Sea Turtle

NMFS proposed to designate critical habitat for six DPSs of green sea turtle, including the North Atlantic DPS, on July 19, 2023. Proposed critical habitat for the Northwest Atlantic DPS of green turtle includes waters ranging from the mean water line to 20 m depth and *Sargassum* habitat in the Gulf and the Atlantic Ocean (Figure 32).

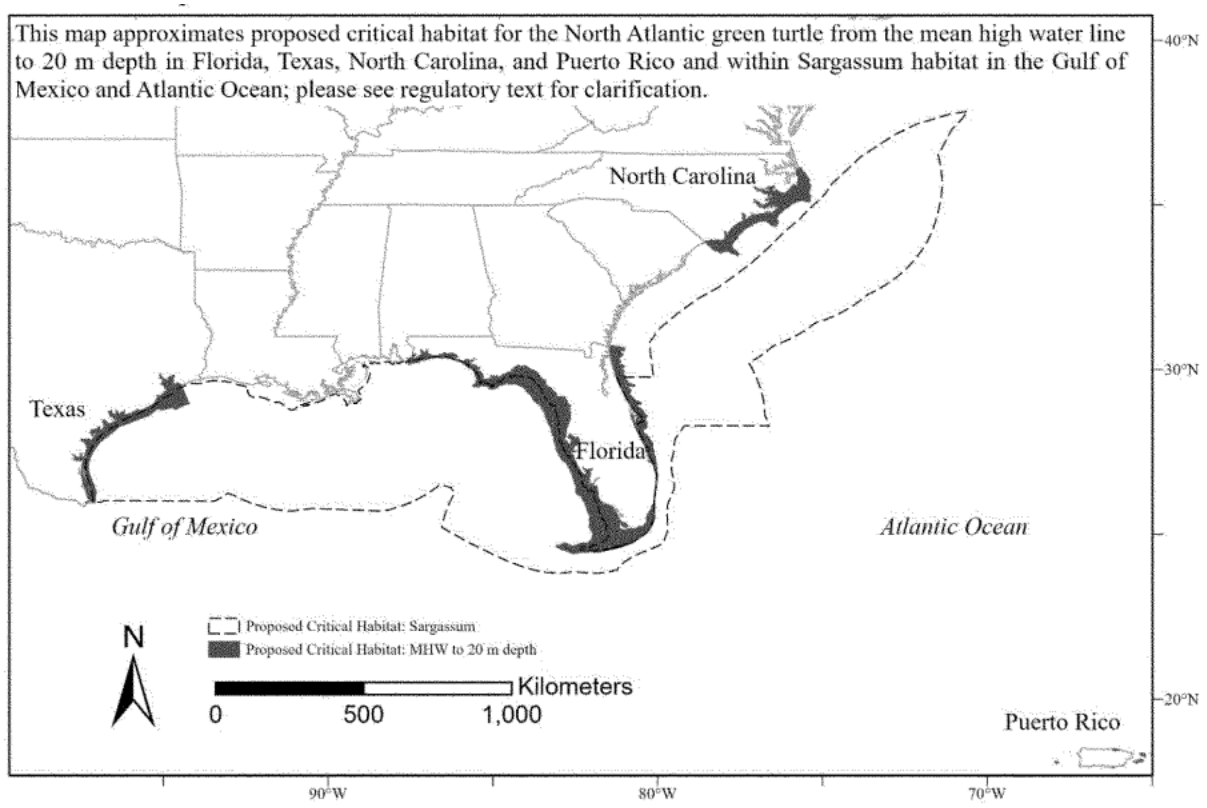


Figure 32. Area of proposed critical habitat for the North Atlantic DPS of green sea turtle

Essential Features of Critical Habitat

Essential features are the PBFs of the habitat that are essential for the conservation of the species. The Proposed Green Turtle Critical Habitat Rule identifies these features as:

1. sufficiently dark and unobstructed nearshore waters adjacent to nesting beaches proposed as critical habitat by USFWS, to allow for the transit, mating, and internesting of reproductive individuals and the transit of post-hatchlings from the high water line to 20 m depth;
2. sufficiently unobstructed corridors that allow for unrestricted transit of reproductive individuals between benthic foraging/resting areas and reproductive areas;
3. underwater refugia and food resources (i.e., seagrasses, macroalgae, and/or invertebrates) of sufficient condition, distribution, diversity, abundance, and density necessary to support survival, development, growth, and/or reproduction; and

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

6.2.8 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).

6.2.8.1 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 12 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 America basin, though they also occur in coastal and offshore waters of the U.S. Atlantic Ocean and occasionally in the Mediterranean Sea which may be due to migration expansion or increased hatchling production (Tomas and Raga 2008). 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. Nesting occurs mainly on beaches in the Gulf of America in large aggregations called arribadas[14]. Kemp's ridley sea turtles have also 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

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

nest was recorded in Virginia. The Kemp's ridley nesting population was exponentially increasing (NMFS et al. 2011a), however since 2009 there has been concern over the slowing of recovery (Gallaway et al. 2016a; Gallaway et al. 2016b; Plotkin 2016).

Gredzens and Shaver (2020) tracked post-nesting Kemp's ridley sea turtles from beaches in Texas and Mexico. The study evaluated the proportion of nesting females from each nesting beach, and using these proportions estimated that up to 82% of adult female Kemp's ridley sea turtles may use the northern GOA, particularly waters shoreward of the 100-m isobath, as their primary foraging area post-nesting. Uribe-Martinez et al. (2021) identified the first known instance of a migration of a Kemp's ridley across the Gulf of America through oceanic waters.

Updated spatial density models based on line-transect and aerial surveys conducted in U.S. waters of the Gulf of America during the GoMMAPPS project show highest Kemp's ridley turtle densities occurring along the northern Gulf in February (Figure 33) and lower densities during the months of May and October (Figure 34 (Rappucci et al. 2023).

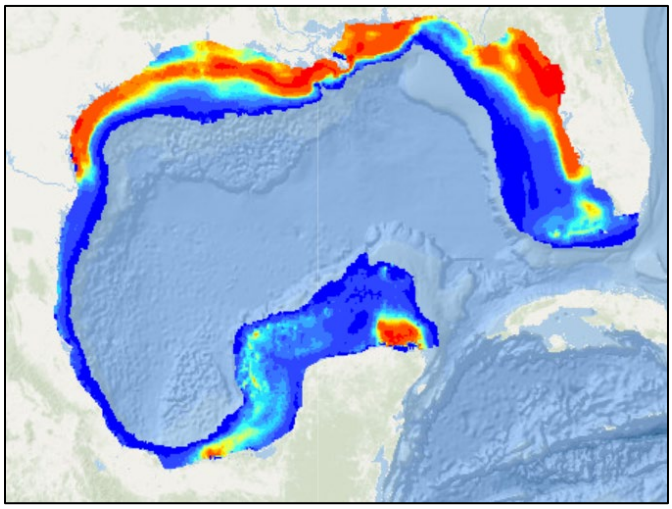


Figure 33. Density map of relative Kemp's ridley turtle abundance in the Gulf in February (Rappucci et al. 2023)

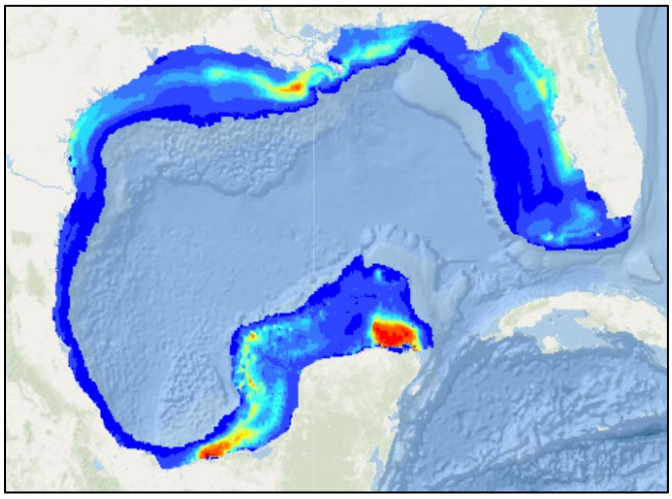


Figure 34. Density map of relative Kemp's ridley turtle abundance in the Gulf in May (Rappucci et al. 2023)

A study by Garrison et al. (2020a) found that dive-surface behaviors for Kemp's ridley turtles in the northern Gulf of America indicated important seasonal, diurnal, and spatial effects on the time available at the surface. There was a significant interaction between season and day, indicating that the diurnal effects were different among the different seasons. Most notably, during the winter and spring, Kemp's ridleys spent a larger amount of time near the surface during daylight hours compared to night hours. During the summer, the time at surface was the same for both day and night and was not significantly different during the fall.

6.2.8.2 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 to 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 to 1.89 in (42 to 48 mm) straight carapace length, 1.26 to 1.73 in (32 to 44 mm) in width, and 0.3 0.4 lb (15 to 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 one to four years or perhaps more (TEWG 2000). Juvenile Kemp's ridley sea turtles use these nearshore coastal habitats from April through November, but move towards more suitable overwintering habitat in deeper offshore waters (or more southern waters along the Atlantic coast) as water temperature drops.

The average rates of growth may vary by location, but generally fall within 2.2 to 2.9 ± 2.4 in per year (5.5 to 7.5 ± 6.2 cm per year (Schmid and Barichivich 2006; Schmid and Woodhead 2000). Age to sexual maturity ranges greatly from five to 16 years, though NMFS et al. (2011a) determined the best estimate of age to maturity for Kemp's ridley sea turtles was 12 years. It is unlikely that most adults grow very much after maturity. While some sea turtles nest annually, the weighted mean remigration rate for Kemp's ridley sea turtles is approximately two years.

Nesting generally occurs from April to July and females lay approximately 2.5 nests per season with each nest containing approximately 100 eggs (Márquez M. 1994).

Stable isotope analysis by Weber et al. (2023) indicated that niche partitioning may occur between size classes of green turtles. Epidermal tissues from larger green turtles captured off the west coast of Florida had higher stable carbon ratios and lower stable nitrogen ratios than smaller green turtles. In addition, larger green turtles exhibited a wider range of carbon and nitrogen isotope ratios. The results indicated that green turtles may prefer to feed on different prey items and/or feed in different habitats based on size class.

6.2.8.3 Status and 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 21st century (Figure 35), 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. Nesting at Rancho Nuevo accounts for just over 81% of all recorded Kemp's ridley nests in Mexico. Following a significant, unexplained one-year decline in 2010, Kemp's ridley nests in Mexico reached a record high of 21,797 in 2012 (NPS 2013). In 2013, there was a second significant decline, with 16,385 nests recorded. In 2014, there were an estimated 10,987 nests and 519,000 hatchlings released from three primary nesting beaches in Mexico (NMFS 2015b).

Recent data, however, indicate an increase in nesting. In 2015, there were 14,006 recorded nests, and in 2016 overall numbers increased to 18,354 recorded nests (Peña 2018). There was a record high nesting season in 2017, with 24,570 nests recorded(Peña 2017). Nesting for 2018 declined to 17,945, with another steep drop to 11,090 nests in 2019, but rebounded in 2020 (18,068 nests), 2021 (17,671 nests), and 2022 (17,418) (Figure 34; (CONANP 2022). At this time, it is unclear whether the increases and declines in nesting seen over the past decade-and-a-half represents a population oscillating around an equilibrium point, if the recent three years (2020-2022) of relatively steady nesting indicates that equilibrium point, or if nesting will decline or increase in the future. At this point, we can only conclude that the population has dramatically rebounded from the lows seen in the 80's and 90's, but we cannot ascertain a current population trend or trajectory at this time.

A small nesting population is also emerging in the United States, primarily in Texas. The number of nests (mainly Padre Island) has increased over the past two decades, with one nest observed in 1985, four in 1995, 50 in 2005, 197 in 2009, 209 in 2012 and 119 in 2014 (NMFS 2015b). A record high of 353 nest were recorded in 2017 (National Park Service data). Nesting in Texas has somewhat paralleled the trends observed in Mexico, characterized by a significant decline in 2010, followed by a second decline in 2013-2014, but with a rebound in 2015, the record nesting in 2017, and then a drop back down to 190 nests in 2019, rebounding to 262 nests in 2020, back to 195 nests in 2021, and then rebounding to 284 nests in 2022 (NPS 2025). Figure 36 shows a trajectory for the animals that nest in Mexico similar to those that nest in Texas.

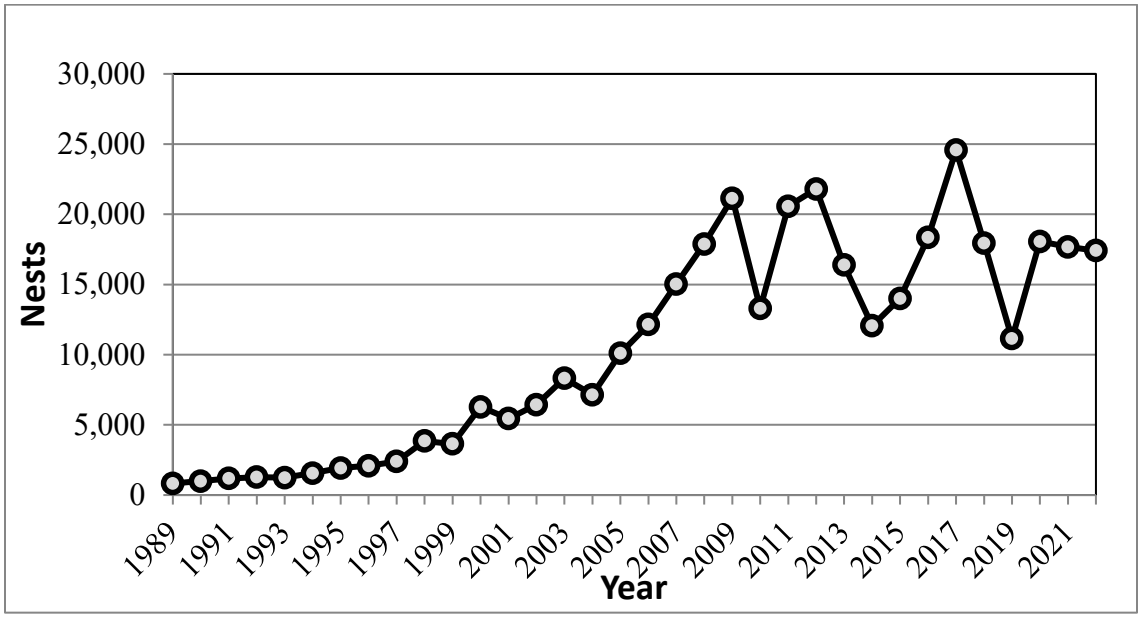
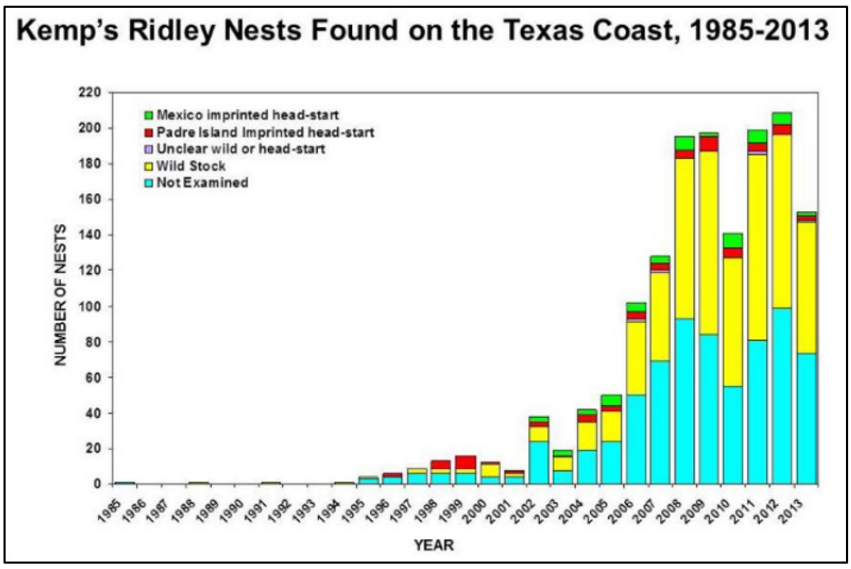


Figure 35. Kemp's ridley nest totals from Mexican beaches (Gladys Porter Zoo nesting database 2019 and CONANP data 2020-2022)



Year	Kemp's ridley (Lepidochelys kempii)
2014	72
2015	101
2016	89
2017	219
2018	123
2019	110
2020	135
2021	111
2022	132
2023	137

Figure 36. Number of Kemp's ridley nests on Texas versus Mexico beaches (Left panel; NPS 2013). Right panel from https://www.nps.gov/pais/learn/nature/nesting-season.htm accessed March 12, 2025

Heppell et al. (2005) predicted in a population model that the population is expected to increase at least 12 to 16% per year and that the population could attain at least 10,000 females nesting on Mexico beaches by 2015. NMFS et al. (2011a) produced an updated model that predicted the population to increase 19% per year and attain at least 10,000 females nesting on Mexico beaches by 2011. Approximately 25,000 nests would be needed for an estimate of 10,000 nesters on the beach, based on an average 2.5 nests/nesting female. While counts did not reach 25,000 nests by 2012, it is clear that the population is steadily increasing. The recent increases in Kemp's ridley sea turtle nesting seen in the last two decades is likely due to a combination of management measures including elimination of direct harvest, nest protection, the use of turtle exclusion devices, reduced trawling effort in Mexico and the United States, and possibly other changes in vital rates (TEWG 1998; TEWG 2000). The species limited range as well as low global abundance makes it particularly vulnerable to new sources of mortality as well as demographic and environmental randomness, all of which are often difficult to predict with any certainty.

Genetic variability in Kemp's ridley turtles is considered high, as measured by heterozygosis at microsatellite loci (NMFS 2011a). Additional analysis of the mitochondrial DNA 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).

6.2.8.4 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,

changing global environmental conditions, fisheries interactions, natural predation, and disease. Of the five sea turtle species in the Gulf of America, Kemp's ridley sea turtles are the most vulnerable to threats, especially threats that cause population-level impacts such as the DWH oil spill and response, due to their already low numbers and location of nesting habitat. We discussed some of these threats in section 5 as relevant to all sea turtle species. The remainder of this section will expand on a few of the aforementioned threats and how they may specifically affect Kemp's ridley sea turtles.

NMFS has documented (via the Sea Turtle Stranding and Salvage Network data, http://www.sefsc.noaa.gov/species/turtles/strandings.htm) elevated sea turtle stranding in the Northern Gulf of America. In the first three weeks of June 2010, over 120 sea turtle strandings were reported from Mississippi and Alabama waters, none of which exhibited any signs of external oiling to indicate effects associated with the DWH oil spill event. A total of 644 sea turtle strandings were reported in 2010 from Louisiana, Mississippi, and Alabama waters, 561 (87 %) of which were Kemp's ridley sea turtles. During March through May of 2011, 267 sea turtle strandings were reported from Mississippi and Alabama waters alone. A total of 525 sea turtle strandings were reported in 2011 from Louisiana, Mississippi, and Alabama waters, with the majority (455) occurring from March through July, 390 (86 %) of which were Kemp's ridley sea turtles. During 2012, a total of 428 sea turtles were reported from Louisiana, Mississippi, and Alabama waters, though the data are incomplete. Of these reported strandings, 301 (70 %) were Kemp's ridley sea turtles. These stranding numbers are significantly greater than reported in past years; Louisiana, Mississippi, and Alabama waters reported 42 and 73 sea turtle strandings for 2008 and 2009, respectively. It should be noted that stranding coverage has increased considerably due to the DWH oil spill event.

Nonetheless, considering that strandings typically represent only a small fraction of actual mortality, these stranding events potentially represent a serious impact to the recovery and survival of the local sea turtle populations. While a definitive cause for these strandings has not been identified, necropsy results indicate a significant number of stranded turtles from these events likely perished due to forced submergence, which is commonly associated with fishery interactions (Stacy 2015). Yet, available information indicates fishery effort was extremely limited during the stranding events. It is notable that in both 2010 and 2011 approximately 85% of all Louisiana, Mississippi, and Alabama stranded sea turtles were Kemp's ridleys; however, this could simply be a function of the species' preference for shallow, inshore waters coupled with increased population abundance as reflected in recent Kemp's ridley nesting increases.

In response to these strandings, and due to speculation that fishery interactions may be the cause, fishery observer effort was shifted to evaluate the inshore skimmer trawl fishery during the summer of 2012. During May-July of that year, observers reported 24 sea turtle interactions in the skimmer trawl fishery, all but one of which were identified as Kemp's ridley (one sea turtle was an unidentified hardshell turtle). Encountered sea turtles were all very small, juvenile specimens ranging from 7.6 to 19.0 in (19.4 to 48.3 cm) curved carapace length (Harms et al.),

and all sea turtles were released alive. The small average size of encountered Kemp's ridley introduces a potential conservation issue, as over 50% of these reported sea turtles could potentially pass through the maximum four-inch bar spacing of TEDs currently required in the shrimp fishery. Due to this issue, a proposed 2012 rule to require TEDs in the skimmer trawl fishery (77 FR 27411) was not implemented. Given the nesting trends and habitat utilization of Kemp's ridley sea turtles, it is likely that fishery interactions in the Northern Gulf of America 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 8.8 specific impacts of the DWH oil spill event on Kemp's ridley sea turtles are considered here. Kemp's ridley sea turtles 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 ridley sea turtles for several reasons. All Kemp's ridley sea turtles in the Gulf belong to the same population (NMFS et al. 2011a), so total population abundance could be calculated based on numbers of hatchlings because all individuals that enter the population could reasonably be expected to inhabit the northern Gulf of America throughout their lives (Trustees 2016).

A total of 217,000 small juvenile Kemp's ridley (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 ridley 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 ridley 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 (greater than three 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 three percent 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 (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 effects 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.

6.2.9 Hawksbill Sea Turtle

The hawksbill sea turtle was listed as endangered throughout its entire range on June 2, 1970 under the Endangered Species Conservation Act of 1969, a precursor to the ESA. Critical habitat was designated on June 2, 1998, in coastal waters surrounding Mona and Monito Islands in Puerto Rico.

6.2.9.1 Species Description and Distribution

Hawksbill sea turtles are small to medium-sized (99 to 150 lb on average [45 to 68 kg]) although females nesting in the Caribbean are known to weigh up to 176 lb (80 kg) (Pritchard et al. 1983). The carapace is usually serrated and has a "tortoise-shell" coloring, ranging from dark to golden brown, with streaks of orange, red, and/or black. The plastron of a hawksbill turtle is typically yellow. The head is elongated and tapers to a point, with a beak-like mouth that gives the species its name. The shape of the mouth allows the hawksbill turtle to reach into holes and crevices of coral reefs to find sponges, their primary adult food source, and other invertebrates. The shells of hatchlings are 1.7 in (42 mm) long, are mostly brown, and somewhat heart-shaped (Eckert 1995; Hillis and Mackay 1989; Van Dam and Sarti 1989).

Hawksbill sea turtles have a circumtropical distribution and usually occur between latitudes 30°N and 30°S in the Atlantic, Pacific, and Indian Oceans. In the western Atlantic, hawksbills are widely distributed throughout the Caribbean Sea, off the coasts of Florida and Texas in the continental United States, in the Greater and Lesser Antilles, and along the mainland of Central America south to Brazil (Amos 1989; Groombridge and Luxmoore 1989; Lund 1985; Meylan and Donnelly 1999; NMFS and USFWS 1998a; Plotkin and Amos 1988; Plotkin and Amos 1990). They are highly migratory and use a wide range of habitats during their lifetimes (Musick and Limpus 1997; Plotkin 2003). Adult hawksbill sea turtles are capable of migrating long distances between nesting beaches and foraging areas. For instance, a female hawksbill sea turtle tagged at Buck Island Reef National Monument (BIRNM) was later identified 1,160 m (1,866 km) away in the Miskito Cays in Nicaragua (Spotila 2004).

Hawksbill sea turtles nest on sandy beaches throughout the tropics and subtropics (Figure 37). Nesting occurs in at least 70 countries, although much of it now only occurs at low densities compared to that of other sea turtle species (NMFS and USFWS 2007b). Surveys at eighty-eight nesting sites worldwide indicate that 22,004 to 29,035 females nest annually (NMFS and USFWS 2013a). Nesting sites in the Atlantic and Caribbean have an estimated total number of nesting females annually across 33 sites at 4,867 (i.e., midpoint of range from 3,626 to 6,108) (NMFS and USFWS 2013a). Meylan and Donnelly (1999) believe that the widely dispersed

nesting areas and low nest densities is likely a result of overexploitation of previously large colonies that have since been depleted over time. The most significant nesting within the United States occurs in Puerto Rico and the U.S. Virgin Islands, specifically on Mona Island and BIRNM, respectively. Although nesting within the continental United States is typically rare, it can occur along the southeast coast of Florida and the Florida Keys. The largest hawksbill nesting population in the western Atlantic occurs in the Yucatán Peninsula of Mexico, where several thousand nests are recorded annually in the states of Campeche, Yucatán, and Quintana Roo (Garduño-Andrade et al. 1999; Spotila 2004). Hawksbill nesting has also been documented in American Samoa and Guam. More information on nesting in other ocean basins may be found in the five-year status review for the species (NMFS and USFWS 2013a).

Mitochondrial DNA studies show that reproductive populations are effectively isolated over ecological time scales (Bass et al. 1996). Substantial efforts have been made to determine the nesting population origins of hawksbill sea turtles assembled in foraging grounds, and genetic research has shown that hawksbills of multiple nesting origins commonly mix in foraging areas (Bowen and Witzell 1996). Since hawksbill sea turtles nest primarily on the beaches where they were born, if a nesting population is decimated, it might not be replenished by sea turtles from other nesting rookeries (Bass et al. 1996).

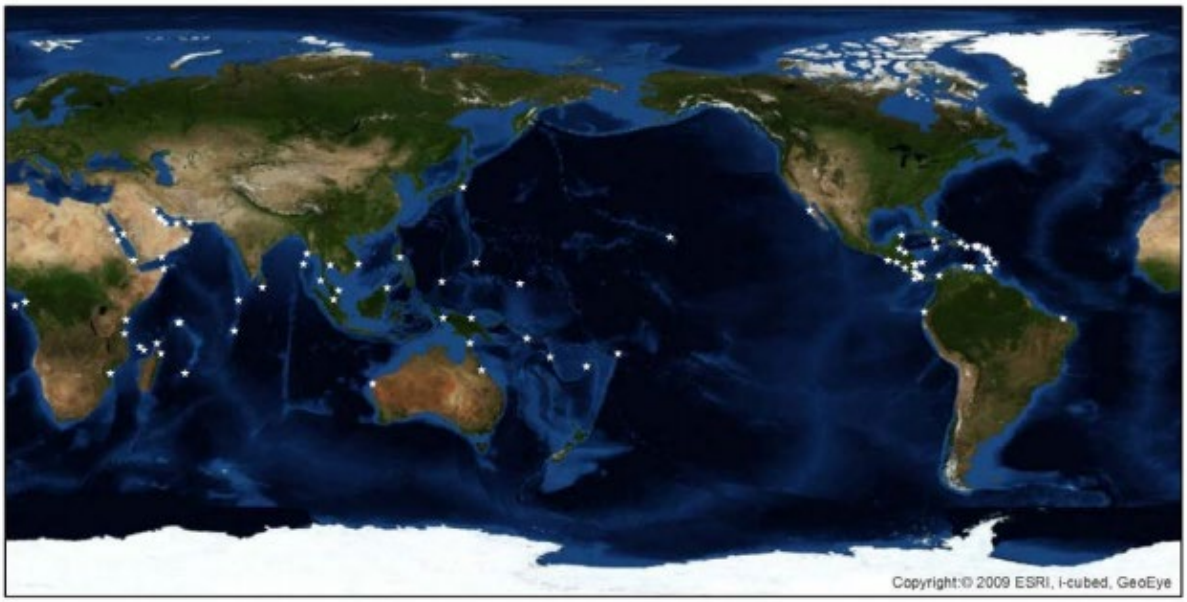


Figure 37. Hawksbill Sea Turtle Global Nesting Distribution. Figure from (NMFS and USFWS 2013a)

6.2.9.2 Life History Information

Hawksbill sea turtles exhibit slow growth rates although they are known to vary within and among populations from a low of 0.4 to 1.2 in (1-3 cm) per year, measured in the Indo-Pacific (Chaloupka and Limpus 1997; Mortimer et al. 2003; Mortimer et al. 2002; Whiting 2000), to a high of two in (5 cm) or more per year, measured at some sites in the Caribbean (Díez and Dam 2002; León and Díez 1999). Differences in growth rates are likely due to differences in diet

and/or density of sea turtles at foraging sites and overall time spent foraging (Bjorndal and Bolten 2000; Chaloupka et al. 2004). Consistent with slow growth, age to maturity for the species is also long, taking between 20 and 40 years, depending on the region (Chaloupka and Musick 1997; Limpus and Miller 2000). Hawksbills in the western Atlantic are known to mature faster (i.e., 20 or more years) than sea turtles found in the Indo-Pacific (i.e., 30 to 40 years) (Boulan 1983; Boulon 1994; Díez and Dam 2002; Limpus and Miller 2000). Males are typically mature when their length reaches 27 inches (69 centimeters), while females are typically mature at 30 in (75 cm) (Eckert et al. 1992; Limpus 1992).

Female hawksbills return to the beaches where they were born (natal beaches) every two to three years to nest (van Dam et al. 1991; Witzell 1983) and generally lay three to five nests per season (Richardson et al. 1999a). Compared with other sea turtles, the number of eggs per nest (clutch) for hawksbills can be quite high. The largest clutches recorded for any sea turtle belong to hawksbills [approximately 250 eggs per nest, (Hirth and Abdel Latif 1980)], though nests in the U.S. Caribbean and Florida more typically contain approximately 140 eggs (NMFS and USFWS 1993). Eggs incubate for approximately 60 days before hatching (Federation 2025). Hatchling hawksbill sea turtles typically measure one to two in (2.5 to 5 cm) in length and weigh approximately 0.5 oz (15 g).

Hawksbills may undertake developmental migrations (migrations as immatures) and reproductive migrations that involve travel over many tens to thousands of miles (Meylan 1999a). Post-hatchlings (oceanic stage juveniles) are believed to live in the open ocean, taking shelter in floating algal mats and drift lines in the Atlantic and Pacific oceans (Musick and Limpus 1997) before returning to more coastal foraging grounds. In the Caribbean, hawksbills are known to almost exclusively feed on sponges (Meylan 1988; van Dam and Díez 1997), although at times they have been seen foraging on other food items, notably corallimorphs and zooanthids (León and Díez 2000; Mayor et al. 1998; van Dam and Díez 1997).

Reproductive females undertake periodic (usually non-annual) migrations to their natal beaches to nest and exhibit a high degree of fidelity to their nest sites. Movements of reproductive males are less certain, but are presumed to involve migrations to nesting beaches or to courtship stations along the migratory corridor. Hawksbills show a high fidelity to their foraging areas as well (van Dam and Díez 1998). Foraging sites are typically areas associated with coral reefs, although hawksbills are also found around rocky outcrops and high energy shoals that are optimum sites for sponge growth. They can also inhabit seagrass pastures in mangrove-fringed bays and estuaries, particularly along the eastern shore of continents where coral reefs are absent (Bjorndal 1997; van Dam and Díez 1998).

Avens et al. (2021) conducted skeletochronological analysis for hawksbills stranded along U.S. coastlines to generate straightline carapace length (SCL)-at-age and somatic growth data. Juveniles transitioned from oceanic to neritic habitat at 1 to 3 years old and mean SCLs of 23 to 24 cm (range 15.7 to 35.0 cm). Initial ages at maturation for this population at minimum nesting

female SCLs were estimated at 15 to 25 years. Somatic growth varied significantly relative to size, age, and stranding location, while no association with sex or calendar year was observed.

6.2.9.3 Status and Population Dynamics

There are currently no reliable estimates of population abundance and trends for non-nesting hawksbills at the time of this consultation; therefore, nesting beach data is currently the primary information source for evaluating trends in global abundance. In general, hawksbills are doing better in the Atlantic and Indian Ocean than in the Pacific Ocean, where despite greater overall abundance, a greater proportion of the nesting sites are declining.

From 1980 to 2003, the number of nests at three primary Mexico nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) increased 15% annually (Heppell et al. 2005); however, due to recent declines in nest counts, decreased survival at other life stages, and updated population modeling, this rate is not expected to continue (NMFS and USFWS 2013a).

In the United States, hawksbills typically laid about 500 to 1,000 nests on Mona Island, Puerto Rico in the past (Diez and van Dam 2007), but after declining, the numbers appear to be increasing in Puerto Rico (NMFS and USFWS 2013a) and Buck Island US Virgin Islands confirmed 86 nests in 2014 (Pollock 2015). Another 56 to 150 nests are typically laid on Buck Island off St. Croix (Meylan 1999b; Mortimer and Donnelly 2008). Nesting also occurs to a lesser extent on beaches on Culebra Island and Vieques Island in Puerto Rico, the mainland of Puerto Rico, and additional beaches on St. Croix, St. John, and St. Thomas, U.S. Virgin Islands.

With respect to regional trends, nesting populations in the Atlantic (especially in the Insular Caribbean and Western Caribbean Mainland) are generally doing better than those in the Indo-Pacific regions. For instance, nine of the ten sites that showed recent increases are located in the Caribbean. Buck Island and St. Croix's East End beaches support two remnant populations of between 17 to 30 nesting females per season (Hillis and Mackay 1989; Mackay 2006). The BIRNM had 86 confirmed hawksbill nests in 2014 (Pollock 2015). While the proportion of hawksbills nesting on Buck Island represents a small proportion of the total hawksbill nesting occurring in the greater Caribbean region, Mortimer and Donnelly (2008) report an increasing trend in nesting at that site based on data collected from 2001 to 2006. The conservation measures implemented when BIRNM was expanded in 2001 most likely explains this increase.

The number of hawksbill turtle nests in the southern Gulf has increased in most of their known nesting sites since 1990. However, no significant temporal trend in annual female size, clutch size, hatching, and emergence success has been observed (Lopez-Castro et al. 2022).

There are no recent abundance estimates for this sparsely distributed species and because their habitats are so specific, we believe the effects to this species from most of the stressors caused by activities under the program will be extremely low, and therefore discountable. We are including this species in this consultation because of the risk of adverse impacts from vessel strike and oil spills.

6.2.9.4 Threats

Hawksbills are currently subjected to the same suite of threats on both nesting beaches and in the marine environment that affect other sea turtles (e.g., interaction with federal and state fisheries, coastal construction, oil spills, changing environmental conditions affecting sex ratios). We discussed some of these in section 5as relevant to all sea turtle species. There are also specific threats that are of special emphasis, or are unique, for hawksbill sea turtles discussed in further detail below.

The historical decline of the species is primarily attributed to centuries of exploitation for the beautifully patterned shell, which made it a highly attractive species to target (Parsons 1972). The fact that reproductive females exhibit a high fidelity for nest sites and the tendency of hawksbills to nest at regular intervals within a season made them an easy target for capture on nesting beaches. The shells from hundreds of thousands of sea turtles in the western Caribbean region were imported into the United Kingdom and France during the nineteenth and early twentieth centuries (Parsons 1972). Additionally, hundreds of thousands of sea turtles contributed to the region's trade with Japan prior to 1993 when a zero quota was imposed (Milliken and Tokunaga 1987), as cited in Brautigram and Eckert (2006).

The continuing demand for the hawksbills' shells as well as other products derived from the species (e.g., leather, oil, perfume, and cosmetics) represents an ongoing threat to its recovery. The British Virgin Islands, Cayman Islands, Cuba, Haiti, and the Turks and Caicos Islands (United Kingdom) all permit some form of legal take of hawksbill sea turtles. In the northern Caribbean, hawksbills continue to be harvested for their shells, which are often carved into hair clips, combs, jewelry, and other trinkets (Márquez M 1990; Stapleton and Stapleton 2006). Additionally, hawksbills are harvested for their eggs and meat, while whole, stuffed sea turtles are sold as curios in the tourist trade. Hawksbill sea turtle products are openly available in the Dominican Republic and Jamaica, despite a prohibition on harvesting hawksbills and their eggs (Fleming 2001). Up to 500 hawksbills per year from two harvest sites within Cuba were legally captured each year until 2008 when the Cuban government placed a voluntary moratorium on the sea-turtle fishery (Carillo et al. 1999; Mortimer and Donnelly 2008). While current nesting trends are unknown, the number of nesting females is suspected to be declining in some areas (Carillo et al. 1999; Moncada et al. 1999). International trade in the shell of this species is prohibited between countries that have signed CITES, but illegal trade still occurs and remains an ongoing threat to hawksbill survival and recovery throughout its range.

Due to their preference to feed on sponges associated with coral reefs, hawksbill sea turtles are particularly sensitive to losses of coral reef communities. Coral reefs are vulnerable to destruction and degradation caused by human activities (e.g., nutrient pollution, sedimentation, contaminant spills, vessel groundings and anchoring, recreational uses) and are also highly sensitive to the effects of changing environmental conditions (e.g., higher incidences of disease and coral bleaching) (Crabbe 2008; Wilkinson 2004). Because continued loss of coral reef

communities (especially in the greater Caribbean region) is expected to impact hawksbill foraging, it represents a major threat to the recovery of the species.

6.2.10 Leatherback Sea Turtle

The leatherback sea turtle was listed as endangered throughout its entire range on June 2, 1970, under the Endangered Species Conservation Act of 1969.

6.2.10.1 Species Description and Distribution

The leatherback is the largest sea turtle in the world, with a CCL often exceeding 5 ft (150 cm) and front flippers that can span almost 9 ft (270 cm) (NMFS and USFWS 1998b). Mature males and females can reach lengths of over 6 ft (2 m) and weigh close to 2,000 lb (900 kg). The leatherback does not have a bony shell. Instead, its shell is approximately 1.5 ins (4 cm) thick and consists of a leathery, oil-saturated connective tissue overlaying loosely interlocking dermal bones. The ridged shell and large flippers help the leatherback during its long-distance trips in search of food.

Unlike other sea turtles, leatherbacks have several unique traits that enable them to live in cold water. For example, leatherbacks have a countercurrent circulatory system[15] (Greer et al. 1973), a thick layer of insulating fat (Davenport et al. 1990; Goff and Lien 1988), gigantothermy[16] (Paladino et al. 1990), and they can increase their body temperature through increased metabolic activity (Bostrom and Jones 2007; Southwood et al. 2005). These adaptations allow leatherbacks to be comfortable in a wide range of temperatures, which helps them to travel further than any other sea turtle species (NMFS and USFWS 1995b). For example, a leatherback may swim more than 6,000 m (10,000 km) in a single year (Benson et al. 2007a; Benson et al. 2011; Eckert 2006; Eckert et al. 2006). They search for food between latitudes 71°N and 47°S, in all oceans, and travel extensively to and from their tropical nesting beaches.

While leatherbacks will look for food in coastal waters, they appear to prefer the open ocean at all life stages (Heppell et al. 2003b). Leatherbacks have pointed tooth-like cusps and sharp-edged jaws that are adapted for a diet of soft-bodied prey such as jellyfish and salps. A leatherback's mouth and throat also have backward-pointing spines that help retain jelly-like prey. Leatherbacks' favorite prey (e.g., medusae, siphonophores, and salps) occur commonly in temperate and northern or sub-arctic latitudes and likely has a strong influence on leatherback distribution in these areas (Plotkin 1995). Leatherbacks are known to be deep divers, with recorded depths in excess of a half-mile (Eckert et al. 1989), but they may also come into

[15] Countercurrent circulation is a highly efficient means of minimizing heat loss through the skin's surface because heat is recycled. For example, a countercurrent circulation system often has an artery containing warm blood from the heart surrounded by a bundle of veins containing cool blood from the body's surface. As the warm blood flows away from the heart, it passes much of its heat to the colder blood returning to the heart via the veins. This conserves heat by recirculating it back to the body's core.

[16] "Gigantothermy" refers to a condition when an animal has relatively high volume compared to its surface area, and as a result, it loses less heat.

shallow waters to locate prey items. In the Atlantic Ocean, they are found as far north as the North Sea, Barents Sea, Newfoundland, and Labrador and as far south as Argentina and the Cape of Good Hope, South Africa (NMFS USFWS 2013). In the U.S., important nesting areas include Florida, St. Croix U.S. Virgin Islands, and Puerto Rico. Other islands of the Caribbean south to Brazil and Venezuela are also important nesting areas in the western Atlantic (NMFS USFWS 2013). Figure 38 displays subpopulation nesting areas and ranges.

Genetic analyses using microsatellite markers along with mitochondrial DNA and tagging data indicate there are seven groups or breeding populations in the Atlantic Ocean: Florida, Northern Caribbean, Western Caribbean, Southern Caribbean/Guianas, West Africa, South Africa, and Brazil (TEWG 2007). General differences in migration patterns and foraging grounds may occur between the seven nesting assemblages, although data to support this is limited in most cases.

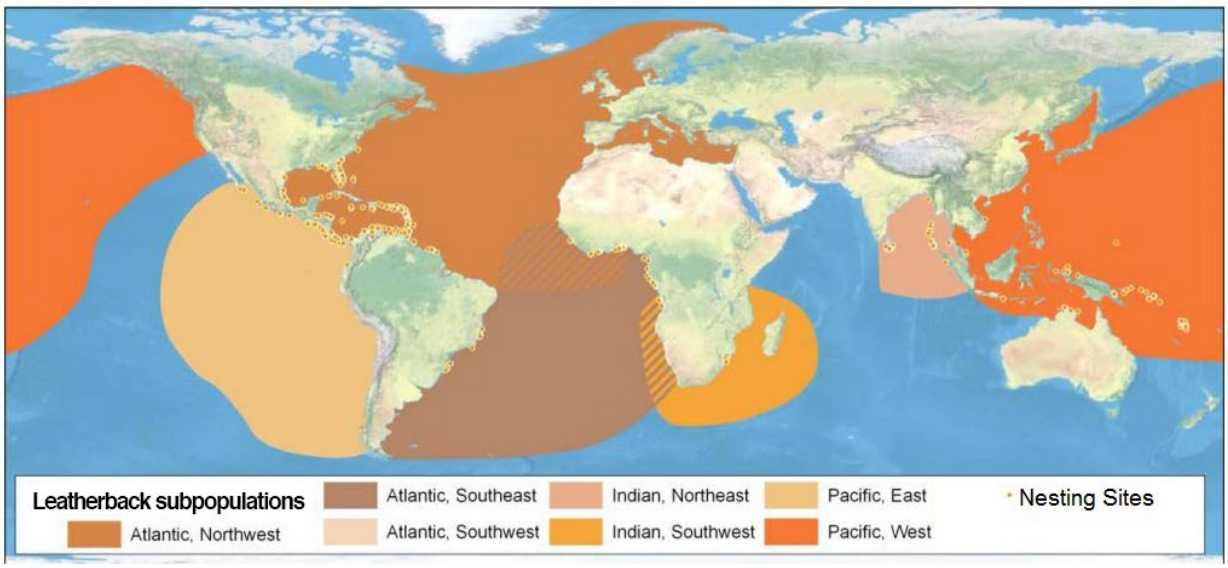


Figure 38. Map identifying the range of the endangered leatherback sea turtle. Adapted from (Wallace et al. 2010)

Evans et al. (2021) evaluated satellite telemetry spanning 15 years to investigate the movements and spatial distribution of female leatherbacks migrating from nesting beaches along the Caribbean coast of Costa Rica and Panama. From May 2004 to May 2018, 40 satellite transmitters were deployed, with 33 having reliable data. Tracking revealed the use of two distinct regions, the Gulf of America and the North Atlantic Ocean. The tracking information supports the hypothesis that leatherbacks are found in the Gulf of America year-round and that leatherbacks use the Gulf of America as a destination rather than just a pass-through region. Within the Gulf of America, turtles are utilizing three primary areas: the northeastern Gulf of America along the Panhandle of Florida, south of Louisiana, and the southern Gulf of America in the Bay of Campeche, Mexico. All three of these areas are connected by a shared corridor. The proportion of individuals migrating into the Gulf of America increased over the study period.

In a study by Sasso et al. (2021), 19 leatherback sea turtles were successfully tagged in the northern Gulf of America, two males and 17 females. The tracking data indicated that they spent

nearly all of their time foraging while on the continental shelf of the Florida Panhandle. Female migration off the presumed foraging area began in late October and continued through early December. The entire west Florida shelf is a heavily used foraging area as turtles migrate south in the autumn and winter.

Updated spatial density models based on line-transect and aerial surveys conducted in U.S. waters of the Gulf of America during the GoMMAPPS project show highest leatherback turtle densities occurring along the northern gulf during the months of July (Figure 39) and August and lower densities in November (Figure 40) (Rappucci et al. 2023).

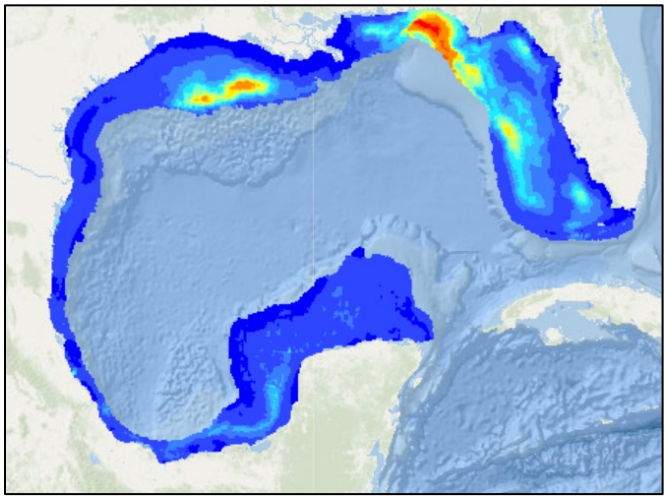


Figure 39. Density map of relative leatherback turtle abundance in the Gulf in July (Rappucci et al. 2023)

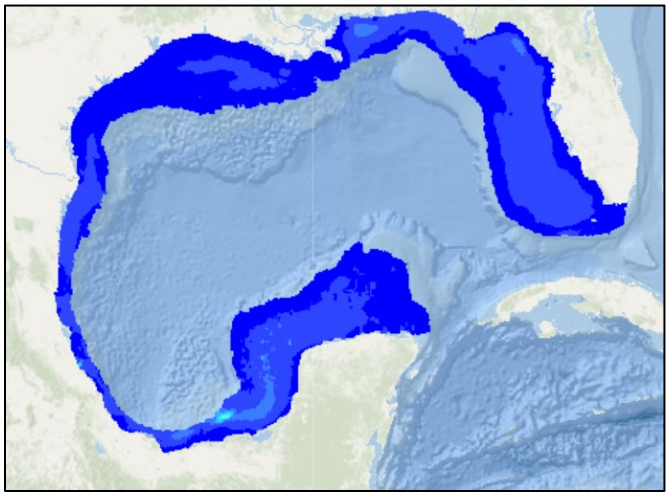


Figure 40. Density map of relative leatherback turtle abundance in the Gulf in November (Rappucci et al. 2023)

6.2.10.2 Life History Information

The leatherback life cycle is broken into several stages: (1) egg/hatchling, (2) post-hatchling, (3) juvenile, (4) subadult, and (5) adult. Leatherbacks are a long-lived species that delay age of maturity, have low and variable survival in the egg and juvenile stages, and have relatively high

and constant annual survival in the subadult and adult life stages (Chaloupka 2002; Crouse 1999; Heppell et al. 1999; Heppell et al. 2003b; Spotila et al. 1996; Spotila et al. 2000). While a robust estimate of the leatherback sea turtle's life span does not exist, the current best estimate for the maximum age is 43 (Avens et al. 2009). It is still unclear when leatherbacks first become sexually mature. Age at maturity has been difficult to ascertain, with estimates ranging from five to 29 years (Avens et al. 2009; Spotila et al. 1996). Using skeletochronological data, Avens et al. (2009)estimated that leatherbacks in the western North Atlantic may not reach maturity until 29 years of age, which is longer than earlier estimates of two to three years by Pritchard and Trebbau (1984), of three to six years by Rhodin (1985), of 13 to 14 years for females by Zug and Parham (1996), and 12 to 14 years for leatherbacks nesting in the U.S. Virgin Islands by Dutton et al. (2005). A more recent study that examined leatherback growth rates estimated an age at maturity of 16.1 years (Jones et al. 2011).

The average size of reproductively active females in the Atlantic is generally 5 to 5.5 ft (150 to 162 cm) CCL (Benson et al. 2007a; Hirth et al. 1993; Starbird and Suarez 1994). Still, females as small as 3.5 to 4 ft (105 to 125 cm) CCL have been observed nesting at various sites (Stewart et al. 2007). In the Atlantic Ocean, equatorial waters appear to be a barrier between breeding populations. In the northwestern Atlantic Ocean, post-nesting female migrations appear to be restricted to north of the Equator but the migration routes vary (Eckert et al. 2012; Saba 2013 as cited in NMFS USFWS 2013). Genetic studies support the satellite telemetry data indicating a strong difference in migration and foraging fidelity between the breeding populations in the northern and southern hemispheres of the Atlantic Ocean (Dutton et al. 2013b; Stewart et al. 2013 as cited in NMFS USFWS 2013).

Female leatherbacks typically nest on sandy, tropical beaches at intervals of one to seven years (Garcia M. and Sarti 2000; McDonald and Dutton 1996; Spotila et al. 2000). Unlike other sea turtle species, female leatherbacks do not always nest at the same beach year after year; some females may even nest at different beaches during the same year (Dutton et al. 2005; Eckert et al. 1989; Keinath and Musick 1993; Steyermark et al. 1996). Individual female leatherbacks have been observed with fertility spans as long as 25 years (Hughes 1996). Females usually lay up to 10 nests during the three to six month nesting season (March through July in the United States), typically eight to 12 days apart, with 100 eggs or more per nest (Eckert et al. 2012; Eckert et al. 1989; Maharaj 2004; Matos ; Stewart and Johnson 2006; Tucker 1988). Yet, up to approximately 30% of the eggs may be infertile (Eckert et al. 1989; Maharaj 2004; Matos ; MTN 1984; Stewart and Johnson 2006; Tucker 1988). The number of leatherback hatchlings that make it out of the nest on to the beach (i.e., emergent success) is approximately 50% worldwide (Eckert et al. 2012). Eggs hatch after 60 to 65 days, and the hatchlings have white striping along the ridges of their backs and on the edges of the flippers. Leatherback hatchlings weigh approximately 1.5 to 2 oz (40 to 50 g), and are approximately 2-3 in (51-76 mm) in length, with fore flippers as long as their bodies. Hatchlings grow rapidly with reported growth rates for leatherbacks from 2.5 to 27.6 in (6 to 70 cm) in length, estimated at 12.6 in (32 cm) per year (Jones et al. 2011).

In the Atlantic, the sex ratio appears to be skewed toward females. The Turtle Expert Working Group (TEWG) reports that nearshore and onshore strandings data from the U.S. Atlantic and Gulf coasts indicate that 60 % of strandings were females (TEWG 2007). Those data also show that the proportion of females among adults (57%) and juveniles (61%) was also skewed toward females in these areas (TEWG 2007). James et al. (2007) collected size and sex data from large subadult and adult leatherbacks off Nova Scotia and concluded a bias toward females at a rate of 1.86:1.

The survival and mortality rates for leatherbacks are difficult to estimate and vary by location. For example, the annual mortality rate for leatherbacks that nested at Playa Grande, Costa Rica, was estimated to be 34.6% in 1993 to 1994 and 34.0% in 1994 to 1995 (Spotila et al. 2000). In contrast, leatherbacks nesting in French Guiana and St. Croix had estimated annual survival rates of 91% (Rivalan et al. 2005) and 89% (Dutton et al. 2005), respectively. For the St. Croix population, the average annual juvenile survival rate was estimated to be approximately 63% and the total survival rate from hatchling to first year of reproduction for a female was estimated to be between 0.4% and 2% (assuming age at first reproduction is between nine and 13 years (Eguchi et al. 2006)). Spotila et al. (1996) estimated first-year survival rates for leatherbacks at 6.25%.

Migratory routes of leatherbacks are not entirely known; however, recent information from satellite tags have documented long travels between nesting beaches and foraging areas in the Atlantic and Pacific Ocean basins (Benson et al. 2007a; Benson et al. 2011; Eckert 2006; Eckert et al. 2006; Ferraroli et al. 2004; Hays et al. 2004; James et al. 2005a). Leatherbacks nesting in Central America and Mexico travel thousands of miles through tropical and temperate waters of the South Pacific (Eckert and Sarti 1997; Shillinger et al. 2008). Data from satellite tagged leatherbacks suggest that they may be traveling in search of seasonal aggregations of jellyfish (Benson et al. 2007b; Bowlby et al. 1994; Graham 2009; Shenker 1984; Starbird et al. 1993; Suchman and Brodeur 2005).

6.2.10.3 Status and Population Dynamics

The status of the Atlantic leatherback population has been less clear than the Pacific population, which has shown dramatic declines at many nesting sites (Santidrián-Tomillo et al. 2007; Sarti Martínez et al. 2007; Spotila et al. 2000). This uncertainty has been a result of inconsistent beach and aerial surveys, cycles of erosion, and reformation of nesting beaches in the Guianas (representing the largest nesting area). Leatherbacks also show a lesser degree of nest-site fidelity than occurs with the hardshell sea turtle species. Coordinated efforts of data collection and analyses by the leatherback TEWG have helped to clarify the understanding of the Atlantic population status (TEWG 2007).

Natal homing, at least within an ocean basin, results in reproductive isolation between five broad geographic regions: eastern and western Pacific, eastern and western Atlantic, and Indian Ocean. Leatherback sea turtles migrate long, transoceanic distances between their tropical nesting beaches and the highly productive temperate waters where they forage, primarily on jellyfish and

tunicates. These gelatinous prey are relatively nutrient-poor, such that leatherbacks must consume large quantities to support their body weight. Leatherbacks weigh about 33% more on their foraging grounds than at nesting, indicating that they probably catabolize fat reserves to fuel migration and subsequent reproduction (James et al. 2005b; Wallace et al. 2006). Sea turtles must meet an energy threshold before returning to nesting beaches. Therefore, their remigration intervals (the time between nesting) are dependent upon foraging success and duration (Hays 2000; Price et al. 2004).

The Southern Caribbean/Guianas stock is the largest known Atlantic leatherback nesting aggregation (TEWG 2007). Using nesting females as a proxy for population, the TEWG (2007) determined that the Southern Caribbean/Guianas stock had demonstrated a long-term, positive population growth rate.

Nesting data for the Northern Caribbean stock is available from Puerto Rico, St. Croix (U.S. Virgin Islands), and the British Virgin Islands (Tortola). In Puerto Rico, the primary nesting beaches are at Fajardo and on the island of Culebra. At the primary nesting beach on St. Croix, the Sandy Point National Wildlife Refuge, nesting has varied from a few hundred nests to a high of 1,008 in 2001, and the average annual growth rate has been approximately 1.1% from 1986 to 2004 (TEWG 2007). Nesting in Tortola is limited, but has been increasing from zero to six nests per year in the late 1980s to 35 to 65 per year in the 2000s, with an annual growth rate of approximately 1.2% between 1994 and 2004 (TEWG 2007). The nesting trend reversed course later, with an annual geometric mean decline of 10% from 2008-2017 driving the long-term trend (1990-2017) down to a 2% annual decline (Group 2019).

The Florida nesting stock nests primarily along the east coast of Florida. This stock is of growing importance, with total nests between 600 and 700 per year in the 2000s following nesting totals fewer than 100 nests per year in the 1980s (Florida Fish and Wildlife Conservation Commission data available at https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/). Using data from the index nesting beach surveys, TEWG (2007) estimated a significant annual nesting growth rate of 1.17% between 1989 and 2005. FWC Index Nesting Beach Survey Data indicates biennial peaks in nesting abundance beginning in 2007 (Figure 41). A similar pattern was also observed statewide (Table 21). This up-and-down pattern is thought to be a result of the cyclical nature of leatherback nesting, similar to the biennial cycle of green turtle nesting. Overall, the trend shows growth on Florida's east coast beaches. Tiwari et al. (2013) report an annual growth rate of 9.7% and a three-generation abundance change of +1,863%. However, nesting declined dramatically on Florida beaches from 2014-2017, with 2017 hitting a decade-low number. The decline was then followed by a partial rebound from 2018 to 2022. The annual geometric mean trend for Florida had been a decline of almost 7% from 2008-2017, but the long-term trend (1990-2017) remains positive with an annual geometric mean increase of over 9% (Northwest Atlantic Leatherback Working Group 2018). The increase since the 2017 low further solidifies the long-term increase, while the pattern in the past decade is less certain.

Table 21. Number of leatherback sea turtle nests in Florida (Data from https://myfwc.com/research/wildlife/sea-turtles/nesting/statewide/)

Nests Recorded	2010	2011	2012	2013	2016	2022
Index Nesting Beaches	552	625	515	322	319	514
Statewide	1,334	1,653	1,712	896	1,054	1,848

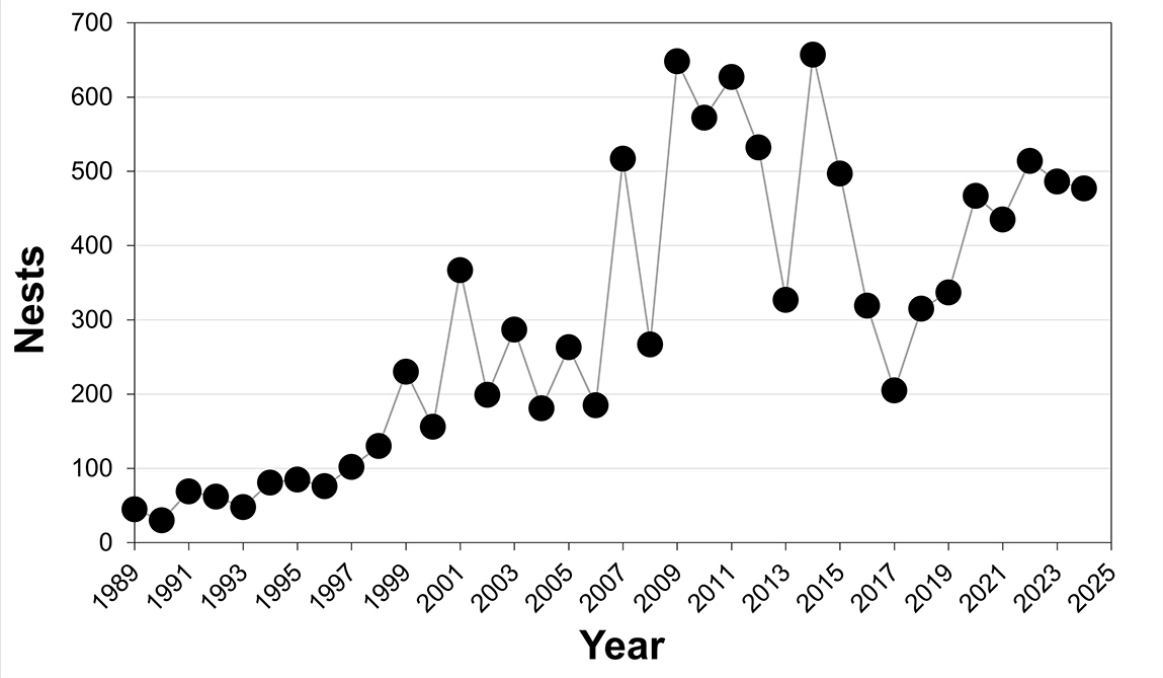


Figure 41. Leatherback sea turtle nesting at Florida index beaches from 1989 to 2025 (Figure from https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/ accessed May 6, 2025)

The total index of nesting female leatherback turtle abundance in the Northwest Atlantic has been estimated to be 20,659. This is similar to other previous estimates and only includes available nesting data from recently and consistently monitored nesting beaches and assumes a three-year remigration period (NMFS and USFWS 2020).

6.2.10.4 Threats

Leatherbacks 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, changing global environmental conditions, fisheries interactions, natural predation, and disease. We discussed some of these in section 5as relevant to all sea turtle species. This section will expand on a few of the aforementioned threats and how they may specifically affect leatherback sea turtles.

Of all sea turtle species, leatherbacks seem to be the most vulnerable to entanglement in fishing gear, especially gillnet and pot/trap lines. This may be because of their body type (large size, long pectoral flippers, and lack of a hard shell), their attraction to gelatinous organisms and algae that collect on buoys and buoy lines at or near the surface, their method of locomotion, and/or perhaps their attraction to the lightsticks used to attract target species in longline fisheries. From 1990 to 2000, 92 entangled leatherbacks were reported from New York through Maine and many other stranded individuals exhibited evidence of prior entanglement (Dwyer 2004). Zug and Parham (1996) point out that a combination of the loss of long-lived adults in fishery-related mortalities and a lack of recruitment from intense egg harvesting in some areas has caused a sharp decline in leatherback sea turtle populations and represents a significant threat to survival and recovery of the species worldwide.

Leatherback sea turtles may also be more susceptible to marine debris ingestion than other sea turtle species due to their predominantly pelagic existence and the tendency of floating debris to concentrate in convergence zones that adults and juveniles use for feeding and migratory purposes (Lutcavage et al. 1997; Shoop and Kenney 1992). The stomach contents of leatherback sea turtles revealed that a substantial percentage (33.8% or 138 of 408 cases examined) contained some form of plastic debris (Mrosovsky et al. 2009). Blocking of the gut by plastic to an extent that could have caused death was evident in 8.7% of all leatherbacks that ingested plastic (Mrosovsky et al. 2009). Mrosovsky et al. (2009) also note that in a number of cases, the ingestion of plastic may not cause death outright, but could cause the animal to absorb fewer nutrients from food, eat less in general, etc. – factors which could cause other adverse effects. The presence of plastic in the digestive tract suggests that leatherbacks might not be able to distinguish between prey items and forms of debris such a plastic bags (Mrosovsky et al. 2009). Balazs (1985) speculated that the plastic object might resemble a food item by its shape, color, size, or even movement as it drifts about, and therefore induce a feeding response in leatherbacks.

As discussed in Section 7.1 changing environmental conditions can be expected to have various impacts on all sea turtles, including leatherbacks. Changing environmental conditions are likely to influence the distribution and abundance of jellyfish, the primary prey item of leatherbacks (NMFS and USFWS 2007c). Several studies have shown leatherback distribution is influenced by jellyfish abundance (e.g., Houghton et al. 2006; Witt et al. 2007; Witt et al. 2006); however, more studies need to be done to monitor how changes to prey items affect distribution and foraging success of leatherbacks so population-level effects can be determined.

6.2.11 Northwest Atlantic Ocean Distinct Population Segment Loggerhead Sea Turtle

The loggerhead sea turtle was listed as a threatened species throughout its global range on July 28, 1978. NMFS and USFWS published a final rule designating nine DPSs for loggerhead sea turtles on September 22, 2011, which became effective October 24, 2011. The Northwest Atlantic DPS is the only one that occurs within the action area and, therefore, considered in this opinion.

6.2.11.1 Species Description and Distribution

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

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

The majority of loggerhead nesting occurs at the western rims of the Atlantic and Indian Oceans concentrated in the north and south temperate zones and subtropics (NRC 1990a). For the NWA DPS, most nesting occurs along the East 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 America, 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 America, and Caribbean Sea. Little is known about the distribution of adult males who are seasonally abundant near nesting beaches.

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 (NMFS and USFWS 2008b). 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 AmericaRecovery Unit[17] (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 2008b). The recovery

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

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.

Garrison et al. (2020a) found that loggerheads in the northern Gulf of America were typically found in shallow water in late spring/early summer, then migrated into deeper water during fall and/or winter months. A broad range of habitats over the continental shelf serve as important foraging habitats for loggerheads, which are resident in limited areas for periods of several months, primarily during cooler water periods from fall through winter. The spatial and seasonal variation in loggerheads represents the shift in habitats and behavioral modes across seasons, with animals moving into deeper waters and spending progressively less time at the surface during cooler months. The dive-surface behaviors for loggerheads indicated important seasonal, diurnal, and spatial effects on the time available at the surface. There was a significant interaction between season and day, indicating that the diurnal effects were different among the different seasons.

Hart et al. (2020) identified high use foraging sites for loggerhead turtles in the northeastern Gulf of America, specifically the Big Bend region off the northwest Florida coast. This region was found to be an important year-round foraging site for loggerheads from several distinct population segments. Further, a range of individual variation in home range size was observed; larger home ranges were in greater water depths.

Iverson et al. (2020) identified migration corridors of post-nesting female adult loggerhead turtles in the Gulf of Americao and Florida Straits, and overlaid the corridors on shipping density, commercial line fishing, and shrimp trawling data. This yielded hotspots in the Florida Straits, off the northwest Florida coast, and off the Tampa Bay coast. Loggerheads migrated in neritic and oceanic waters, with some leaving the Gulf of America. Neritic waters west of Florida and in the Florida Straits were observed to be high use migration corridors, with migration mainly occurring in July and August.

Silver-Gorges et al. (2021) evaluated the epibionts on the carapace of loggerhead sea turtles as well as stable isotopic values to infer foraging regions, twenty-three individuals for epibionts and 22 individuals for stable isotopes. Sample collection for epibiont and stable isotope analysis was done on females nesting on St. George Island in the Northern Gulf of AmericaRecovery Unit. It was determined that select epibiont meiofauna taxa and nematode abundance provided more discriminative and informative information for identifying broad foraging locations and foraging ecology than macrofauna. Dissimilarities in epibionts also correlated to dissimilarities in individual stable isotope values.

Updated spatial density models based on line-transect and aerial surveys conducted in U.S. waters of the Gulf of America during the GoMMAPPS project show highest loggerhead turtle densities occurring along the northern gulf during the months of February (Figure 42) and March and lower densities in October (Figure **43**; (Rappucci et al. 2023).

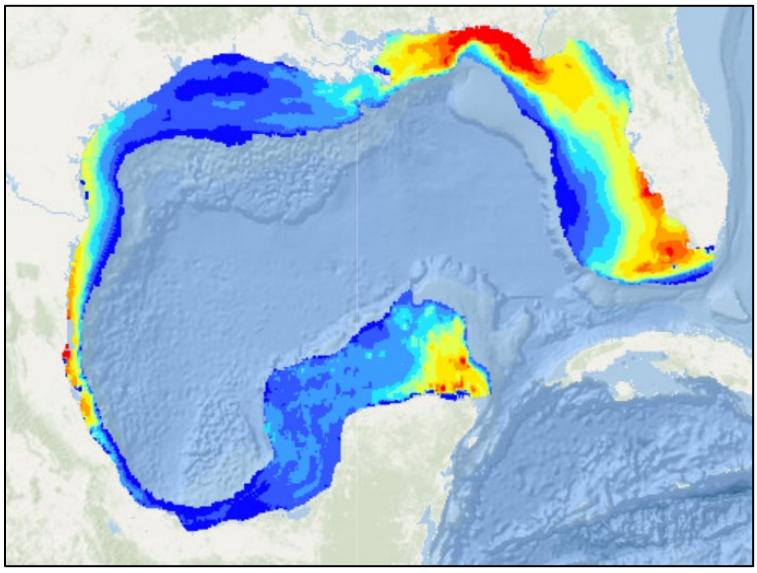


Figure 42. Density map of relative loggerhead turtle abundance in the Gulf in February (Rappucci et al. 2023)

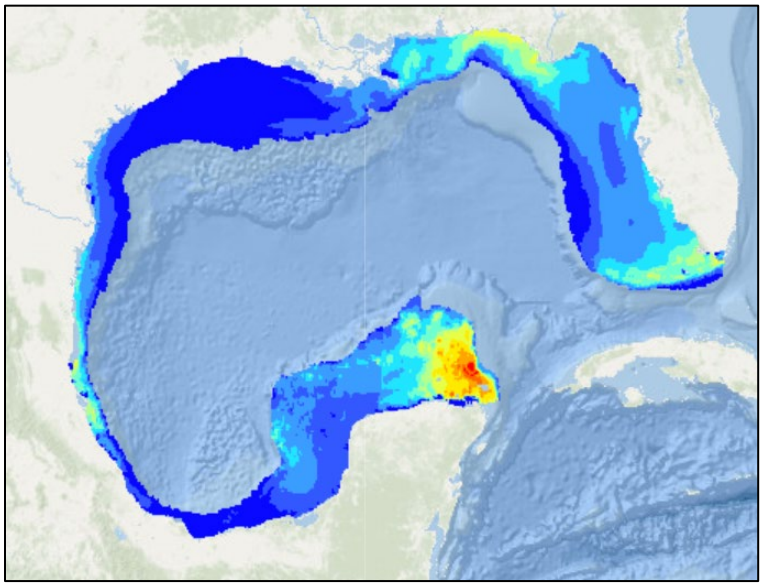


Figure 43**. Density map of relative loggerhead turtle abundance in the Gulf in October (Rappucci et al. 2023)**

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 zone[18]), (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 2008b). Loggerheads are long-lived animals. They reach sexual maturity

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

between 20 and 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 to 126 eggs (Dodd 1988) which incubate for 42 to 75 days before hatching (NMFS and USFWS 2008b). Loggerhead hatchlings are 1.5 to 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 to 2 in (2.9 to 5.4 cm) per year (Bjorndal et al. 2003; Snover 2002) over a period as long as seven to 12 years (Bolten et al. 1998) before moving to more coastal habitats. Studies have suggested that not all loggerhead sea turtles follow the model of circumnavigating the North Atlantic Gyre as pelagic juveniles, followed by permanent settlement into benthic environments (Bolten and Witherington 2003; Laurent et al. 1998). These studies suggest some turtles may either remain in the oceanic habitat in the North Atlantic longer than hypothesized, or they move back and forth between oceanic and coastal habitats interchangeably (Witzell 2002). Stranding records indicate that when immature loggerheads reach 15 to 24 inches (40 to 60 centimeters) SCL, they begin to reside in coastal inshore waters of the continental shelf throughout the U.S. Atlantic and Gulf (Witzell 2002).

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

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

Offshore, adults primarily inhabit continental shelf waters, from New York south through Florida, the Bahamas, Cuba, and the Gulf. Seasonal use of mid-Atlantic shelf waters, especially offshore New Jersey, Delaware, and Virginia during summer months, and offshore shelf waters, such as Onslow Bay (off the North Carolina coast), during winter months has also been

documented (Hawkes et al. 2014; Hawkes et al. 2007). 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. 2008a; 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. Moncada et al. (2010) report the recapture in Cuban waters of five adult female loggerheads originally flipper-tagged in Quintana Roo, Mexico, indicating that Cuban shelf waters likely also provide foraging habitat for adult females that nest in Mexico.

6.2.11.2 Status and Population Dynamics

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

Numbers of nests and nesting females can vary widely from year to year. Nesting beach surveys, though, can provide a reliable assessment of trends in the adult female population, due to the strong nest site fidelity of female loggerhead sea turtles, as long as such studies are sufficiently long and survey effort and methods are standardized (e.g., (NMFS and USFWS 2008b). NMFS and USFWS (2008b) 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.

Benscoter et al. (2022) quantified the number of nesting loggerhead sea turtle females that were less than 87 centimeter curved carapace length notch (CLCL-n). A CCL-n of greater than 87 centimeters has been previous used as the size classification for reproducing females and is what is used in the estimates provided for in the Recovery Plan for the Northwest Atlantic Ocean population. Nesting loggerhead females were evaluated at three sites that represent different segments of the Northwest Atlantic population: Gulf Shores, Alabama; Dry Tortugas National Park; and Everglades National Park, which each represent an individual Recovery Unit (RU). Across all years in the study period, from 2011 to 2019, Alabama was sampled from 2011 to 2017, Dry Tortuga from 2011 to 2019, and the Everglades from 2014 to 2019. The total number of individually sampled turtles was 352. The CCL-n of the smaller-sized nesting loggerhead females ranged from 74.0 to 86.9 cm. Thirteen percent of the loggerheads nesting on beaches at the three sites were smaller than the standard size considered a reproductive female for this species in this region. The smaller reproductive females behaved differently than their larger counterparts, specifically they exhibited shorter migration distances and migrated along shallower depths compared to the larger (greater than 87 centimeter CCL-n) reproductive females. The authors hypothesize that the smaller sizes of nesting loggerhead females in the three RUs in the Northwest Atlantic may be indicative of slower growth rates and/or maturation at younger ages, which may represent a shorter juvenile stage for these turtles.

Peninsular Florida Recovery Unit

The Peninsular Florida Recovery Unit is the largest loggerhead nesting assemblage in the Northwest Atlantic. A near-complete nest census (all beaches including index nesting beaches) undertaken from 1989 to 2007 showed an average of 64,513 loggerhead nests per year, representing approximately 15,735 nesting females per year (NMFS and USFWS 2008b). The statewide estimated total for 2016 was 122,706 nests and 18,631 of those from Florida's Gulf coast (FWRI nesting database).

Over 90% of loggerhead sea turtle nesting in the U.S. occurs in Florida (Ceriani et al. 2021). The majority of loggerhead nesting in Florida occurs along the southeastern coast of the state and the Peninsular Florida Recovery Unit is the largest loggerhead nesting assemblage in the Northwest Atlantic. The statewide estimated total for 2022 was 116,765 nests and 18,293 of those from Florida's Gulf coast (FWRI nesting database).

Since the start of the Florida Index Nesting Beach Survey program in 1989, counts of loggerhead nests on Florida beaches have ranged from a minimum of 28,876 in 2007 to a maximum of 65,807 nests in 2016 (note: these numbers do not represent Florida's total annual nest counts because they are collected only on a subset of beaches and only during a 109-day time window) (FFWCC 2018). Following a 52% increase between 1989 and 1998, nest counts declined sharply (53%) over nearly a decade (1998-2007). However, annual nest counts showed a strong increase (65%) since then (2007-2017) (FFWCC 2018). Index beaches in the Florida Panhandle, which are not part of the set of core beaches, had the second highest loggerhead nest counts in 2017 since these surveys to detect trends began in that area in 1997. Based on the currently available information, NMFS categorizes the loggerhead Northwest Atlantic Ocean DPS population trend as being stable (NMFS and USFWS 2023).

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 44). FWRI performed a detailed analysis of the long-term loggerhead index nesting data (1989 to 2013) (http://myfwc.com/research/wildlife/sea-turtles/nesting/). Over that time period, three distinct trends were identified. From 1989 to 1998, there was a 30% increase that was then followed by a sharp decline over the subsequent decade. Large increases in loggerhead nesting occurred since then. FWRI examined the trend from the 1998 nesting high through 2013 and found the decade-long post-1998 decline had reversed and there was no longer a demonstrable trend.

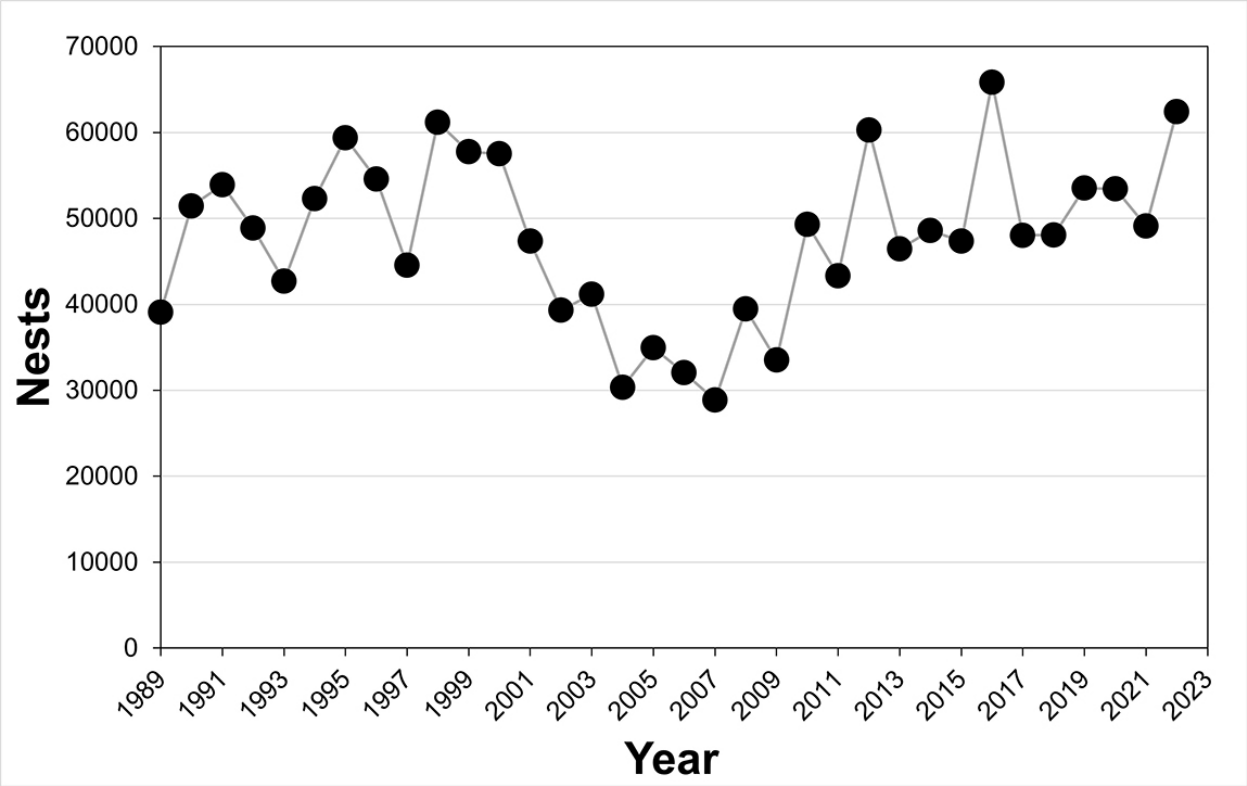


Figure 44. Loggerhead sea turtle nesting at Florida index beaches since 1989. Survey effort remained nearly identical (Figure from Florida Fish and Wildlife Conservation Commission website accessed June 30, 2023, https://myfwc.com/research/wildlife/sea-turtes/nesting/beach-survey-totals/)

Northern Recovery Unit

Annual nest totals from beaches within the Northern Recovery Unit averaged 5,215 nests from 1989 to 2008, a period of near-complete surveys of NRU nesting beaches (Georgia Department of Natural Resources [GADNR] unpublished data, North Carolina Wildlife Resources Commission [NCWRC] unpublished data, South Carolina Department of Natural Resources [SCDNR] unpublished data), and represent approximately 1,272 nesting females per year, assuming 4.1 nests per female (Murphy and Hopkins 1984). The loggerhead nesting trend from daily beach surveys showed a significant decline of 1.3% annually from 1989 to 2008. Nest totals from aerial surveys conducted by SCDNR showed a 1.9% annual decline in nesting in South Carolina from 1980 to 2008. Overall, there is strong statistical data to suggest the Northern Recovery Unite had experienced a long-term decline over that period of time.

Nesting numbers of the Northern Recovery Unit are shown in Table 22. Georgia nesting has rebounded to show the first statistically significant increasing trend since comprehensive nesting surveys began in 1989 (Dodd 2024). South Carolina and North Carolina nesting have also begun to show a shift away from the declining trend seen in these areas from 1989 to 2008.

Table 22. Total number of loggerhead nests in the northern recovery unit (datasets compiled at www.seaturtle.org)

Nests Recorded	2016	2017	2018	2019	2020	2021	2022
Georgia	3,265	2,155	1,735	3,945	2,786	2,493	4,071
South Carolina	6,443	5,232	2,762	8,774	5,551	5,639	7,970
North Carolina	1,612	1,195	765	2,291	1,335	1,448	1,906
Total	11,320	8,582	5,262	15,010	9,672	9,580	13,947

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 to 2013, with a subsequent steep drop in 2014. Nesting then rebounded in 2015 and 2016, setting new highs each of those years. Nesting in 2017 dropped back down from the 2016 high, but was still the second highest on record. After another drop in 2018, a new record was set for the 2019 season, with a return to 2016 levels in 2020 and 2021 and then a rebound to the second highest level on record in 2022 (Figure 45).

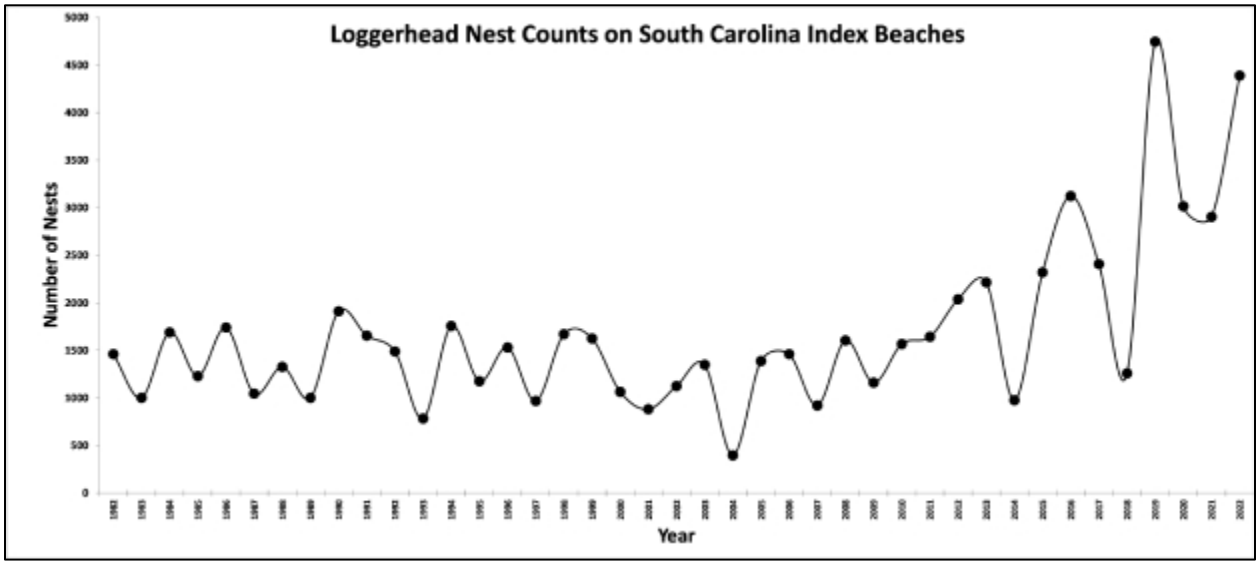


Figure 45. South Carolina index nesting beach counts for loggerhead sea turtles (from the South Caroloina Department of Natural Resources website on July 3, 2023 https://www.dnr.sc.gov//seaturtle/ibs.htm)

Other Northwest Atlantic DPS Recovery Units

The remaining three recovery units—Dry Tortugas, Northern Gulf, and Greater Caribbean—are much smaller nesting assemblages, but they are still considered essential to the continued existence of the species. Nesting surveys for the Dry Tortugas are conducted as part of Florida's statewide survey program. Between 2018 and 2022, nest counts ranged from 240 to 543, with a mean of 407 (FWRI nesting database). Nesting on the Florida Panhandle index beaches, which represents the majority of Northern Gulf of America 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 to 2007 average in 2011. Nesting numbers have increased since this period (Figure 46). Total nesting numbers are not available for the Greater Caribbean, but binned annual average crawls (Table 23) provide a relative sense of nesting activity in this region (NMFS and USFWS 2023).

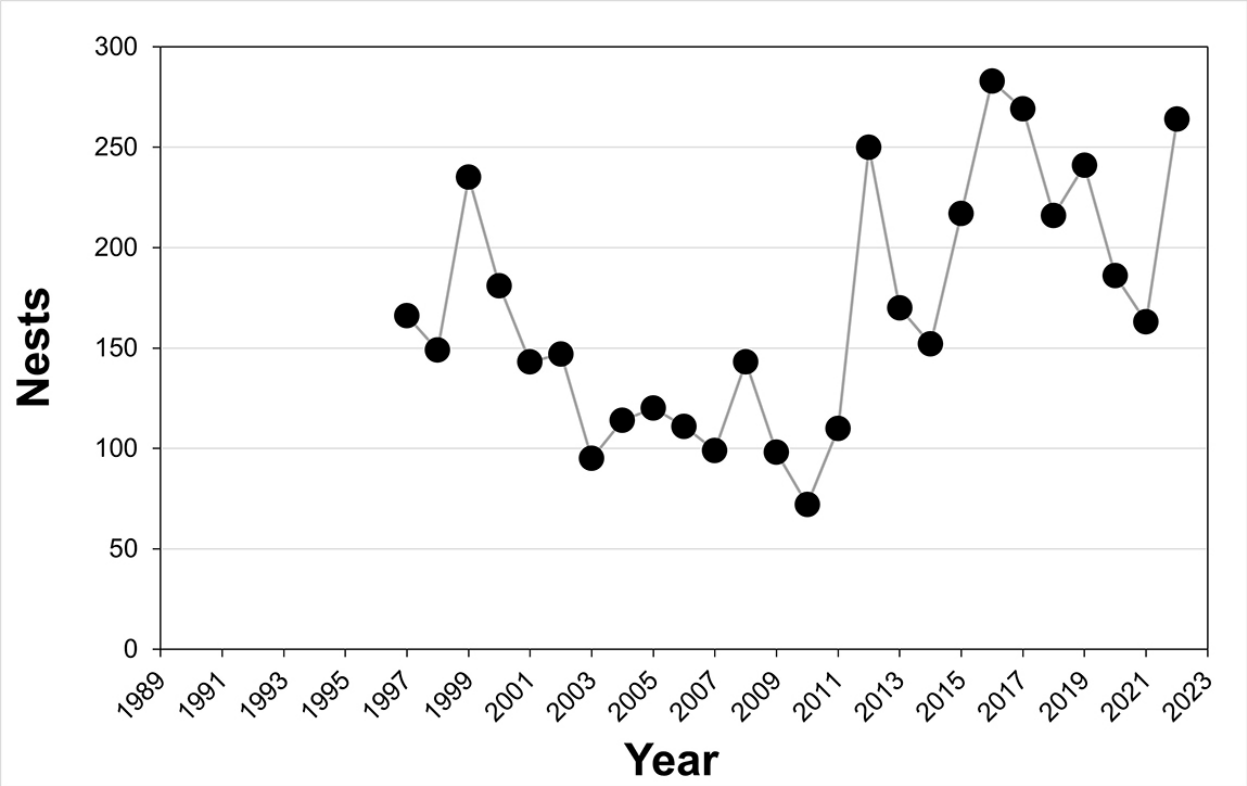


Figure 46. . Loggerhead sea turtle nesting at Florida panhandle index beaches since 1989. Survey effort remained nearly identical (Figure from FWCC website accessed July 3, 2023, https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/

Table 23. Greater Caribbean Recovery Unit crawl data (NMFS and USFWS 2023)

Binned Average Annual Crawls per Beach	Estimated Number of Nesting Beaches	Estimated Annual Crawls
Unknown	20	At least 20
Less than 25	272	272 to 6,800
25 to 100	32	800 to 3,200
100 to 500	13	1,300 to 6,500
500 to 1,000	4	2,000 to 4,000
Total	342	4,392 to 21,520

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 (Arendt et al. 2009; Ehrhart et al. 2007; Epperly et al. 2007). Researchers believe that this increase in catch per unit effort 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 (2008b), caution about extrapolating localized in-water trends to the broader population and relating localized trends in neritic sites to population trends at nesting beaches. The apparent overall increase in the abundance of neritic loggerheads in the southeastern United States may be due to increased abundance of the largest oceanic/neritic juveniles (historically referred to as small benthic juveniles), which could indicate a relatively large number of individuals around the same age may mature in the near future (TEWG 2009). In-water studies throughout the eastern United States, however, indicate a substantial decrease in the abundance of the smallest oceanic/neritic juvenile loggerheads, a pattern corroborated by stranding data (TEWG 2009).

Population Estimate

The NMFS Southeast Fishery Science Center developed a preliminary stage/age demographic model to help determine the estimated impacts of mortality reductions on loggerhead sea turtle population dynamics (NMFS-SEFSC 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 approximately 20,000 to 40,000 individuals, with a low likelihood of being up to 70,000 (NMFS-SEFSC 2009a). A less robust estimate for total benthic females in the western North Atlantic was also obtained, yielding approximately 30,000 to 300,000 individuals, up to less than one million (NMFS-SEFSC 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 to 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 to 1,111,000) (NEFSC and SEFSC 2011).

6.2.11.3 Threats

The threats faced by loggerhead sea turtles are summarized in the general discussion of threats in Section 6.2.5.1. Yet the impact of fishery interactions is a point of further emphasis for this species. The joint NMFS and USFWS Loggerhead Biological Review Team determined that the greatest threats to the NWA DPS of loggerheads result from cumulative fishery bycatch in neritic and oceanic habitats (Conant et al. 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. 1991a).

Specific information regarding potential impacts from changes in environmental conditions on loggerheads is also available. Modeling suggests an increase of two degrees Celsius 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. 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).

Ataman et al. (2021) investigated injuries of loggerhead sea turtles nesting on Florida Atlantic beaches. Approximately 24% of the 450 sea turtles evaluated had an external injury. Where injuries were able to be identified to a specific cause, approximately 60 instances, the majority or 75% of the injuries were attributed to vessel strike.

6.2.12 Gulf Sturgeon

Gulf sturgeon were listed as threatened effective October 30, 1991 (56 FR 49653, September 30, 1991), after their stocks were greatly reduced or extirpated throughout much of their historic range by overfishing, dam construction, and habitat degradation. NMFS and the USFWS jointly manage Gulf sturgeon. In riverine habitats, USFWS is responsible for all consultations regarding Gulf sturgeon and critical habitat. In estuarine habitats, responsibility is divided based on the action agency involved. USFWS consults with the Department of Transportation, the USEPA, the USCG, and the Federal Emergency Management Agency; NMFS consults with the DoD, USACE, BOEM, and any other federal agencies not specifically mentioned at 50 C.F.R. § 226.214. In marine areas, NMFS is responsible for all consultations regarding Gulf sturgeon and

critical habitat. In 2009, NMFS and USFWS conducted a 5-year review and found Gulf sturgeon continued to meet the definition of a threatened species (USFWS and NMFS 2009b).

6.2.12.1 Species Description and Distribution

The Gulf sturgeon is a subspecies of the Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*). Gulf sturgeon are nearly cylindrical fish with an extended snout, vertical mouth, five rows of scutes (bony plates surrounding the body), four chin barbels (slender, whisker-like feelers extending from the head used for touch and taste), and a heterocercal (upper lobe is longer than lower) caudal fin (tail fin). Adults range from 6-8 ft in length and weigh up to 200 lb; females grow larger than males. Gulf sturgeon spawn in freshwater and then migrate to feed and grow in estuarine/marine (brackish/salt) waters. Large subadults and adults feed primarily on lancelets, brachiopods, amphipods and other crustaceans, polychaetes, and gastropods. Small Gulf sturgeons feed on benthic infauna such as amphipods, grass shrimp, isopods, oligochaetes, polychaetes, and chironomid and ceratopogonid larvae, found in the intertidal zone. Subadults of more than 5 kg and adults in the freshwater middle river reaches essentially fast during the summer and fall (Mason Jr. and Clugston 1993).

Historically, Gulf sturgeon occurred from the Mississippi River east to Tampa Bay. Sporadic occurrences were recorded as far west as the Rio Grande River in Texas and Mexico, and as far east and south as Florida Bay (Reynolds 1993; Wooley and Crateau 1985). The subspecies' present spawning range extends from the Pearl River system in Louisiana east to the Suwannee River in Florida, and can occur in nearshore and estuarine waters from the Mississippi River east to Tampa Bay (Figure 47).

When Gulf sturgeon are in nearshore waters of the Gulf of America, they occur primarily from shore out to approximately 2.6 km (1.4 nm), and on a few occasions have been transmitter-detected swimming past offshore natural and artificial reefs approximately 20 km offshore (Fox 2025; USFWS and NMFS 2009b). These findings are consistent with similar studies on Gulf Sturgeon coastal distribution and habitat usage in the Gulf of America (Fox et al. 2002; Ross et al. 2009b). Given the commonly cited detection range of 500 m, some individuals could have

been at least 1.75 km from shore.

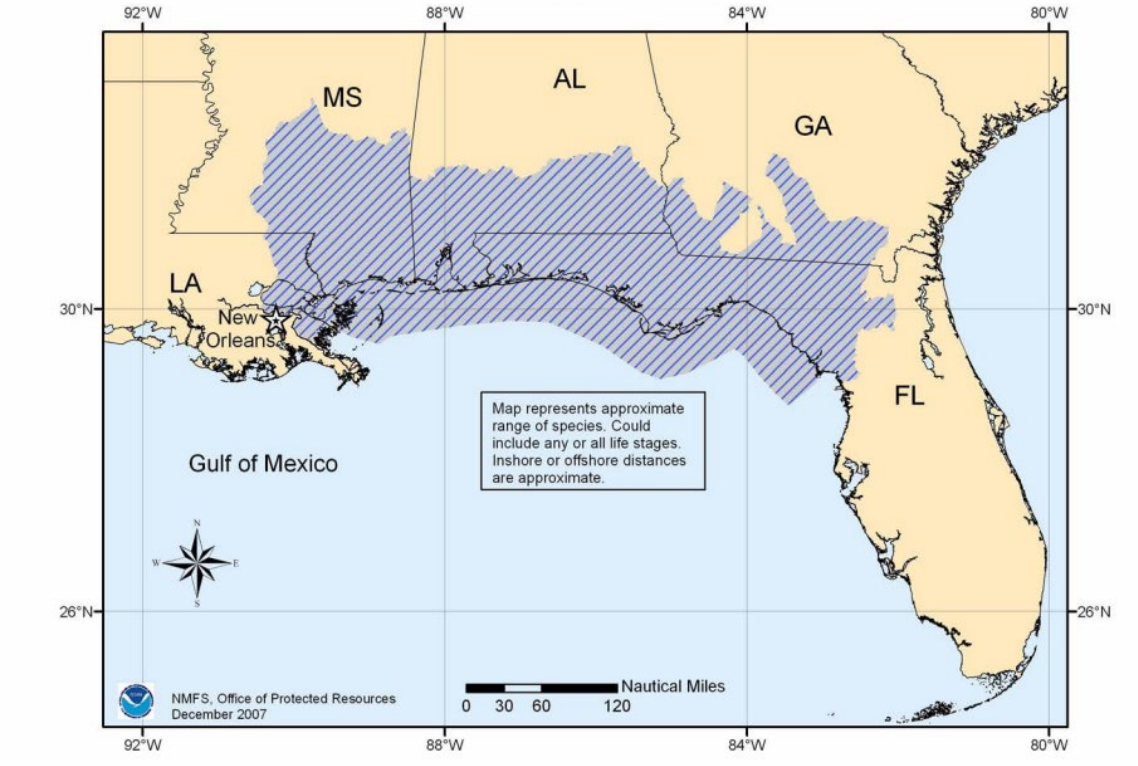


Figure 47. Gulf sturgeon distribution

6.2.12.2 Life History

Gulf sturgeon are long-lived, with some individuals reaching at least 42 years in age (Huff 1975). Age at sexual maturity ranges from eight to 17 years for females and seven to 21 years for males (Huff 1975). Chapman and Carr (Chapman and Carr 1995) estimated that mature female Gulf sturgeon that weigh between 64 and 112 lb (29-51 kg) produce an average of 400,000 eggs. Spawning intervals range from one to five years for males, while females require longer intervals ranging from three to five years (Fox et al. 2000; Huff 1975).

Gulf sturgeon move from the Gulf of America into coastal rivers in early spring (i.e., March through May). Fox et al (2000) found water temperatures at time of river entry differed significantly by reproductive stage and sex. Individuals enter the river system when water temperatures range between 11.2°C and 27.1°C. Spawning occurs in the upper reaches of rivers in the spring when water temperature is around 15°C to 20°C. While Sulak and Clugston (1999) suggest that sturgeon spawning activity is related to moon phase, other researchers have found little evidence of spawning associated with lunar cycles (Fox et al. 2000; Slack et al. 1999). Fertilization is external; females deposit their eggs on the river bottom and males fertilize them. Gulf sturgeon eggs are demersal, adhesive, and vary in color from gray to brown to black (Huff 1975; Vladykov and Greely 1963). Parauka et al. (1991) reported that hatching time for artificially spawned Gulf sturgeon ranged from 85.5 hours at 18.4°C to 54.4 hours at about 23°C. Published research on the life history of younger Gulf sturgeon is limited. After hatching, young-

of-year individuals generally disperse downstream of spawning sites, though some may travel upstream as well (Clugston et al. 1995; Sulak and Clugston 1999), and move into estuarine feeding areas for the winter months.

Tagging studies confirm that Gulf sturgeon exhibit a high degree of river fidelity (Carr 1983). Of 4,100 fish tagged, 21% (860 of 4,100 fish) were later recaptured in the river of their initial collection, eight fish (0.2%) moved between river systems, and the remaining fish (78.8%) have not yet been recaptured (NMFS and USFWS 1995a). There is no information documenting the presence of spawning adults in non-natal rivers. However, there is some evidence of movements by both male and female Gulf sturgeon (n = 22) from natal rivers into non-natal rivers (Carr et al. 1996; Craft et al. 2001b; Fox et al. 2002; Ross et al. 2001; Wooley and Crateau 1985).

Gene flow is low in Gulf sturgeon stocks, with each stock exchanging less than one mature female per generation (Waldman and Wirgin 1998). Genetic studies confirm that Gulf sturgeon exhibit river-specific fidelity. Stabile et al. (Stabile et al. 1996) analyzed tissue taken from Gulf sturgeon in eight drainages along the Gulf of America for genetic diversity and noted significant differences among Gulf sturgeon stocks, which suggests region-specific affinities and likely river-specific fidelity. Five regional or river-specific stocks (from west to east) have been identified: (1) Lake Pontchartrain and Pearl River, (2) Pascagoula River, (3) Escambia and Yellow Rivers, (4) Choctawhatchee River, and (5) Apalachicola, Ochlockonee, and Suwannee Rivers (Stabile et al. 1996).

After spawning, Gulf sturgeon move downstream to areas referred to as “summer resting” or “holding” areas. Adults and subadults are not distributed uniformly throughout the river, but instead show a preference for these discrete holding areas usually located in the lower and middle river reaches (Hightower et al. 2002). While it was suggested these holding areas were sought for cooler water temperatures (Carr et al. 1996; Chapman and Carr 1995), Hightower et al. (Hightower et al. 2002) found that water temperatures in holding areas where Gulf sturgeon were repeatedly found in the Choctawhatchee River were similar to temperatures where sturgeon were only occasionally found elsewhere in the river.

In the fall, movement from the rivers into the estuaries and associated bays begins in September (at water temperatures around 23°C) and continues through November (Foster and Clugston 1997; Huff 1975; Wooley and Crateau 1985). Because the adult and large subadult sturgeon have spent at least six months fasting or foraging sparingly on detritus (Mason and Clugston 1993) in the rivers, it is presumed they immediately begin foraging. Telemetry data indicate Gulf sturgeon are found in high concentrations near the mouths of their natal rivers with individual fish traveling relatively quickly between foraging areas where they spend an extended period of time (Edwards et al. 2007; Edwards et al. 2003).

Most subadult and adult Gulf sturgeon spend the cool winter months (October/November through March/ April) in the bays, estuaries, and the nearshore (Clugston et al. 1995; Fox et al. 2002; Odenkirk 1989). Tagged fish have been located in well-oxygenated shallow water (less

than 7 m) areas that support burrowing macro invertebrates (Craft et al. 2001b; Fox and Hightower 1998; Fox et al. 2002; Parauka et al. 2001; Rogillio et al. 2007; Ross et al. 2001; Ross et al. 2009a). These areas may include shallow shoals 5-7 ft (1.5-2.1 m), deep holes near passes (Craft et al. 2001b), unvegetated sand habitats such as sandbars, and intertidal and subtidal energy zones (Abele and Kim 1986; Menzel 1971; Ross et al. 2009a). Subadult and adult Gulf sturgeon overwintering in Choctawhatchee Bay (Florida) were generally found to occupy the sandy shoreline habitat at depths of 4-6 ft (2-3 m) (Fox et al. 2002; Parauka et al. 2001). These shifting, predominantly sandy, areas support a variety of potential prey items including estuarine crustaceans, small bivalve mollusks, ghost shrimp, small crabs, various polychaete worms, and lancelets (Abele and Kim 1986; AFS 1989; Menzel 1971). Preference for sandy habitat is supported by studies in other areas that have correlated Gulf sturgeon presence to sandy substrate (Fox et al. 2002).

Gulf sturgeon are described as opportunistic and indiscriminate benthivores that change their diets and foraging areas during different life stages. Their guts generally contain benthic marine invertebrates including amphiopods, lancelets, polychaetes, gastropods, shrimp, isopods, molluscs, and crustaceans (Carr et al. 1996; Fox et al. 2002; Huff 1975; Mason and Clugston 1993). Generally, Gulf sturgeon prey are burrowing species that feed on detritus and/or suspended particles, and inhabit sandy substrate. In the river, young-of-year sturgeon eat aquatic invertebrates and detritus (Mason and Clugston 1993; Sulak and Clugston 1999) and juveniles forage throughout the river on aquatic insects (e.g., mayflies and caddisflies), worms (oligochaete), and bivalves (Huff 1975; Mason and Clugston 1993). Adults forage sparingly in freshwater and depend almost entirely on estuarine and marine prey for their growth (Gu et al. 2001). Both adult and subadult Gulf sturgeon are known to lose up to 30% of their total body weight while in fresh water, and subsequently compensate the loss during winter feeding in marine areas (Carr 1983; Clugston et al. 1995; Heise et al. 1999; Morrow et al. 1998; Ross 2000; Sulak and Clugston 1999; Wooley and Crateau 1985).

6.2.12.3 Status and Population Dynamics

Abundance of Gulf sturgeon is measured at the riverine scale. Currently, seven rivers are known to support reproducing populations of Gulf sturgeon: Pearl, Pascagoula, Escambia, Yellow (+Blackwater), Choctawhatchee, Apalachicola, and Suwannee. Gulf sturgeon abundance estimates by river and year for the seven known reproducing populations are presented in Table 24. Each of these estimates carries specific assumptions, and not all estimates were generated using data collected in a similar fashion or modeled the same way. Direct comparison among systems must take those differences into consideration. The number of individuals within each riverine population is variable across their range but, generally over the last decade (USFWS and NMFS 2009b), populations in the eastern part of the range (Suwannee, Apalachicola Choctawhatchee) appear to be relatively stable in number or have a slightly increasing population trend. In the western portion of the range, populations in the Pearl and Pascagoula Rivers have never been nearly as abundant as those to the east, and their current status, post-

hurricanes Katrina and Rita, is unknown as comprehensive surveys have not occurred. The Apalachicola River abundance has seen a decline in recent years (Dula et al. 2022).

We have updated Table 23 with the best available science, acknowledging that it does not include post-DWH information for all river systems. While the "minimum population abundance" column relies on 2023 data provided to us by the FWS, there are no more recent studies than those we previously relied on assessing the populations in the Pearl and Pascagoula rivers. We acknowledge again, as the court in *Sierra Club v. NMFS* noted regarding the 2020 opinion, that DWH impacts may have reduced the number of sturgeon in these rivers, and provide here an analysis of potential impacts to the overall population. USFWS and NMFS (2022) state that "substantial areas of critical habitat" and "significant numbers of adult fish were potentially exposed" to oil from Deepwater Horizon, but actual exposure and consequences from that exposure are uncertain and unquantified.

According to the DWH Trustees' programmatic damage assessment (2016), between 1,100 and 3,600 Gulf sturgeon were estimated to be exposed to DWH oil in the marine nearshore areas of the northern Gulf, representing a large proportion of the populations from six of the eight river systems occupied by Gulf sturgeon. Overall, 63 percent of fish from these six populations (Pearl, Pascagoula, Escambia, Blackwater, Yellow, Choctawhatchee) were potentially exposed to oil from the DWH spill. Although a direct kill of Gulf sturgeon from the oil was not observed, the Trustees found evidence of physiological injury. This evidence includes exposure biomarkers for DNA damage and immunosuppression between Gulf sturgeon that were—and were not—exposed to the oil, as supported by field observations and laboratory studies (FWS 2015). We note that no estimates of exposures by population or the consequences of those exposures are available.

Estimates of survival for western Gulf rivers (Pearl and Pascagoula) were considerably lower than for the rivers of the northern and eastern Gulf in 2010 (0.54 compared to 0.96), though by 2011 confidence intervals of the estimates for all rivers again overlapped, suggesting effects of the Deepwater Horizon oil spill were relatively short-lived but significant for the two western populations of Gulf sturgeon (Pine 2024). However, more recently (2015-2021), annual population growth for the Pearl and Pascagoula is estimated to be approximately 1.2 (approximately 20% increase in abundance per 5-year period), which is the highest observed for Gulf sturgeon populations (Pine 2024). Given the existing uncertainty and the science available since the Deepwater Horizon oil spill, we have updated Table 23 with the best available science while acknowledging that uncertainty remains, in particular with regard to the Pearl and Pascagoula populations.

Over the next 5 years, mark-recapture efforts in both the Pearl and Pascagoula systems should allow for an updated estimate of abundance in both systems, thereby providing a new perspective on the recovery of these two westernmost populations.

Table 24. Gulf Sturgeon Abundance Estimates by River and Year, with Confidence Intervals (CI) for the Seven Known Reproducing Populations (data from (NMFS 2022; Sulak et al. 2016; USFWS and NMFS 2009b).

River	Year of data collection	Abundance Estimate	Lower Bound 95 percent CI	Upper Bound 95 percent CI	Minimum population Abundance**	10 year index trend**	Source
Suwannee	2012-13	9,743	3,437	29,653	7,600	NA	Sulak 2016
Apalachicola	2014	1,288*	1,081	1,607	450	Decreasing	Sulak 2016
Choctawhatchee	2008	2,800	not reported	not reported	2,000	Stable	USFWS 2009
Yellow (+Blackwater)	2010-11 (2013)	1,036 (329)	724 (165)	1,348 (661)	1,600***	Stable	Sulak 2016
Escambia	2015	372	241	576	1,600***	Stable	Sulak 2016
Pascagoula	2000	216	124	429	NA	NA	Sulak 2016
Pearl	2001	430	323	605	NA	NA	Rogillio et al. 2001

*Reported as 503 juveniles and 785 adult/subadults.
**Based on unpublished 2023 USFWS data;
***Yellow, Escambia, and Blackwater combined minimum abundance is 1,600

6.2.12.4 Threats

The 1991 listing rule (56 FR 49653) for Gulf sturgeon cited the following impacts and threats: 1) dams on the Pearl, Alabama, and Apalachicola rivers; also on the North Bay arm of St. Andrew Bay; 2) channel improvement and maintenance activities: dredging and de-snagging; 3) water quality degradation, and 4) contaminants.

In 2009, NMFS and USFWS conducted a 5-year review of the Gulf sturgeon and identified several new threats to the Gulf sturgeon (USFWS and NMFS 2009b). The following is a comprehensive list of threats to Gulf sturgeon, additional details are in the 5-year status review (USFWS and NMFS 2009b):

- Pollution from industrial, agricultural, and municipal activities is believed responsible for a suite of physical, behavioral, and physiological impacts to sturgeon worldwide. Specific impacts of pollution and contamination on sturgeon have been identified to include muscle atrophy; abnormality of gonad, sperm, and egg development; morphogenesis of organs, tumors; and disruption of hormone production.

- Chemicals and metals such as chlordane, dichlorodiphenyldichloroethylene, dichlorodiphenyltrichloroethane, dieldrin, polychlorinated biphenyls, cadmium, mercury, and selenium settle to the river bottom and are later incorporated into the food web as they are consumed by benthic feeders, such as sturgeon or macroinvertebrates.
- Bycatch from fisheries may continue although all directed fisheries of Gulf sturgeon have been closed since 1990 (NMFS and USFWS 1995a). Although confirmed reports are rare, it is a common opinion among Gulf sturgeon researchers that bycatch mortality continues.
- Dredging activities can pose significant impacts to aquatic ecosystems by: (1) direct removal/burial of organisms; (2) turbidity/siltation effects; (3) contaminant resuspension; (4) sound/disturbance; (5) alterations to hydrodynamic regime and physical habitat; and (6) loss of riparian habitat. Dredging operations may also destroy benthic feeding areas, disrupt spawning migrations, and resuspend fine sediments causing siltation over required substrate in spawning habitat. Because Gulf sturgeon are benthic omnivores, the modification of the benthos affects the quality, quantity, and availability of prey.
- Collisions between jumping Gulf sturgeon and fast-moving boats on the Suwannee River and elsewhere are a relatively recent and new source of sturgeon mortality and pose a serious public safety issue as well. The Florida Fish and Wildlife Commission documented three collisions in the Suwannee River in 2008, and one incident in 2009.
- Dams represent a significant impact to Gulf sturgeon by blocking passage to historical spawning habitats, which reduces the amount of available spawning habitat or entirely impede access to it. The ongoing operations of these dams also affect downstream habitat.
- Changing global environmental conditions may affect Gulf sturgeon by leading to accelerated changes in habitats utilized by Gulf sturgeon through saltwater intrusion, changes in water temperature, and extreme weather periods that could increase both droughts and floods.
- Hurricanes have resulted in mortality of Gulf sturgeon in both Escambia Bay after Hurricane Ivan in 2004 (USFWS 2005) and Hurricane Katrina in 2005.
- Red tide is the common name for a harmful algal bloom of marine algae (*Karenia brevis*) that produces a brevetoxin that is absorbed directly across the gill membranes of fish or through ingestion of algal cells. Fish mortalities associated with K. brevis events are very common and widespread. Blooms of red tides have been increasing in frequency in the Gulf of America since the 1990s and have likely killed Gulf sturgeon at both the juvenile and adult life stages.

- Aquaculture: Although the state of Florida has BMPs to reduce the risk of hybridization and escapement, the threat of introduction of captive fishes into the wild continues.

Additionally, other emerging threats to Gulf sturgeon include contaminant spills, such as oil, and vessel propeller strikes. It may be that these are not new threats but we have only recently become more aware of them because of higher public awareness. Hurricanes may also be a threat to this species, causing major disturbance to their habitat and mass mortality events (Dula 2022).

Both acute and episodic events are known to affect individual populations of Gulf sturgeon that in turn, affect overall population numbers. For example, on August 9, 2011, an overflow of "black liquor" (an extremely alkaline waste byproduct of the paper industry) was accidentally released by a paper mill into the Pearl River near Bogalusa, Louisiana, that may have affected the status and abundance of the Pearl River population. While paper mills regularly use acid to balance the black liquor's pH before releasing the material, as permitted by the Louisiana Department of Environmental Quality, this material released was not treated.[19] The untreated waste byproduct created a low oxygen ("hypoxic") environment lethal to aquatic life. These hypoxic conditions moved downstream of the release site killing fish and mussels in the Pearl River over several days. Within a week after the spill, the dissolved oxygen concentrations returned to normal in all areas of the Pearl River tested by Louisiana Department of Wildlife and Fisheries. The investigation of fish mortality began on August 13, 2011, several days after the spill occurred. Twenty-eight Gulf sturgeon carcasses (38-168 cm TL) were collected in the Pearl River after the spill (Sanzenbach 2011a; Sanzenbach 2011b) and anecdotal information suggests many other Gulf sturgeon carcasses were not collected. The smaller fish collected represent young-of-year and indicate spawning is likely occurring in the Pearl River. The spill occurred during the time when Gulf sturgeon were still occupying the freshwater habitat. Because the materials moved downriver after the spill, the entire Pearl River population of Gulf sturgeon was likely impacted.

6.2.13 Gulf Sturgeon Critical Habitat

NMFS and USFWS jointly designated Gulf sturgeon critical habitat on April 18, 2003 (50 CFR § 226.214). The agencies designated 7 seven riverine areas (Units 1-7) and 7 seven estuarine/marine areas (Units 8-14) as critical habitat based on the physical and biological features that support the species. Critical habitat units encompass a total of 2,783 river kilometers (rkm) and 6,042 km^2 of estuarine and marine habitats (Figure 48). NMFS's jurisdiction encompasses the seven units in marine and estuarine waters (Units 8-14), though NMFS's consultation responsibilities for projects in estuarine waters are limited to specific action agencies (Table 25).

[19] The extreme alkalinity of the untreated black liquor caused it to quickly bond with oxygen (aerobic) to dissociate in water. This reduced the amount of oxygen available within the water column, creating a hypoxic environment (< 1mg/L of dissolved oxygen) lethal to aquatic life.

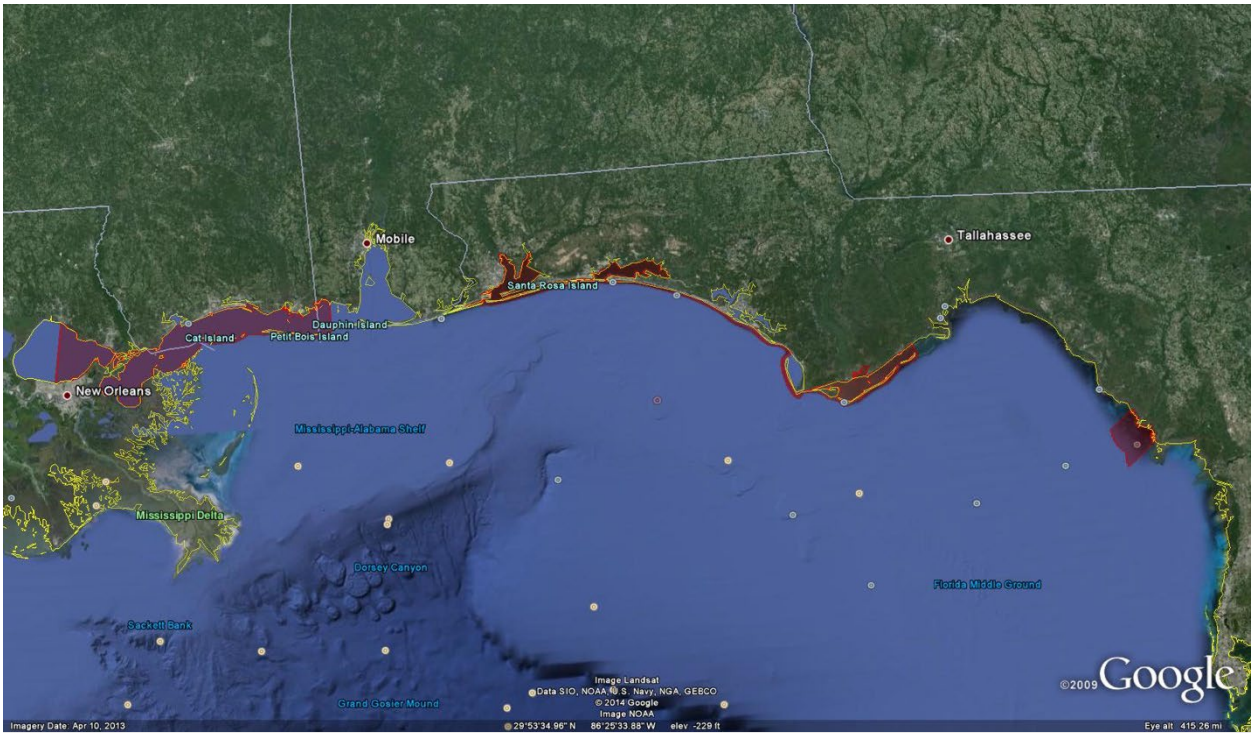


Figure 48. Gulf sturgeon critical habitat in estuarine and marine waters (Units 8-14)

Table 25. Gulf Sturgeon Consultation Responsibility for Projects in Estuarine Waters

Lead Action Agency	NMFS	USFWS
Department of Transportation	--	X
U.S. Environmental Protection Agency	--	X
U.S. Coast Guard	--	X
Federal Emergency Management Agency	--	X
Department of Defense	X	--
U.S. Army Corps of Engineers	X	--
Minerals Management Service (now Bureau of Ocean Energy Management)	X	--
Other	X	--

Gulf sturgeon use rivers for spawning, larval and juvenile feeding, adult resting and staging, and to move between the areas that support these components. Gulf sturgeon use the lower riverine, estuarine, and marine environment during winter months primarily for feeding and for inter-river migrations. Within the estuarine environment, Gulf sturgeon are typically found in waters 6.6-13.1 ft (2-4 m) deep and use depths outside this range less than expected based on availability (Fox et al. 2002). Further, habitats where Gulf sturgeon are typically found have sediments with a high percentage (>80%) of sand (Fox et al. 2002). Adult sturgeon appear to spend extended

periods of time in specific areas of the estuary and then travel relatively quickly to other areas where they again spend extended amounts of time (Edwards and Butterworth 2007; Edwards et al. 2003). (Sulak et al. 2012) believe Gulf sturgeon feed continuously during these periods, which may last for one to three months. Additionally, it appears that there may be certain areas where Gulf sturgeon concentrate. Estuaries and bays adjacent to riverine areas provide unobstructed passage of sturgeon from feeding areas to spawning grounds.

Essential Features of Critical Habitat

NMFS and USFWS identified seven habitat features essential for the conservation of Gulf sturgeon. Four of these features are found in the marine and estuarine units of critical habitat:

1. Abundant food items, such as detritus, aquatic insects, worms, and/ or mollusk, within riverine habitats for larval and juvenile life stages; and abundant prey items, such as amphipods, lancelets, polychaetes, gastropods, ghost shrimp, isopods, mollusk and/or crustaceans, within estuarine and marine habitats and substrates for subadult and adult life stages;
2. Water quality, including temperature, salinity, pH, hardness, turbidity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages;
3. Sediment quality, including texture and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages; and
4. Safe and unobstructed migratory pathways necessary for passage within and between riverine, estuarine, and marine habitats (e.g., an unobstructed river or a dammed river that still allows for passage).

Unit 8 encompasses Lake Pontchartrain east of the Lake Pontchartrain Causeway, all of Little Lake, The Rigolets, Lake St. Catherine, Lake Borgne, including Heron Bay, and the Mississippi Sound (Figure 49). Critical habitat follows the shorelines around the perimeters of each included lake. The Mississippi Sound includes adjacent open bays including Pascagoula Bay, Point aux Chenes Bay, Grand Bay, Sandy Bay, and barrier island passes, including Ship Island Pass, Dog Keys Pass, Horn Island Pass, and Petit Bois Pass. The northern boundary of the Mississippi Sound is the shoreline of the mainland between Heron Bay Point, Mississippi and Point aux Pins, Alabama. Critical habitat excludes St. Louis Bay, north of the railroad bridge across its mouth; Biloxi Bay, north of the U.S. Highway 90 bridge; and Back Bay of Biloxi. The southern boundary follows along the broken shoreline of Lake Borgne created by low swamp islands from Malheureux Point to Isleau Pitre. From the northeast point of Isleau Pitre, the boundary continues in a straight north-northeast line to the point 1 nautical mile (nmi) (1.9 km) seaward of the western most extremity of Cat Island (30°13′N, 89°10′W). The southern boundary continues 1 nmi (1.9 km) offshore of the barrier islands and offshore of the 72 COLREGS lines at barrier island passes (defined at 33 C.F.R. §80.815(d), (e)) to the eastern boundary. Between Cat Island and Ship Island there is no 72 COLREGS line. We, therefore, defined that section of the unit

southern boundary as 1 nmi (1.9 km) offshore of a straight line drawn from the southern tip of Cat Island to the western tip of Ship Island. The eastern boundary is the line of longitude 88°18.8′W from its intersection with the shore (Point aux Pins) to its intersection with the southern boundary. The lateral extent of Unit 8 is the MHW line on each shoreline of the included water bodies or the entrance to rivers, bayous, and creeks.

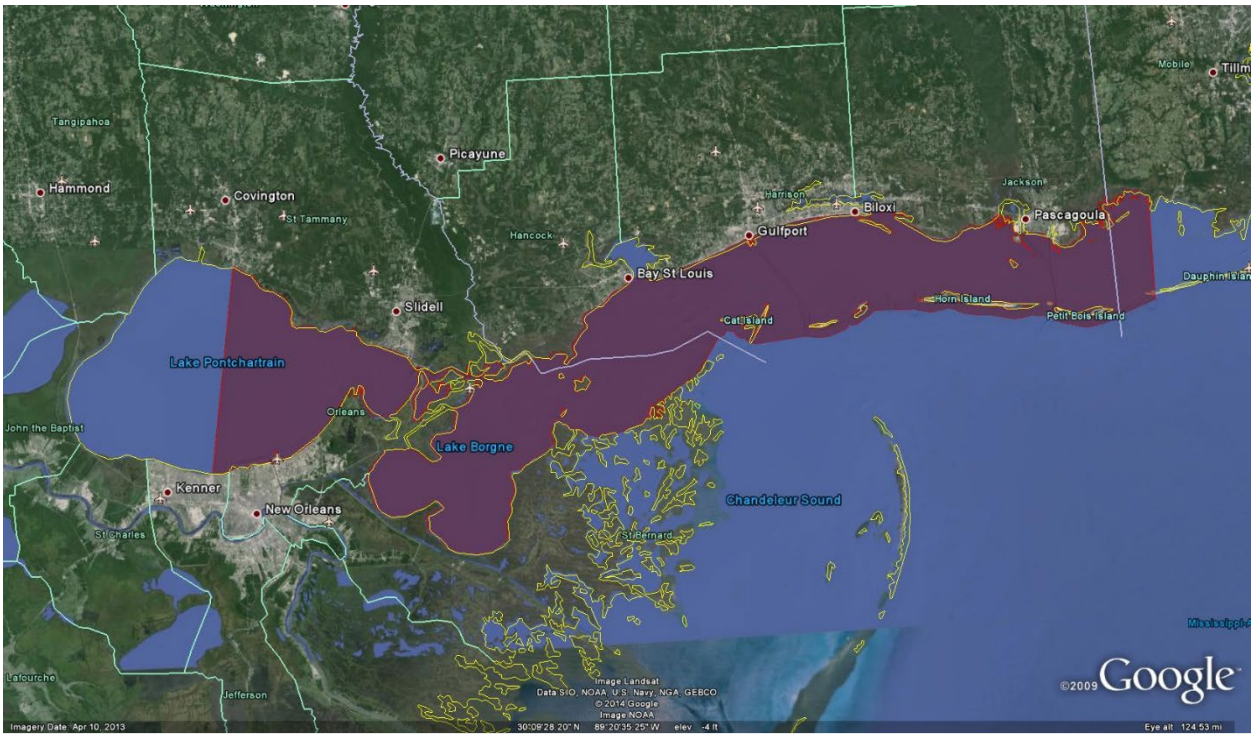


Figure 49. Gulf sturgeon critical habitat Unit 8

The Pearl River and its distributaries flow into The Rigolets, Little Lake, and Lake Borgne, the western extension of Mississippi Sound. The Rigolets connect Lake Pontchartrain and Lake St. Catherine with Little Lake and Lake Borgne. The Pascagoula River and its distributaries flow into Pascagoula Bay and Mississippi Sound. This unit provides juvenile, subadult, and adult feeding, resting, and passage habitat for Gulf sturgeon from the Pascagoula and the Pearl River subpopulations. One or both of these subpopulations have been documented by tagging data, historic sightings, and incidental captures as using Pascagoula Bay, The Rigolets, the eastern half of Lake Pontchartrain, Little Lake, Lake St. Catherine, Lake Borgne, Mississippi Sound, within 1 nmi (1.9 km) of the nearshore Gulf of America adjacent to the barrier islands and within the passes (Morrow et al. 1998; Reynolds 1993; Rogillio et al. 2002; Rogillio et al. 2007; Ross et al. 2001; Ross et al. 2009b). Substrate in these areas ranges from sand to silt, all of which contains known Gulf sturgeon prey items. The Rigolets is an 11.3 km (7 mi)-long and about 0.6 km (0.4 mi)-wide passage connecting Lake Pontchartrain and Lake Borgne. This brackish water area is used by adult Gulf sturgeon as a staging area for osmoregulation and for passage to and from wintering areas (Rogillio et al. 2002). Incidental catches of Gulf sturgeon are documented from Lake St. Catherine and Sawmill Pass (Reynolds 1993). Based on the proximity of Little Lake,

Lake St. Catherine, and Sawmill Pass to The Rigolets and Pearl River, we believe these areas are also used for staging and feeding and, therefore, were included with The Rigolets as critical habitat.

Rogillio et al. (2002) and Morrow et al. (1998) indicated that Lake Pontchartrain and Lake Borgne were used by Gulf sturgeon as wintering habitat, with most catches during late September through March. Lake Pontchartrain is 57.9 km (36 mi) long, 35.4 km (22 mi) wide at its widest point, and 3-4.9 m (10-16 ft) deep (USDOC 2002). Morrow et al. (1998) documented Gulf sturgeon from the Pearl River system using Lake Pontchartrain (verified by tags) and summarized existing Gulf sturgeon records, which indicated greater use of the eastern half of Lake Pontchartrain. Although Rogillio et al. (2002) did not relocate any of their sonic tagged adult Gulf sturgeon in Lake Pontchartrain, NMFS has identified the eastern part of this lake as an important winter habitat for juveniles and subadults. Furthermore, we believe that Gulf sturgeon forage in Lake Pontchartrain during the winter. The Lake Pontchartrain Causeway, twin toll highway bridges, extends 33.6 km (20.9 mi) across Lake Pontchartrain from Indian Beach on the south shore to Lewisburg and Mandeville on the north shore. Most records of Gulf sturgeon from Lake Pontchartrain are located east of the causeway, with concentrations near Bayou Lacombe and Goose Point, both on the eastern north shore (Morrow et al. 1998; Reynolds 1993). While Gulf sturgeon have also been documented west of the causeway, generally near the mouths of small river systems(68 FR 13370), we excluded the western portion of Lake Pontchartrain because we believe that the sturgeon utilizing this area are coming from western tributaries and not the Pearl River. Lake Pontchartrain connects by The Rigolets with Lake Borgne. Lake Borgne, the western extension of Mississippi Sound, is partly separated from Mississippi Sound by Grassy Island, Half Moon (Wuebbles et al. 2017) Island, and Le Petit Pass Island. Lake Borgne is approximately 14.3 km (23 mi) in length, 3-6 km (5-10 mi) in width and 1.8-3 m (6-10 ft) in depth. Many Gulf sturgeon were anecdotally reported as taken incidentally in shrimp trawls in Lake Borgne 0.6-1.2 km (1-2 mi) south of the Pearl River between August and October from the 1950s through the 1980s (Reynolds 1993). There are twenty-two additional records of Gulf sturgeon in Lake Borgne (68 FR 13370). Known locations are spread out around the perimeter of the lake, including at the mouth of The Rigolets, Violet Canal, Bayou Bienvenue, Polebe, Alligator Point, and at Half Moon Island (Reynolds 1993).

The Mississippi Sound is separated from the Gulf of America by a chain of barrier islands, including Cat, Ship, Horn, and Petit Bois Islands. Natural depths of 3.7-5.5 m (12-18 ft) are found throughout the Sound and a channel 3.7 m (12 ft) deep has been dredged where necessary from Mobile Bay to New Orleans. Incidental captures and studies confirm that both Pearl River and Pascagoula River adult Gulf sturgeon winter in the Mississippi Sound, particularly around barrier islands and barrier islands passes (Reynolds 1993; Rogillio et al. 2007; Ross et al. 2001). Pascagoula Bay is adjacent to the Mississippi Sound. Gulf sturgeon exiting the Pascagoula River move both east and west, with telemetry locations as far east as Dauphin Island and as far west as Cat Island and the entrance to Lake Pontchartrain (Ross et al. 2001). Tagged Gulf sturgeon from the Pearl River subpopulation have been located between Cat Island, Ship Island, Horn

Island, and east of Petit Bois Islands to the Alabama State line (Rogillio et al. 2002). Gulf sturgeon have also been documented within 1 nmi (1.9 km) off the barrier islands of Mississippi Sound.

Habitat used by Gulf sturgeon in the vicinity of the barrier islands is 1.9-5.9 m (6.2-19.4 ft) deep (average 4.2 m [13.8 ft]), with clean sand substrata (Heise et al. 1999; Rogillio et al. 2007; Ross et al. 2001). Preliminary data from substrate samples taken in the barrier island areas indicate that all samples contained lancelets (Ross et al. 2001). Inshore locations where Gulf sturgeon were located (Deer Island, Round Island) were 1.9-2.8 m (6.2-9.2 ft) deep and all had mud (mostly silt and clay) substrata (Heise et al. 1999), typical of substrates supporting known Gulf sturgeon prey.

Unit 9 includes Pensacola Bay and its adjacent main bays and coves (Figure 50). These include Big Lagoon, Escambia Bay, East Bay, Blackwater Bay, Bayou Grande, Macky Bay, Saultsmar Cove, Bass Hole Cove, and Catfish Basin. All other bays, bayous, creeks, and rivers are excluded at their mouths. The western boundary is the Florida State Highway 292 Bridge crossing Big Lagoon to Perdido Key. The southern boundary is the 72 COLREGS line between Perdido Key and Santa Rosa Island (defined at 33 C.F.R. § 80.810). The eastern boundary is the Florida State Highway 399 Bridge at Gulf Breeze, Florida. The lateral extent of Unit 9 is the MHW line on each shoreline of the included waterbodies.

The Pensacola Bay system includes five interconnected bays, including Escambia Bay, Pensacola Bay, Blackwater Bay, East Bay, and the Santa Rosa Sound. The Santa Rosa Sound is addressed separately in Unit 10. The Escambia River and its distributaries (Little White River, Dead River, and Simpson River) empty into Escambia Bay, including Bass Hole Cove, Saultsmar Cove, and Macky Bay. The Yellow River empties into Blackwater Bay. The entire system discharges into the Gulf of America, primarily through a narrow pass at the mouth of Pensacola Bay.

The Pensacola Bay system provides winter feeding and migration habitat for Gulf sturgeon from the Escambia River and Yellow River subpopulations. Florida Department of Environmental Protection researchers conducted tracking studies in the Pensacola Bay system from 1999-2002 to observe Gulf sturgeon winter migrations. They identified specific areas in the bays where Escambia River and Yellow River Gulf sturgeon collect, or migrate through, during the fall and winter season. These studies also identified two main habitat types where Gulf sturgeon concentrate during winter months. Movement is generally along the shoreline area of Pensacola Bay. Gulf sturgeon showed a preference for several areas in the bay, including Redfish Point, Fort Dickens, and Escribano Point, near Catfish Basin (Craft et al. 2001a; Fox and Hightower 1998). Sandy shoal areas located along the south and east side of Garcon Point, south shore of East Bay (Redfish Point area) and near Fair Point, appear to be commonly used, especially in the fall and early spring. During midwinter, sturgeon are commonly found in deep holes located north of the barrier island at Ft. Pickens, south of the Pensacola Naval Air Station, and at the entrance of Pensacola Pass. The depth in these areas ranges from 6-12.1 m (20-40 ft). Other

areas where tagged fish were frequently located include Escribano Point, near Catfish Basin, and the mouth of the Yellow River. Previous incidental captures of Gulf sturgeon have been recorded in Pensacola Bay, Big Lagoon, and Bayou Grande (Reynolds 1993).

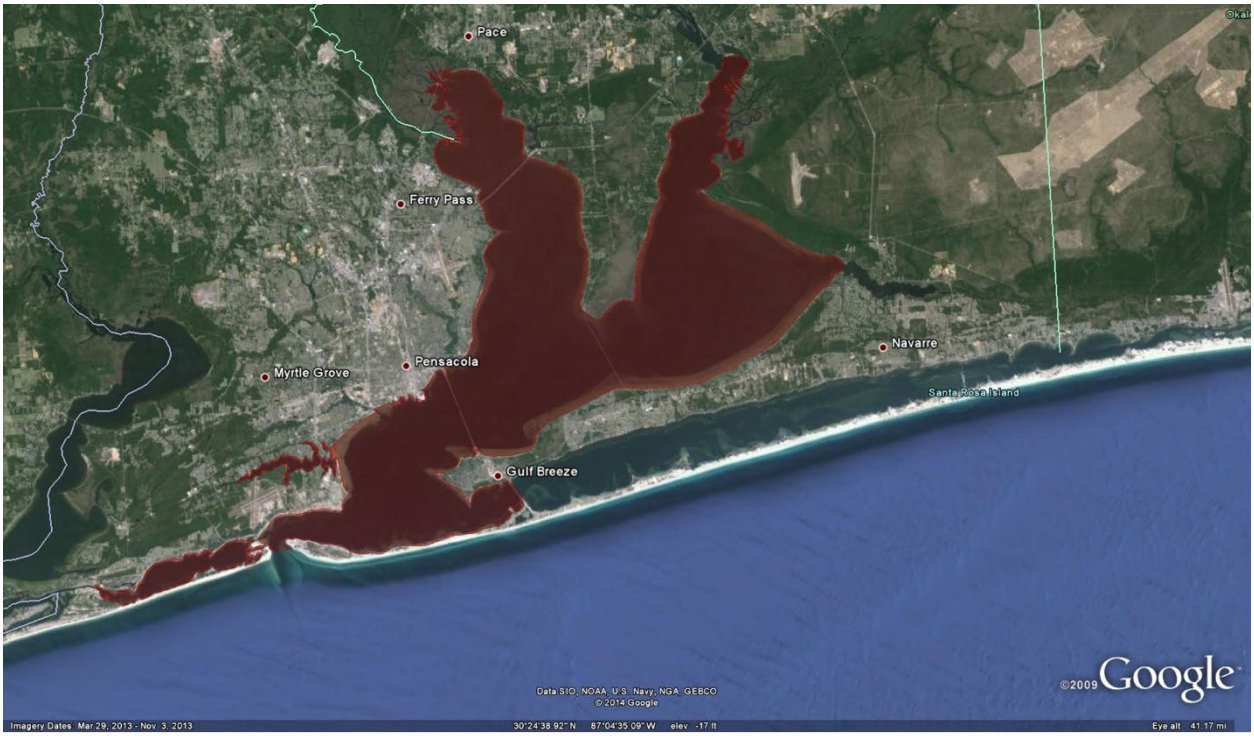


Figure 50. Gulf sturgeon critical habitat Unit 9

Unit 10 includes the Santa Rosa Sound, bounded on the west by the Florida State Highway 399 bridge in Gulf Breeze, Florida and the east by U.S. Highway 98 bridge in Fort Walton Beach, Florida (Figure 51). The northern and southern boundaries of Unit 10 are formed by the shorelines to the MHW line or by the entrance to rivers, bayous, and creeks.

The Santa Rosa Sound is a lagoon between the mainland and Santa Rosa Island that connects Pensacola Bay in the west with Choctawhatchee Bay in the east. The Sound extends east to west approximately 57.9 km (35.9 mi) and varies in width between 0.32 and 3.5 km (0.2 to 2.2 mi). The Intracoastal Waterway transects the sound. The Santa Rosa Sound is designated as critical habitat because we believe it provides a single continuous migratory pathway between Choctawhatchee Bay, Pensacola Bay, and the Gulf of America for feeding and genetic interchange. Within the last 3,000 years, periodic shoaling closed the opening of Choctawhatchee Bay to the Gulf of America.

For many years, the Santa Rosa Sound provided the only way for Choctawhatchee River Gulf sturgeon to migrate to the Gulf of America (Wakeford 2001). Recent locations of subadult and adult Gulf sturgeon within the Santa Rosa Sound confirm its present use by the Choctawhatchee River subpopulations (Fox et al. 2002). The Escambia and Yellow Rivers subpopulations may also use this area due to its close proximity. Gulf sturgeon have been located mid-channel and in

shoreline areas in 2-5.2 m (6.6-17.1 ft) depths and sand substrate. The approximate length of the critical habitat unit is 52.8 km (33 mi). Bridges were chosen as the eastern and western boundaries for ease in identification. Any portion of the sound not included in this unit is captured by the adjacent critical habitat units.

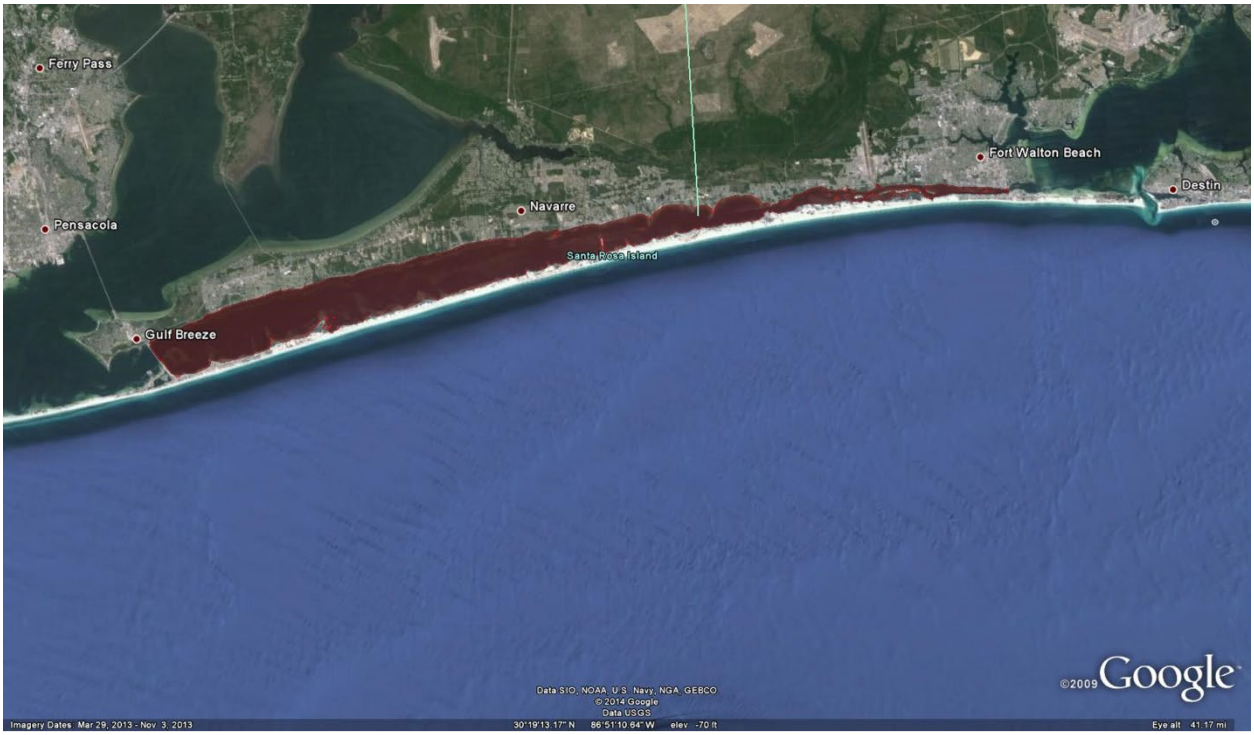


Figure 51. Gulf sturgeon critical habitat Unit 10

Unit 11 is a portion of the Gulf of America along the shoreline of the Florida panhandle (Figure 52). The western boundary is the line of longitude 87°20.0′W, approximately 1 nmi (1.9 km) west of Pensacola Pass from its intersection with the shore to its intersection with the southern boundary. The northern boundary is the MHW of the mainland shoreline and the 72 COLREGS line at passes as defined at 30 C.F.R. § 80.810 (a–f). The southern boundary of the unit is 1 nmi (1.9 km) offshore of the northern boundary; the eastern boundary is the line of longitude 85°17.0′W from its intersection with the shore (near Money Bayou between Cape San Blas and Indian Peninsula) to its intersection with the southern boundary.

Unit 11 includes winter feeding and migration habitat for Gulf sturgeon from the Yellow River, Choctawhatchee River, and Apalachicola River subpopulations. Telemetry relocation data suggest that these subpopulations feed in nearshore Gulf of America waters between their natal river systems (Fox et al. 2002). Gulf sturgeon from the Choctawhatchee River subpopulation have been documented both east and west of Choctawhatchee Bay (Fox et al. 2002).

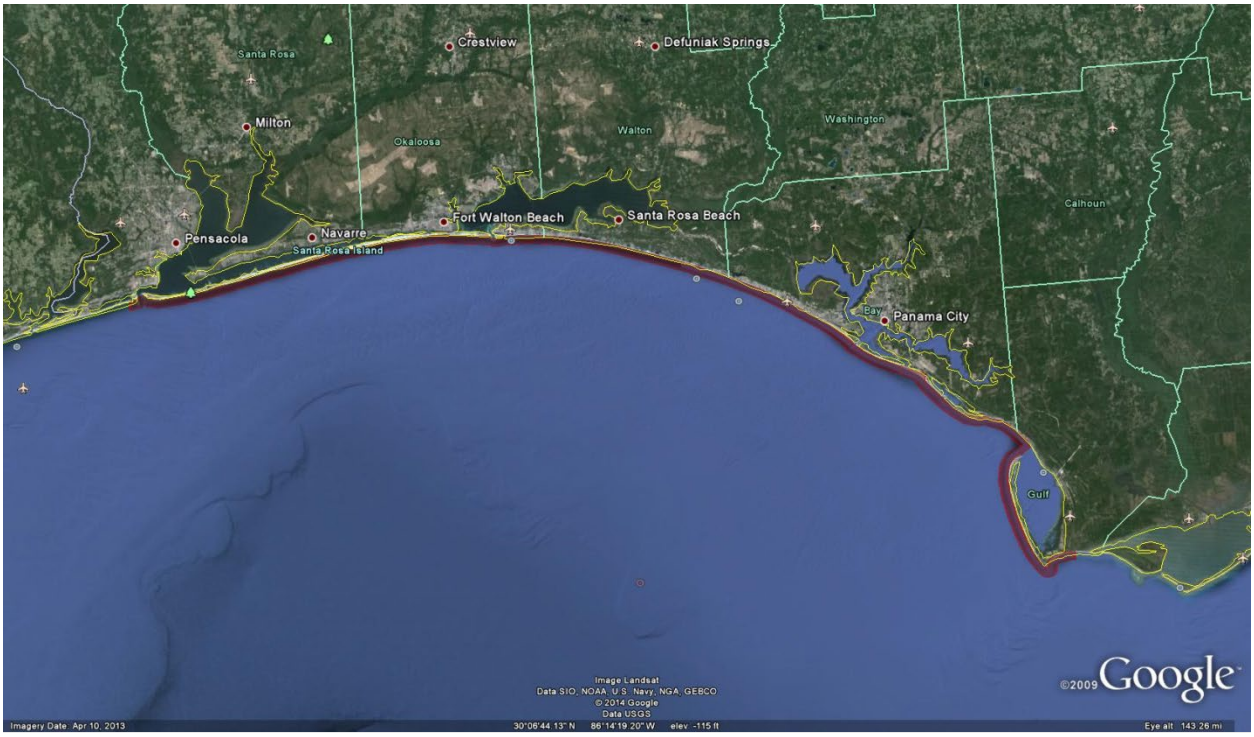


Figure 52. Gulf sturgeon critical habitat Unit 11

During the winter of 2001–2002, personnel from both USGS and FWS attached pop-up satellite tags to 20 Gulf sturgeon (12 from the Suwannee River, 4 four from the Choctawhatchee River, two from the Apalachicola River, and two from the Yellow River) to identify winter feeding areas in the Gulf of America. These data suggest that Gulf sturgeon from the Yellow River, Choctawhatchee River, and Apalachicola River remain within 1.6 km (1 mi) of the coastline between these river systems. Examination of bathymetry data along the Gulf of America coastline between the Pensacola Bay and Apalachicola Bay reveals that depths of less than 6 m (19.7 ft), where Gulf sturgeon are generally found, are all contained within 1 nmi (1.9 km) from shore. Gulf nearshore substrate contains unconsolidated, fine-medium grain sands that support crustaceans such as mole crabs, sand fleas, various amphipod species, and lancelets. Based on movement patterns, it appears these Gulf sturgeon were feeding in the nearshore Gulf of America on route to their natal rivers. Given this information, we included the nearshore (up to 1 nmi [1.9 km]) Gulf of America waters in this unit between Pensacola and Apalachicola Bays.

Unit 12 includes the main body of Choctawhatchee Bay, Hogtown Bayou, Jolly Bay, Bunker Cove, and Grassy Cove (Figure 53). All other bayous, creeks, and rivers are excluded at their mouths/entrances. The western unit boundary is the U.S. Highway 98 bridge at Fort Walton Beach, Florida; the southern boundary is the 72 COLREGS line across East (Destin) Pass as defined at 33 CFR §80.810 (f). The lateral extent of Unit 12 is the MHW line on each shoreline of the included water bodies.



Figure 53. Gulf sturgeon critical habitat Unit 12

Choctawhatchee Bay provides important habitat for maintaining the health of subadult and adult Gulf sturgeon as evidenced by a large number of Gulf sturgeon overwintering in the system (Parauka et al. 2011). The Choctawhatchee Bay offers a feeding area for both subadults and adults (Fox et al. 2002). Tagged subadults showed a preference for shoreline habitats which are predominated by sandy substrates, low salinity, and water depths less than 3 m (10 ft) (Parauka et al. 2011). Most adult Gulf sturgeon were located in shallow water (2-4 m [6.6-13.1 ft]) with predominantly (greater than 80 percent) sandy sediment (Fox et al. 2002). Ghost shrimp, a component of the sturgeon diet, are typically found in substrates ranging from sandy mud to organic silty sand (Lovett and Felder 1989), and their densities were greatest nearshore along the middle and eastern portions of the Choctawhatchee Bay (Heard et al. 2000), the area frequented by the Gulf sturgeon (Fox et al. 2002). We included the deeper central portion of the Bay in Unit 12 as critical habitat because the Gulf sturgeon are known to use the deeper bay waters for movement between the shoreline areas (Fox et al. 2002).

Unit 13 includes the main body of Apalachicola Bay and its adjacent sounds, bays, and the nearshore waters of the Gulf of America (Figure 54). These consist of St. Vincent Sound, including Indian Lagoon; Apalachicola Bay including Horseshoe Cove and All Tides Cove; East Bay including Little Bay and Big Bay; and St George Sound, including Rattlesnake Cove and East Cove. Barrier Island passes (Indian Pass, West Pass, and East Pass) are also included. Sike's Cut is excluded from the lighted buoys on the Gulf of America side to the day boards on the bay side. The southern unit boundary includes water extending into the Gulf of America 1 nmi (1.9 km) from the MHW line of the barrier islands and from 72 COLREGS lines between the barrier

islands (defined at 33 CFR §80.805 (e–h)); the western boundary is the line of longitude 85°17.0'W from its intersection with the shore (near Money Bayou between Cape San Blas and Indian Peninsula) to its intersection with the southern boundary. The eastern boundary of the unit is formed by a straight line drawn from the shoreline of Lanark Village at 29°53.1'N, 84°35.0'W to a point that is 1 nmi (1.9 km) offshore from the northeastern extremity of Dog Island at 29°49.6'N, 84°33.2'W. The lateral extent of Unit 13 is the MHW line on each shoreline of the included water bodies or the entrance of excluded rivers, bayous, and creeks.



Figure 54. Gulf sturgeon critical habitat Unit 13

The Apalachicola River empties into Apalachicola Bay near Little Bay and Big Bay. The Apalachicola Bay system, a highly productive lagoon-and-barrier island complex, consists of the bay proper, East Bay, St. George Sound, Indian Lagoon, and St. Vincent Sound (Wakeford 2001). It is relatively shallow, averaging 2-3 m (6.6-9.8 ft) in depth (Dulaiova and Burnett 2008; Huang and Spaulding 2002). The benthic habitat type most often found in Apalachicola Bay system is soft sediment, comprising approximately 70% of the estuarine area (Dulaiova and Burnett 2008). Its composition of sand, clay, and silt varies considerably depending on the location in the bay. The Apalachicola Bay connects with the Gulf of America through several passes, including Indian Pass, West Pass, East Pass, and Sike's Cut, a man-made opening established in the mid-1950s (Odenkirk 1989).

Unit 13 provides winter feeding migration habitat for the Apalachicola River Gulf sturgeon subpopulation. Gulf sturgeon have been documented by sightings, incidental captures, and telemetry studies throughout Apalachicola Bay, East Bay, St. George Sound, St. Vincent Sound, and Indian Lagoon (Odenkirk 1989; Wooley and Crateau 1985). Gulf sturgeon have also been

documented in Indian Pass, West Pass, East Pass, and just north of Dog Island (Odenkirk 1989; Wooley and Crateau 1985). Substantial weight gains and the presence of suitable habitat for prey items indicate that Gulf sturgeon are feeding while within these bodies of water (Odenkirk 1989; Wooley and Crateau 1985). These areas are also used for accessing adjacent marine and estuarine feeding areas designated in Unit 11. Gulf sturgeon are believed to migrate from Apalachicola Bay into the Gulf of America following prevailing currents and exiting primarily through the two most western passes (Indian and West) (Odenkirk 1989). No Gulf sturgeon have been documented using Sike's Cut; therefore, Sike's Cut was excluded from our designation. Tag return data from incidental captures and relocation data document Gulf sturgeon south of the Apalachicola barrier islands, generally within 1 one mile of the shoreline (Odenkirk 1989). On June 8, 1992, a commercial shrimp fisher provided anecdotal information that he and other shrimp fishers, had caught hundreds of Gulf sturgeon, with estimated weights generally between 22.7-27.2 kg (50-60 lb), in the same location, each spring (April, May, and June), for the past 30 years (1962-1992). The fisher described the location as south of St. George Island, within a few hundred yards of the beach. He described the capture areas as being adjacent to a shoal extending approximately 3.2 km (2 mi) offshore. Examination of bathymetric data shows that there are several shoals in that general vicinity. Since we were unable to confirm the specific location of the area described by this fisher, we extended this critical habitat unit only 1 nmi (1.9 km) offshore of the barrier islands bordering Apalachicola Bay and Cape San Blas, a distance for which we have supporting telemetry data.

Unit 14 includes Suwannee Sound and a portion of adjacent Gulf of America waters extending 9 nm from shore (16.7 km) out to the State territorial water boundary (Figure 55). Its northern boundary is formed by a straight line from the northern tip of Big Pine Island (at approximately 29°23′N, 83°12′W) to the federal-state boundary at 29°17′N, 83°21′W; the southern boundary is formed by a straight line from the southern tip of Richards Island (at approximately 29°11′N, 83°04′W) to the federal-state boundary at 29°04′N, 83°15′W. The lateral extent of Unit 14 is the MHW line along the shorelines and the mouths of the Suwannee River (East and West Pass), its distributaries and other rivers, creeks, or water bodies.

The Suwannee River system is unique among Gulf sturgeon river systems in that the river flows directly into the Suwannee Sound and Gulf of America without any intervening barrier islands. Suwannee Sound is a shallow (typically less than 2 m (6.6 ft), estuarine basin, a little less than 10 nm (8 km) long and a little over 4 nm (8 km) wide at its widest point. It is enclosed on its seaward side by Suwannee Reef, an approximately 14.6 nm (27 km) long arc of oyster reefs and shoals (Edwards et al. 2003). The bathymetry of waters off the coastline and north and south of Suwannee Sound is different from the waters adjacent to other systems. Shallow waters are not confined to the nearshore environment, and depths less than 6 m (19.7 ft) extend 9 - 10 mi (14.5 to 16.1 km) off the coastline.

Telemetry data confirm that subadult and adult Gulf sturgeon leave the river during October and November and enter Suwannee Sound and the nearshore Gulf of America (Carr et al. 1996;

Edwards et al. 2003). Tracking data indicate that Gulf sturgeon move slowly and remained offshore of Suwannee Sound in nearby shallow (less than 6 m [19.7 ft]) marine/estuarine habitats for a period of two months, until at least mid or late December. Overall movement patterns are punctuated by periods of slow movement within small areas, suggesting foraging (Edwards et al. 2003). Mason and Clugston (1993) found large, immigrating Suwannee River Gulf sturgeon fed on nearshore coastal shelf organisms, including lancelets (*Branchiostoma caribaeum*), brachiopods (*Glottida pyramida*), unidentified pelagic shrimps, polychaetes, unidentified marine molluscs, starfish, and sea cucumbers. Carr et al. (1996) found that adult Gulf sturgeon feed primarily on brachiopods and ghost shrimp before entering the river. Numerous underwater beds containing brachiopods have been located in the Suwannee River estuary and adjacent areas in Suwannee Sound (68 FR 13370). Stomach content analyses using a nonlethal method of stomach pumping (lavaging) support that Gulf sturgeon from the Suwannee River subpopulation feed primarily on brachiopods, and to lesser amounts on ghost shrimp, amphipods, and worms prior to entering the river (68 FR 13370).

Gulf sturgeon tracking and relocation data were used to delineate the boundaries of this critical habitat unit. In 1998, 18 out of 19 sonic-tagged Gulf sturgeon were consistently relocated and found to be concentrated in a relatively small area (115 km^2 [44.4 mi^2]) offshore of Suwannee Sound (Edwards et al. 2003). Specific locations within the concentration area were around Waldley Channel, West Gap, and Hedemon Reef. The farthest offshore area was Hedemon Reef, approximately 5 to 6 nm (9.3 to 11.1 km) from the Suwannee River opening.

Telemetry data and tag recaptures documented Gulf sturgeon using Gulf of America waters as far out as 9 nm (16.7 km) (Edwards et al. 2003; Sulak and Clugston 1999). Additionally, on March 22, 2002, two Gulf sturgeon were observed jumping in the area of 29°14′N, 83°18′W, further substantiating the Gulf sturgeon's use of shallow State waters further offshore (greater than 6 nm (11.1 km) (68 FR 13370). Benthic samples taken where the fish were jumping were comprised of fine sand substrate and lancelets. Lancelets are recovered less frequently than brachiopods in the stomachs of Suwannee River Gulf sturgeon, but this may be a result of quicker decomposition of lancelets during digestion compared to brachiopods. Our designation, therefore, included waters out to 9 nm (16.7 km) to encompass those areas that we believed were essential for the conservation of Gulf sturgeon. The northern extent of the tracked sturgeon concentration area depicted in Edwards et al. (2003) corresponds approximately to the northern-most extremity of Big Pine Island. We, therefore, chose that easily identifiable location for the northern limit of this critical habitat unit. The southern extent of the concentration area depicted in (Caballero et al. 2007) corresponds approximately to Richards Island. In addition to the telemetry data, Gulf sturgeon sightings are frequently reported around Deer Island and Derrick Key (68 FR 13370). Derrick Key, where Gulf sturgeon sightings are frequently reported, is approximately 1 mile (1.6 km) offshore of Richards Island. Based on these data, we designated the southernmost extremity of Richards Island for the southern limit of Unit 14.

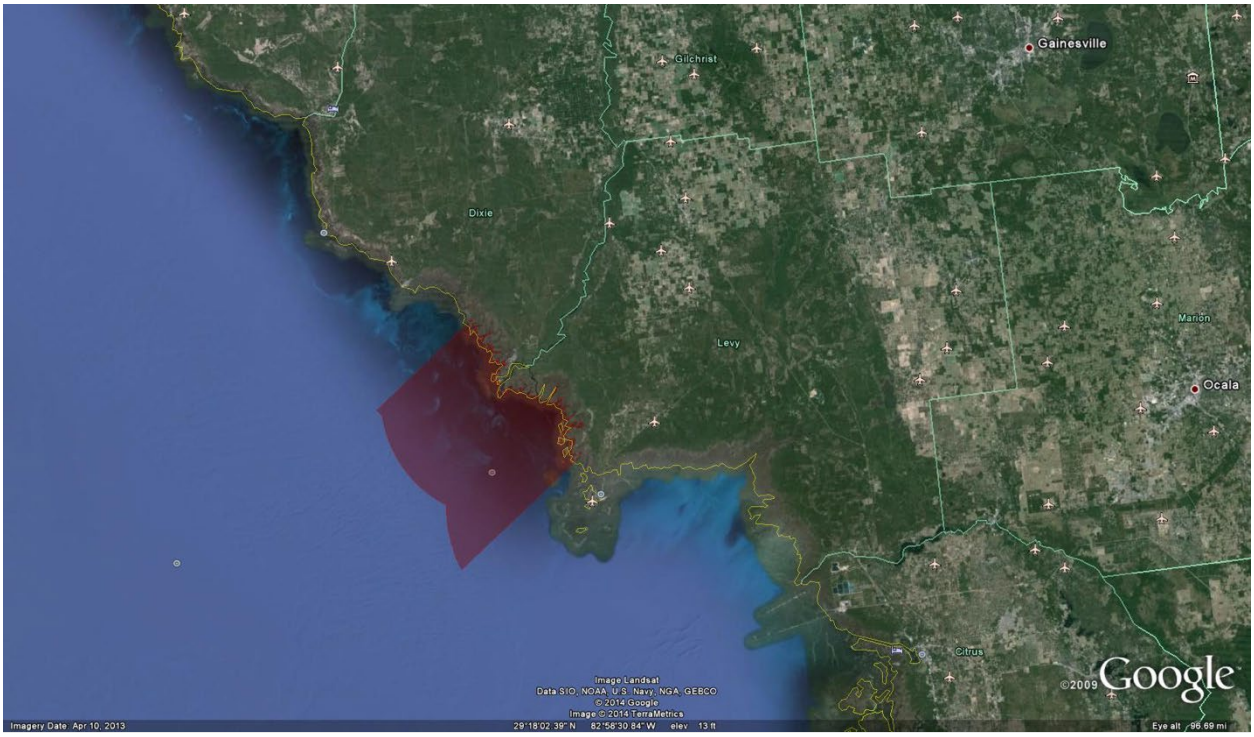


Figure 55. Gulf sturgeon critical habitat Unit 14

6.2.13.1 Status

Activities associated with coastal development have been and continue to be the primary threat to marine and estuarine units of Gulf sturgeon critical habitat. These activities generally include dredge and fill projects, freshwater withdrawals, and storm water drainage systems. Although many coastal development activities are currently regulated, some permitted direct and/or indirect damage to habitat from increased urbanization still occurs and is expected to continue in the future.

Each unit is impacted by a number of activities including dredging, shoreline armoring, installation of breakwaters, and construction of docks, piers, marinas, and artificial reefs. Since tracking began in 2003, NMFS has documented the amount of critical habitat affected by federal actions (Table 26). Most of these impacts were temporary, with effects lasting a few days to months, but generally less than a year. However, some critical habitat has been permanently lost from each of the units. The majority of permanent loss has occurred in Units 8 and 11 as part of beach nourishment and shoreline stabilization projects.

Table 26. Amount of Critical Habitat Impacted by Federal Actions since 2003

Unit	Total Acreage Impacted	Permanent Acreage Loss
8	66,546	655
9	11,485	43
10	4.5	0.55

11	3,925	2,851
12	15	0.12
13	671	1.8
14	10	10

6.2.13.2 Threats

As stated in the final rule designating Gulf sturgeon critical habitat, the following activities, when authorized, funded or carried out by a federal agency, may destroy or adversely modify critical habitat:

- Actions that would appreciably reduce the abundance of riverine prey for larval and juvenile sturgeon, or of estuarine and marine prey for juvenile and adult Gulf sturgeon, within a designated critical habitat unit, such as dredging, dredged material disposal, channelization, in-stream mining, and land uses that cause excessive turbidity or sedimentation.
- Actions that would alter water quality within a designated critical habitat unit, including temperature, salinity, pH, hardness, turbidity, oxygen content, and other chemical characteristics, such that it is appreciably impaired for normal Gulf sturgeon behavior, reproduction, growth, or viability, such as dredging; dredged material disposal; channelization; impoundment; in-stream mining; water diversion; dam operations; land uses that cause excessive turbidity; and release of chemicals, biological pollutants, or heated effluents into surface water or connected groundwater via point sources or dispersed non-point sources.
- Actions that would alter sediment quality within a designated critical habitat unit such that it is appreciably impaired for normal Gulf sturgeon behavior, reproduction, growth, or viability, such as dredged material disposal; channelization; impoundment; in-stream mining; land uses that cause excessive sedimentation; and release of chemical or biological pollutants that accumulate in sediments.
- Actions that would obstruct migratory pathways within and between adjacent riverine, estuarine, and marine critical habitat units, such as dams, dredging, point-source-pollutant discharges, and other physical or chemical alterations of channels and passes that restrict Gulf sturgeon movement (68 FR 13399).

Dredge and fill activities associated with the creation and maintenance of navigation channels as well as coastal development can result in the loss of Gulf sturgeon habitat (Wooley and Crateau 1985). Dredging activities can pose significant impacts to aquatic ecosystems by: (1) direct removal/burial of organisms; (2) turbidity/siltation effects; (3) contaminant re-suspension; (4) sound/disturbance; (5) alterations to hydrodynamic regime and physical habitat; and (6) loss of riparian habitat (Chytalo 1996; Winger et al. 2000). In regards to Gulf sturgeon and their critical habitat, dredging may alter benthic feeding areas, disrupt spawning migrations, modify substrate

composition, and transform benthic morphology. Dredge and fill activities have and continue to threaten Gulf sturgeon critical habitat.

Evaluations of water and sediment quality in Gulf Sturgeon habitat on the northern Gulf of America coast have consistently shown elevated pollutant loads. Chemicals and metals such as chlordane, DDE, DDT, dieldrin, PCBs, cadmium, mercury, and selenium settle to the river bottom and are later incorporated into the food web as they are consumed by benthic feeders, such as sturgeon or macroinvertebrates. Some of these compounds may affect physiological processes and impede the ability of a fish to withstand stress, while simultaneously increasing the stress of the surrounding environment by reducing dissolved oxygen (DO, altering pH, and altering other water quality properties. Although little is known about contaminant effects on Gulf sturgeon, pollution from industrial, agricultural, and municipal activities is believed to be responsible for a suite of physical, behavioral, and physiological impacts to sturgeon species worldwide (Agusa et al. 2004; Bickham et al. 1998; Chebanov and Billard 2001; Kajiwara et al. 2003; Khodorevskaya et al. 1997; Lescheid et al. 1995).

7 ENVIRONMENTAL BASELINE

The "environmental baseline" refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to 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 C.F.R. §402.02). In this section, we discuss the environmental baseline within the action area as it applies to species that are likely to be adversely affected by the Oil and Gas Program.

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

7.1 Environmental Trends

Temperature profiles have been collected in the Gulf since the 1920s. The Gulf of America region has experienced a warming rate of ~ 0.193°C decade^{-1} since 1970, and has warmed at least 1.0°C in the past ~50 years (Wang et al. 2023). The rate of warming in the Gulf of America

is twice that for the global ocean (0.086°C decade^{-1}), but only slightly higher than the warming trend in the subtropical northern Atlantic Ocean (0.183°C decade^{-1}) (Wang et al. 2023). Overall, the Atlantic Ocean region appears to be warming faster than all other ocean basins except the Southern Ocean, and is projected to continue experience substantial warming in the upper 2,000 meters of water even under conservative emissions scenarios (Cheng et al. 2022). On average, the general warming trend in the North Atlantic Ocean over the last 80 years is 0.031±0.0006 ºC per decade in the upper 2,000 m (6,561.7 ft) of the ocean (Polyakov et al. 2009).

One consequence of warming waters in the Gulf of America is exacerbation of hypoxic conditions in the 'Dead Zone' primarily caused by excessive nutrient pollution and freshwater discharge from the Mississippi River basin. Rising temperatures reduce oxygen solubility and affect water stratification, further worsening hypoxia (Altieri and Gedan 2015; Bianchi et al. 2010; Laurent et al. 2018). Air emissions from oil and gas activities, particularly nitrogen oxides (NOx), may also contribute to nutrient loading via atmospheric deposition, potentially influencing hypoxia in coastal waters (BOEM 2023b). Changes to the marine biophysical environment are also affecting the growth and movement dynamics of pelagic *Sargassum* in the Gulf of America; which is designated as critical habitat for juvenile green sea turtles (Marsh et al. 2023; Sanchez-Rubio et al. 2018).

A recent study has provided additional evidence that long-term warming has led to changes in ocean circulation which have altered the migration timing of marine species (Langan et al. 2021). In the Gulf of America, fish and invertebrate species shifted to deeper regions, rather than exhibiting a pole-ward shift like other continental shelf species assemblages in North America (Pinsky et al. 2013). Along the Texas coast over a 35-year timeframe, researchers observed 32 species exhibiting range shifts, either expanding or contracting their expected distribution due to changing environmental factors (Fujiwara et al. 2019).

These changes in species distributions and community structure could potentially affect ESA-listed species. Key marine predators are predicted to experience a 35% change in core habitat area in the Pacific Ocean, with both losses and gains in habitat due to changing environmental conditions (Hazen et al. 2012) and we anticipate similar effects in the Atlantic, including the Gulf of America. Notably, leatherback turtles were predicted to gain core habitat area, whereas loggerhead turtles and blue whales were predicted to experience losses in available core habitat. McMahon and Hays (2006) predicted increased ocean temperatures will expand the distribution of leatherback turtles into more northern latitudes. The authors noted this is already occurring in the Atlantic Ocean. (MacLeod 2009) estimated, based upon expected shifts in water temperature, 88% of cetaceans will be affected by changing environmental conditions, with 47% predicted to experience unfavorable conditions (e.g., range contraction). Willis-Norton et al. (2015) acknowledged there will be both habitat loss and gain, but overall changing environmental conditions could result in a 15% loss of core pelagic habitat for leatherback turtles in the eastern South Pacific Ocean, which is likely to be similar for this species in the action area.

For ESA-listed corals and mollusk species that form calcium carbonate shells, one of the greatest threats contributing to the extinction risk of ESA-listed species is ocean acidification driven by global carbon dioxide emissions. Ocean acidification occurs as carbon dioxide concentrations increase in the atmosphere, more carbon dioxide is absorbed by the oceans, causing lower pH and reduced availability of calcium carbonate. Because of the increase in carbon dioxide and other greenhouse gases (GHGs) in the atmosphere since the Industrial Revolution, ocean acidification has already occurred throughout the world's oceans, including in the Caribbean, and is predicted to increase considerably between now and 2100 (IPCC 2014; IPCC 2023). Predicted rates of ocean acidification will have adverse impacts on species richness especially for strongly calcifying species, such as corals, echinoderms, and mollusks (Scherer et al. 2022) which provide food resources and habitat for sea turtle species.

Though predicting the precise consequences of changing environmental conditions on highly mobile marine species is difficult (Simmonds and Isaac 2007), recent research has indicated a range of consequences already occurring (Lettrich et al. 2023). Marine mammal species with restricted geographical distributions and habitat tolerances will have limited opportunities to adapt to the changing conditions of their environment. Marine mammals rely on stable environments where prey availability is relatively predictable (Lettrich et al. 2023). Vulnerability assessments, for instance, can provide a framework for evaluating the impacts of changing environmental conditions over a broad range of species using currently available information. Vulnerability to changing environmental conditions was determined to be very high for 47 U.S. marine mammal stocks in the North Atlantic, Gulf of America, and Caribbean when exposure (projected change in environmental conditions) and sensitivity (ability to tolerate and adapt to changing conditions) were assessed to categorize stocks with a vulnerability index (Lettrich et al. 2023). Temperature, ocean pH, and dissolved oxygen were the primary drivers, which in turn impacted prey and habitat parameters. The Gulf of America was also considered to be "highly" or "very highly" vulnerable to changing environmental conditioins in this study.

Changes in the marine ecosystem caused by changing environmental conditions could influence the distribution and abundance of lower trophic levels (e.g., phytoplankton, zooplankton, submerged aquatic vegetation, crustaceans, mollusks, forage fish), ultimately affecting primary foraging areas of ESA-listed species including marine mammals, sea turtles, and fish. For example, blue whales, as predators that specialize in eating krill, are likely to change their distribution in response to changes in the distribution of krill (Clapham et al. 1999; Payne et al. 1986; Payne et al. 1990). Pecl and Jackson (2008) predicted changing environmental conditions will likely result in squid that hatch out smaller and earlier, undergo faster growth over shorter lifespans, and mature younger at a smaller size. This could have negative consequences for species such as sperm whales, whose diets can be dominated by cephalopods. For ESA-listed species that undergo long migrations, if either prey availability or habitat suitability is disrupted by changing ocean temperatures regimes, the timing of migration can change or negatively impact population sustainability (Simmonds and Eliott 2009).

Sea turtles are especially sensitive to temperature-related changes in their life history and habitat. Notably, 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 to 35°C (Ackerman 1997). Increases in global temperature could skew future sex ratios toward higher numbers of females (NMFS and USFWS 2007aa; NMFS and USFWS 2007db; NMFS and USFWS 2013ba; NMFS and USFWS 2013cb; NMFS and USFWS 2015). These impacts will be exacerbated by sea level rise.

Our review highlights evidence of significant changes in environmental conditions in the Gulf of America that may affect ESA-listed species and their habitats. While it is difficult to predict the consequences of these changing environmental conditions to a particular species or habitat, a range of consequences are expected that are likely to change the status of the species and the condition of their habitats. This is discussed further in the Integration and Synthesis (Section 12).

7.2 Sound

Anthropogenic noise continues to be a major concern for marine species, especially marine mammals, in the Gulf. Sound is a stressor that is produced by many activities discussed in the remaining baseline sections below.

NMFS has established criteria to predict varying levels of responses of marine species to anthropogenic sound, based upon hearing injury and behavioral responses (http://www.nmfs.noaa.gov/pr/acoustics/guidelines.htm). Responses to sound exposure may include lethal or nonlethal injury, temporary hearing impairment, behavioral harassment and stress, or no apparent response. Contributions to ambient sound levels include vessels, geophysical exploration, and the construction, operational, and decommissioning of offshore structures. Since the 2020 consultation on the Oil and Gas Program, several policies on managing anthropogenic sound in the marine environment provide guidance for programs such as incidental harassment permits under the Marine Mammal Protection Act and permits for research involving sound-producing activities. For example, NOAA is working cooperatively with the shipbuilding industry to find technologically based solutions to reduce the amount of sound produced by commercial vessels. BOEM and BSEE have implemented and periodically revised Gulf of America-wide measures through ESA consultation with NMFS, such as BOEM NTL 2016-G02, to reduce the risk of harassment to sperm whales from sound produced by geological and geophysical surveying activities and the explosive removal of offshore structures.

NOAA has implemented the CetSound Ocean Sound Strategy (http://cetsound.noaa.gov/) that improves understanding of anthropogenic sound impacts on cetacean species. CetSound produced modeled ambient sound maps for several sound source types in the Gulf of America. Annual average ambient sound sums of the modeled source types including seismic airgun surveys at different frequencies and depths is displayed in Figure 56. Other modeled events that can be viewed on the CetSound website for the Gulf of America include annual average ambient

sound for only seismic airguns surveys, summed sound sources without airguns, and explosive severance of an oil platform during decommissioning.

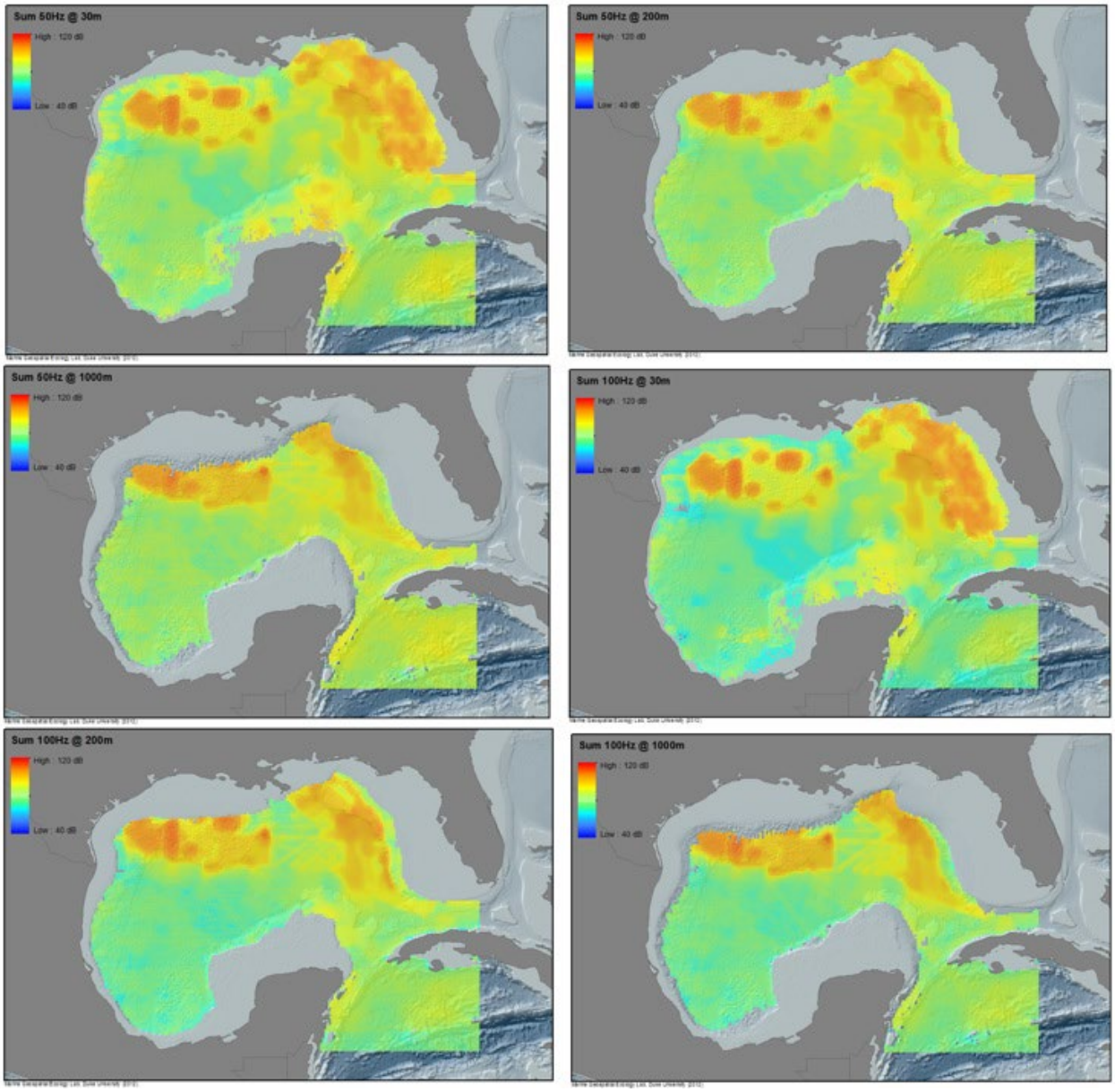


Figure 56. Predicted average contribution to ambient sound from modeled sound sources including seismic airgun surveys at different depths for 50 Hz and 100 Hz. Source: Marine Geospatial Ecology Lab, Duke University (2012) as published on CetSound website

The Gulf of America soundscape is being studied over the long-term by NOAA's Sound Reference Station Network (https://www.pmel.noaa.gov/acoustics/ocean-sound-reference.html). This network uses static PAM hydrophone (sound recorder) units to monitor trends and changes in the ambient sound field in U.S. federal waters. In addition to this network, there have been several other hydrophone units in the northern Gulf of America (Figure 57). A study by Wiggins et al. (2016) placed two high-frequency acoustic recording packages (HARPs) in 100 m to 250 m

water depths and three HARPs in approximately 1,000 m water depth to compare low-frequency sound pressure spectrum levels over three years. NOAA's Southeast Fisheries Science Center (SEFSC0, UCSD's Scripps Institution of Oceanography (SIO), and partners initiated a comprehensive, long-term, multi-scale passive acoustic monitoring program throughout the US and Gulf of America waters from 2020 to 2025 to expand upon the initial study. Through this program, scientists are collecting data needed to develop predictive habitat models to assess the processes driving seasonal, interannual, and decadal trends in spatial distribution, density, and abundance of oceanic cetaceans and to assess contributions of ambient noise sources to the Gulf soundscape. This collaborative study deploys HARPs, continuously recording over the 10-100 kHz band, over the 5-year period. Additionally, the study leverages 10 years of historic HARP recordings at five long-term sites, collected by SIO as part of the DWH damage assessment to enhance the assessment of trends in cetacean density and noise (Rafter et al. 2022). Here, we include the preliminary results from the first year of the HARP recordings at sites collected under the "LISTEN Gulf of Mexico (GoMex) project" from 2020-2021 (Figure 57).

The low-frequency ambient soundscape, between 10-1000 Hz, was dominated by sounds from anthropogenic activities, notably seismic exploration at deep sites and shipping at shallow sites. Seismic survey signals dominated the ambient soundscape below 100 Hz throughout the historic time series and at the new 2020-2021 sites, with the same surveys detected simultaneously at distant sites throughout the Gulf. Sounds levels are most elevated in the airgun frequency band (10 Hz to 100 Hz) at sites GC and MC, which are located within or near active lease blocks, and more moderately at the site DT, where these deepwater signals propagate effectively, but signals are not typically produced nearby. During quieter periods between seismic surveys, moderately elevated sound levels in the 30-90 Hz frequency band are often evident, representing noise from vessel traffic.

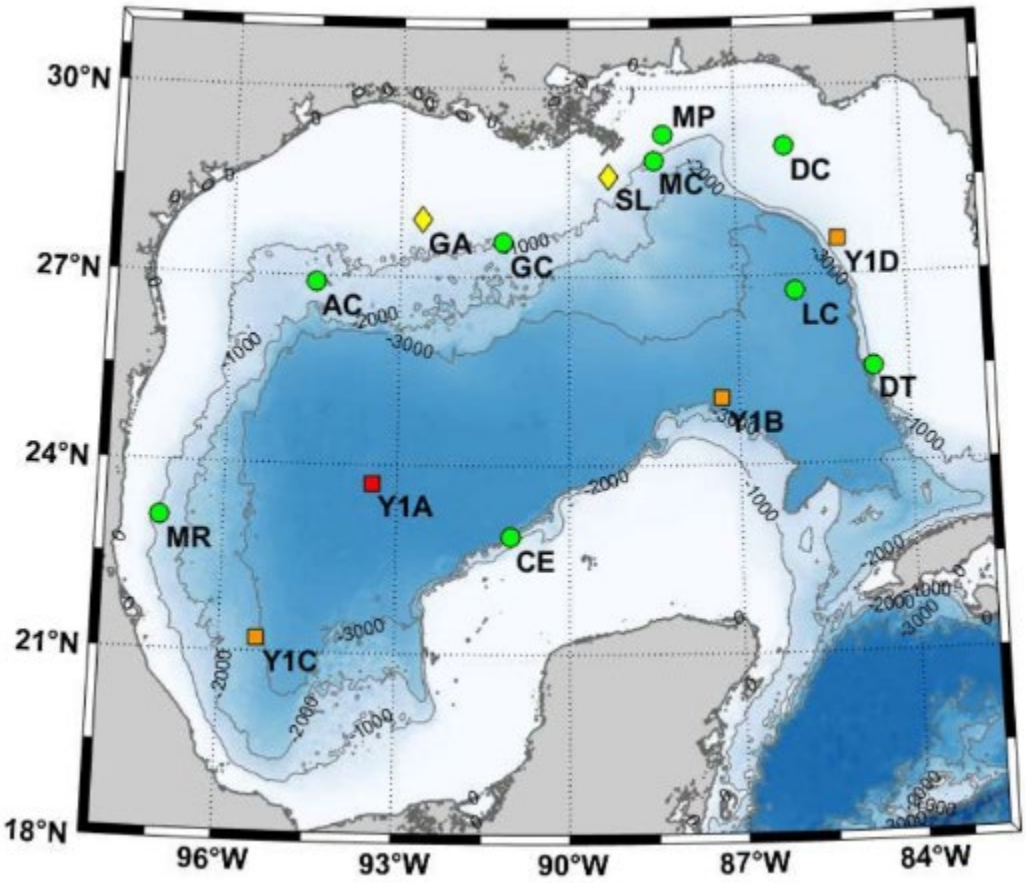


Figure 57. Location of the HARPs and Mid-Acoustic Frequency Recording Packages (MARPs). Green circles represent multi-year HARP sites, orange squares represent single-year HARP sites, yellow diamonds represent MARP sites where there was no effect because of data quality issues (Figure from Wiggins et al. 2016)

The monitoring data also demonstrates spatially and temporally variable patterns in noise concentration. The spatial distribution of monthly median octave band-levels at each site over the 2020-2021 period highlights some of the noise sources described in Table 27 (Rafter et al. 2022). The 31.5 Hz octave-band-level represents noise from shipping traffic, and the 500 Hz band-level represents noise from weather. The 31.5 Hz octave band-levels are generally higher in the western Gulf than the eastern Gulf, which is expected given the distribution of airgun energy in the northwestern Gulf. April, May and December have particularly high levels across western sites, and in September, levels were especially high at the central Gulf sites. These correspond with locations of seismic survey activity. Ambient sound levels were lowest at site DC (De Soto Canyon), followed by sites MC, DT and Y1D. However, noise levels were elevated in March and April. Site DC has substantially lower noise levels in the 125 Hz octave band, which encompasses Rice's whale call frequencies, compared to fall and winter. This may be attributed to seasonal weather variation seen at higher frequencies, during the spring and summer months.

Unsurprisingly, ship noise dominated the ambient soundscapes at the two shipping lane sites (GA – Galveston, SL – Southern Louisiana), where the highest number of ship detections and longest time with ship noise present occurred. At sites outside of the shipping lanes, vessel transit detections and time present were high at Alaminos Canyon (near ports of Corpus Christi and Houston) (Rafter et al. 2022).

Table 27. Minimum and maximum ambient band-levels received over the August 2020-2021 period in the octave bands centered on 31.5 Hz, 63 Hz, 125 Hz, and 500 Hz (Rafter et al. 2022)

Octave Band (Hz)	Minimum RL (dB re μPa^2)	Maximum RL (dB re μPa^2)
16	83.0	110.2
31.5	84.9	114.4
63	82.4	115.3
125	77.0	105.4
250	74.7	99.7
500	77.8	93.8

Commercial shipping is a significant contributor to ambient noise in the Gulf of America. Haver et al. (2021) recently assessed chronic low-frequency noise from commercial shipping as a global threat to marine animals. Based on monthly vessel activity data, the Gulf site had the highest number of overall transits, more than double the number of cargo transits, and five times as many tanker transits compared to other sites, with a monthly average of 91 transits. Data also showed that tug vessels traveled farther and spent more time within the buffer than other categories of vessels. At the three monitoring sites with high levels of shipping traffic, including the Gulf, daily average sound levels were consistently near to or higher than 100 db re 1 µPa in both the 63 and 125 Hz one-third octave. In comparison, sound levels were ~20 dB lower year-round in Hawaii and ~10-20 dB lower in the Alaskan Arctic (depending on season). The highest sound levels measured in the Gulf of Alaska were also the highest sound levels measured across all five sites.

7.3 Fisheries Bycatch and Interactions

Commercial and recreational fisheries can result in substantial detrimental impacts on populations of ESA-listed species. Past trends of overharvesting in fisheries have contributed to population declines of many ESA-listed fish species. Although directed fishing for the species covered in this opinion is prohibited under the ESA, many listed species are still captured as "bycatch" in fishing operations targeting other species. Bycatch occurs when fishing operations interact with marine mammals, sea turtles, and fish species that are not the target species for commercial harvest. Large marine species are particularly susceptible to entanglement in fishing gear that is being actively deployed as well as derelict or "ghost fishing" gear that has been abandoned in the pelagic environment.

7.3.1 Federal Fisheries

Commercial and recreational fisheries managed by NMFS under the Magnuson-Stevens Act in the Gulf of America have interacted with sea turtles, sperm whales, and Gulf sturgeon throughout the past. While interactions between federal fisheries and sperm whales or Gulf sturgeon are rare, threatened and endangered sea turtles are more susceptible to interactions with several types of fishing gear in the action area including gillnet, hook-and-line (i.e., vertical line), and trawl gear. A recent study assessing relative bycatch risk in U.S. federal fisheries determined that the Gulf of America's highly-migratory species pelagic longline, shrimp trawl, and fish vertical line fisheries had the highest interaction rates with marine mammals and ESA-listed turtles, based on reported bycatch data from 2010-2015 (Savoca et al. 2020).

Impacts to listed species and critical habitats have been evaluated via ESA section 7 consultation for all fisheries managed under a fishery management plan (FMP) (15 USC § 1853) or for which any federal action is taken to manage that fishery. Past consultations have addressed the effects of federally permitted fisheries on ESA-listed species, sought to minimize the adverse impacts of the action on ESA-listed species, and, when appropriate, have authorized the incidental taking of these species. Formal section 7 consultations have been conducted on the following federal fisheries that operate in the action area: Coastal Migratory Pelagics, Highly Migratory Species (HMS) Atlantic Shark and Smoothhound, Gulf Reef Fish, and Southeastern Shrimp Trawl Fisheries. NMFS has issued an ITS for the take of sea turtles in each of these fisheries that can be found in Appendix A of this opinion. A summary of each consultation is provided below, but more detailed information can be found in the respective biological opinions (NMFS 2011b; NMFS 2011c; NMFS 2012b; NMFS 2015a). Since the 2020 consultation on the Oil and Gas Program, NMFS completed the reinitiation of the formal section 7 consultation on the Implementation of the Sea Turtle Conservation Regulations under the ESA and the Authorization of the Southeast U.S. Shrimp Fisheries in Federal Waters under the MSA.

Sperm whales can become entangled in fishing gear such as longlines or gillnets. While this species is less susceptible to threats posed by fishing gear than other more coastal cetaceans, there is a report of a sperm whale entanglement within the Gulf. Further, Thode et al. (2015)and Straley et al. (2015) used PAM and decoy sound production to demonstrate that sperm whales may be attracted to the acoustic cues of fishing vessels for catch depredation, which could lead to gear entanglement.

Three federal commercial fisheries overlap geographically with Rice's whale proposed critical habitat in the Gulf of America and potentially could interact with the species (Figure 58). These include the Category I Atlantic Ocean, Caribbean, Gulf of America large pelagic longline fishery, and two Category III fisheries: 1) the Southeastern U.S. Atlantic, Gulf of America shark bottom longline/hook-and-line fishery and 2) the Southeastern U.S. Atlantic, Gulf of America, and Caribbean snapper-grouper and other reef fish bottom longline/hook-and-line fishery (Hayes et al. 2023). Direct interactions with gillnets, purse seines, shrimp trawls, and trap pots may be unlikely, but indirect interactions, such as entanglement in derelict "ghost fishing" gear may pose

a threat for Rice's whales. Indirect effects of fishing harvest, such as ecosystem wide trophic impacts, may also be of concern (Rosel 2016).

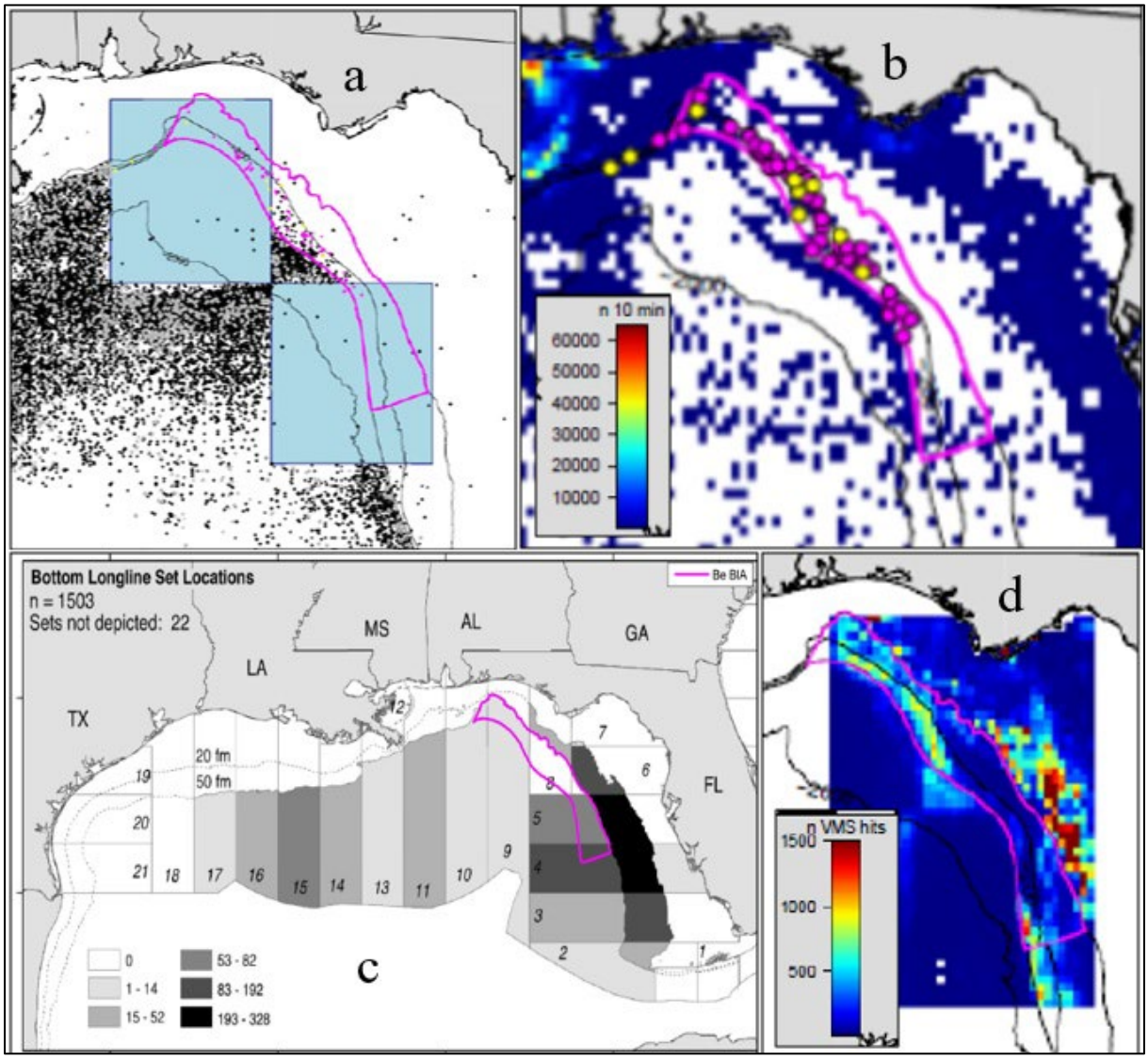


Figure 58. a.) Pelagic longline set locations - blue boxes represent the De Soto Canyon MPA, which is closed to pelagic longline fishing year-round and covers approximately 2/3 of the Rice's whale BIA. b.) Shrimp trawl active fishing effort near the BIA from 2002-2014. c.) Bottom longline sets from 2006-2009. d.) Vessel Monitoring System ping locations from vessels carrying reef fish permit and shark directed permit, and may represent both transiting and active fishing. Figures from Rosel (2016)

Gulf sturgeon are believed to be susceptible to capture only in trawls and gillnet gear via entanglement. However, because Gulf sturgeon occur in the Gulf of America only during winter months and during that time most migrate alongshore and to barrier island habitats within shallower state waters, we believe federal fisheries have only a minor impact on the species. On December 15, 2009, an observer documented a Gulf sturgeon capture in a shrimp trawl operating in federal waters; the animal was released alive. This observation was the first and only record of a Gulf sturgeon incidentally caught by a federal shrimp trawl. This capture, among other things,

led to reinitiation of consultation on the federal shrimp fisheries in the southeastern United States. Previous section 7 consultations on federal fisheries discounted effects on Gulf sturgeon because of their rarity in federal waters. The 2014 biological opinion on the federal shrimp fisheries (NMFS 2014c) determined that while capture of Gulf sturgeon in shrimp trawls remains an unlikely event, trawling could adversely affect the species though it would not jeopardize its continued existence.

7.3.1.1 Coastal Migratory Pelagics Fishery

In 2015, NMFS completed a section 7 consultation on the continued authorization of the coastal migratory pelagics fishery in the Gulf and South Atlantic (NMFS 2015a). In the Gulf of America, hook-and-line, gillnet, and cast net gears are used commercially, while the recreational sector uses hook-and-line gear. The hook-and-line effort is primarily trolling. The biological opinion concluded that green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles as well as smalltooth sawfish and Atlantic sturgeon may be adversely affected by operation of the fishery. However, the proposed action was not expected to jeopardize the continued existence of any of these species and an ITS was provided.

7.3.1.2 Highly Migratory Species Atlantic Shark and Smoothhound Fisheries

These fisheries include commercial shark bottom longline and gillnet fisheries and recreational shark fisheries under the Fishery Management Plan (FMP) for Atlantic Tunas, Swordfish, and Sharks (HMS FMP). NMFS has formally consulted several times on the effects of HMS shark fisheries on sea turtles (NMFS 2003; NMFS 2008; NMFS 2012a). NMFS has also authorized a federal smoothhound fishery that will be managed as part of the HMS shark fisheries. NMFS (2012b) analyzed the potential adverse effects from the smoothhound fishery on sea turtles for the first time. Both bottom longline and gillnet are known to adversely affect sea turtles. From 2007-2011, the sandbar shark research fishery had 100% observer coverage, with 4-6% observer coverage in the remaining shark fisheries. During that period, ten sea turtle takes (all loggerheads) were observed on bottom longline gear in the sandbar shark research fishery and five were taken outside the research fishery. The five non-research fishery takes were extrapolated to the entire fishery, providing an estimate of 45.6 sea turtle takes (all loggerheads) for non-sandbar shark research fishery from 2007-2010 (Carlson and Gulak 2012; Carlson et al. 2016). No sea turtle takes were observed in the non-research fishery in 2011 (NMFS 2012a). Because the research fishery has a 100% observer coverage requirement, those observed takes were not extrapolated (Carlson and Gulak 2012; Carlson et al. 2016). Because few smoothhound trips were observed, no sea turtle captures were documented in the smoothhound fishery.

The most recent ESA section 7 consultation on the continued operation of Atlantic shark and smoothhound fisheries and Amendments 3 and 4 to the Consolidated HMS FMP was completed on December 12, 2012 (NMFS 2012b). The consultation concluded the proposed action was not likely to jeopardize the continued existence of sea turtles. An ITS was provided authorizing 18 takes (nine of which could be lethal) of each species for hawksbill and leatherback sea turtles

every three years. Loggerhead, green and Kemp's ridley turtle takes were 126, 57, and 36, respectively.

7.3.1.3 Gulf Reef Fish Fishery

The Gulf reef fish fishery uses two basic types of gear: spear or powerhead, and hook-and-line gear. Hook-and-line gear used in the fishery includes both commercial bottom longline and commercial and recreational vertical line (e.g., handline, bandit gear, rod-and-reel).

Prior to 2008, the reef fish fishery was believed to have relatively moderate levels of sea turtle bycatch attributed to the hook-and-line component of the fishery (i.e., approximately 107 captures and 41 mortalities annually, all species combined, for the entire fishery) (NMFS 2005a). In 2008, SEFSC observer programs and subsequent analyses indicated that the overall amount and extent of incidental take for sea turtles specified in the incidental take statement of the 2005 opinion on the reef fish fishery had been severely exceeded by the bottom longline component of the fishery: approximately 974 captures and at least 325 mortalities estimated for the period July 2006-2007.

In response, NMFS published an Emergency Rule prohibiting the use of bottom longline gear in the reef fish fishery shoreward of a line approximating the 50-fathom depth contour in the eastern Gulf of America, essentially closing the bottom longline sector of the reef fish fishery in the eastern Gulf of America for six months pending the implementation of a long-term management strategy. The Gulf Council (Council) developed a long-term management strategy via a new amendment (Amendment 31 to the Reef Fish FMP). The amendment included: (1) a prohibition on the use of bottom longline gear in the Gulf reef fish fishery, shoreward of a line approximating the 35-fathom contour east of Cape San Blas, Florida, from June through August and; (2) a reduction in the number of bottom longline vessels operating in the fishery via an endorsement program and a restriction on the total number of hooks that may be possessed onboard each Gulf reef fish bottom longline vessel to 1,000, only 750 of which may be rigged for fishing.

On October 13, 2009, SERO completed an opinion that analyzed the expected effects of the continued operation of the Gulf reef fish fishery under the changes proposed in Amendment 31 (NMFS-SEFSC 2009b). The opinion concluded that sea turtle takes would be substantially reduced compared to the fishery as it was previously prosecuted, and that operation of the fishery would not jeopardize the continued existence of any sea turtle species. Amendment 31 was implemented on May 26, 2010. In August 2011, consultation was reinitiated to address the DWH oil release event and potential changes to the environmental baseline. Reinitiation of consultation was not related to any material change in the fishery itself, violations of any terms and conditions of the 2009 opinion or an exceedance of the incidental take statement. The resulting September 30, 2011, opinion concluded the continued operation of the Gulf reef fish fishery is not likely to jeopardize the continued existence of any listed sea turtles (NMFS 2011b).

7.3.1.4 Southeastern Shrimp Trawl Fisheries

The high activity of shrimp trawl fishing fleets in the Gulf poses risks of bycatch to listed species including sea turtles, marine mammals, sturgeon, and shark species (NMFS 2014a). The shrimp trawl fishery FMP was amended March 9, 2020, increasing the allowable amount of fishing effort in several zones off the coasts of Missisippi, Louisiana, and Texas (Council 2019). The consultation history for this fishery is closely tied to the lengthy regulatory history governing the use of TEDs and a series of regulations aimed at reducing potential for incidental mortality of sea turtles in commercial shrimp trawl fisheries. The level of annual mortality described in (NRC 1990b) is believed to have continued until 1992-1994, when U.S. law required all shrimp trawlers in the Atlantic and Gulf to use TEDs, allowing at least some sea turtles to escape nets before drowning (NMFS 2002).[20] TEDs approved for use have had to demonstrate 97% effectiveness in excluding sea turtles from trawls in controlled testing. These regulations have been refined over the years to ensure that TED effectiveness is maximized through proper placement and installation, configuration (e.g., width of bar spacing), flotation, and more widespread use.

Despite the apparent success of TEDs for some species of sea turtles (e.g., Kemp's ridleys), TEDs were later discovered to not adequately protect all species and size classes of sea turtles. Analyses by Epperly and Teas (2002) indicated that the minimum requirements for the escape opening dimension in TEDs in use at that time were too small for some sea turtles and that as many as 47% of the loggerheads stranding annually along the Atlantic and Gulf were too large to fit the existing openings. On December 2, 2002, NMFS completed an opinion on shrimp trawling in the southeastern United States (NMFS 2002) under proposed revisions to the TED regulations requiring larger escape openings (68 FR 8456 2003), February 21, 2003). This opinion determined that the shrimp trawl fishery under the revised TED regulations would not jeopardize the continued existence of any sea turtle species. The determination was based in part on the opinion's analysis that shows the revised TED regulations are expected to reduce shrimp trawl related mortality by 94% for loggerheads and 97% for leatherbacks. In February 2003, NMFS implemented the revisions to the TED regulations.

Although mitigation measures have greatly reduced the impact on sea turtle populations, the shrimp trawl fishery is still responsible for large numbers of turtle mortalities each year. The Gulf fleet accounts for a large percentage of the sea turtle bycatch in this fishery. In 2010, the Gulf shrimp trawl fishery had an estimated bycatch mortality of 5,166 turtles (18 leatherback, 778 loggerhead, 486 green and 3,884 Kemp's ridley). By comparison, the southeast Atlantic fishery had an estimated bycatch mortality of 1,033 turtles (8 leatherback, 673 loggerhead, 28 green and 324 Kemp's ridley) in 2010 (NMFS 2014b).

[20] TEDs were mandatory on all shrimping vessels. However, certain shrimpers (e.g., fishers using skimmer trawls or targeting bait shrimp) could operate without TEDs if they agreed to follow specific tow-time restrictions.

On May 9, 2012, NMFS completed a biological opinion that analyzed the continued implementation of the sea turtle conservation regulations and the continued authorization of the Southeast U.S. shrimp fisheries in federal waters under the Magnuson-Stevens Act (NMFS 2012c). The opinion also considered a proposed amendment to the sea turtle conservation regulations to withdraw the alternative tow-time restriction at 50 CFR §223.206(d)(2)(ii)(A)(3) for skimmer trawls, pusher-head trawls, and wing nets (butterfly trawls) and instead require all of those vessels to use TEDs. The opinion concluded that the proposed action was not likely to jeopardize the continued existence of any sea turtle species. An ITS was provided that used anticipated trawl effort and fleet TED compliance (i.e., compliance resulting in overall average sea turtle catch rates in the shrimp otter trawl fleet at or below 12%) as surrogates for sea turtle takes. On November 21, 2012, NMFS determined that a Final Rule requiring TEDs in skimmer trawls, pusher-head trawls, and wing nets was not warranted and withdrew the proposal. The decision to not implement the Final Rule created a change to the proposed action analyzed in the 2012 opinion and triggered the need to reinitiate consultation. Consequently, NMFS reinitiated consultation on November 26, 2012. Consultation was completed in April 2014; the continued implementation of the sea turtle conservation regulations and the continued authorization of the Southeast U.S. shrimp fisheries in federal waters under the Magnuson-Stevens Act was not likely to jeopardize the continued existence of any sea turtle species. The ITS maintained the use of anticipated trawl effort and fleet TED compliance as surrogates for numerical sea turtle takes.

More recent studies demonstrate continued take from the fisheries. From 2011 to 2016, mandatory fisheries observer data for the southeastern shrimp trawl fishery found that otter and skimmer shrimp trawls captured 158 listed sea turtles, five Atlantic sturgeon, and five small-tooth sawfish (Scott-Denton et al. 2020). Data from 2002, 2009, 2014, and 2015 in NOAA's National Bycatch Report Database System indicated that the shrimp trawl was likely to capture 709 sea turtles annually as bycatch (Savoca et al. 2020).

On April 26, 2021, NMFS completed reinitiation on the consultation that analyzed the continued implementation of the sea turtle conservation regulations and the continued authorization of the Southeast U.S. shrimp fisheries in federal waters under the MSA (NMFS-SERO 2021). Reinitiation of the 2014 consultation (NMFS 2014a) was triggered by three factors: 1) the listing of new species under the ESA (e.g., green sea turtle DPSs (May 26, 2016) and giant manta ray (February 21, 2018); 2) new bycatch information developed to better analyze the effects of the shrimp fisheries on sea turtle populations; and 3) the December 2019 Final Rule requiring TEDs for a portion of the skimmer trawl fisheries. The reinitiated biological opinion for the reinitiated consultation concluded that the proposed action was not likely to jeopardize the continued existence of any listed species, including sea turtle species. The ITS was revised to include anticipated incidental otter trawl takes for green sea turtles (1,313 total mortalities) and smalltooth sawfish (903 total mortalities) (NMFS-SERO 2021).

7.3.2 State Fisheries

Several coastal state fisheries are known to incidentally take listed species, and available information on these fisheries is documented through different agencies (NMFS 2014c). State commercial and recreational fisheries use gear types including trawling, pot fisheries, gillnets, and vertical line, which are all known to incidentally take sea turtles and/or Gulf sturgeon (NMFS 2014c). However, most available state data are based on extremely low observer coverage, or sea turtles were not part of data collection. Thus, these data provide insight into gear interactions that could occur but are not indicative of the magnitude of the overall problem (NMFS 2014c). The 2001 HMS biological opinion (discussed in fisheries section above) has an excellent summary of turtles taken in state fisheries throughout the action area.

In addition to commercial state fisheries, protected sea turtles can also be incidentally captured by hook and line recreational fishers. Observations of state recreational fisheries have shown that loggerhead, leatherback, Kemp's ridley, and green sea turtles are known to bite baited hooks. Further, observations show that loggerheads and Kemp's ridley frequently ingest the hooks. Hooked turtles have been reported by the public fishing from boats, piers, beaches, banks, and jetties. A detailed summary of the known impacts of hook-and-line incidental captures to loggerhead sea turtles can be found in the TEWG reports (TEWG 1998; TEWG 2000).

Although not as commonly as sea turtles, Gulf sturgeon are also likely to interact with state fisheries. The Gulf sturgeon recovery plan (USFWS and GSMFC 1995) documents that Gulf sturgeon are occasionally incidentally captured in state shrimp fisheries in bays and sounds along the northern Gulf of America. There are two recorded interactions (NMFS 2014a) of a Gulf sturgeon with the shrimp trawl fishery: one in federal waters (January 1, 2011) and one in state waters of the Gulf of America (December 15, 2009). In the Pearl River, Mississippi/Louisiana, a trammel/gillnet fishery is conducted for gar. Because of the gear (minimum of 3-in mesh square, up to 3,000 ft in length) and the year-around nature of the fishery, it is probable that Gulf sturgeon are intercepted in this fishery. While state regulations prohibit taking or possession of whole or any body parts, including roe, there is no reporting to determine capture or release rates.

State fisheries authorized in waters off the coast of Florida are known to occasionally capture smalltooth sawfish. Fishers who capture smalltooth sawfish most commonly are recreationally fishing for snook (*Centropomus undecimalis*), redfish (*Scianops ocellatus*), and sharks (NMFS-SERO 2021). Encounter data indicate that the majority of these interactions are nonlethal.

7.4 Oil and Gas

Oil and gas operations on the OCS have been ongoing for more than 50 years and involve a variety of activities that may adversely affect ESA-listed species in the action area. As of 2022, Gulf of America federal offshore operations produce 1.7 MMbbl of crude oil per day, representing 15% of all U.S. crude oil production (EIA 2024). These activities and resulting impacts include vessels making supply deliveries, drilling operations, seismic surveys, fluid

spills, oil spills and response, and decommissioning operations. To the extent the past, present or anticipated impacts arise from federal actions that are not part of the federal actions considered in this consultation, they form part of the environmental baseline (e.g., prior, completed exploration, development and decommissioning activities).These activities and resulting impacts include vessels making supply deliveries, drilling operations, seismic surveys, fluid spills, oil spills and response, and oil decommissioning operations. To the extent the past, present or anticipated impacts arise from federal actions that are not part of the federal actions under consultation here, they form part of the environmental baseline (e.g., prior, completed exploration, development and decommissioning activities).

In the time following the issuance of the 2020 opinion, the Gulf oil and gas states (Louisiana, Texas, and Mississippi) experienced an active hurricane season in 2020 and were impacted by a category 4 hurricane in 2021. The Category 4 Hurricane Ida made landfall near Port Fourchon, Louisiana, which temporarily shut down 96% of crude oil production and 94% of natural gas production in the U.S. federally administered areas of the Gulf of America.

Natural seeps are a major petroleum input to the offshore Gulf of America waters. There are an estimated 1,401 “seep zones” located in the northern Gulf of America in U.S. waters delineated by BOEM lease blocks; natural seeps in the entire Gulf are estimated to release a range of 173,000 to 669,000 bbl per year (NAS 2022; O’Reilly et al. 2022). Previous studies (NRC 2003) estimated higher annual seepage for the entire Gulf at about 980,000 bbl (140,000 tonnes) per year, or about three times the estimated amount of oil spilled by the 1989 Exxon Valdez event (about 270,000 bbl) SteynSteyn (2010) or a quarter of the amount released by the DWH event (4.9 MMbbl of oil) (Lubchenco and Sutley 2010).

7.4.1 Lease Sales and Drilling

The sale of OCS leases in the Gulf of America and the resulting exploration and development of these leases for oil and natural gas resources affects the status of ESA-listed species in the action area. BOEM administers the OCSLA and authorizes the exploration and development of wells in Gulf leases. Since the issuance of the 2020 opinion, there have been five federal oil and gas lease sales in the Gulf (2020-2023). As of August 1, 2023, there are a total of 2,193 leases in the Gulf of America, 13 of which occur within the Eastern Planning Area. On September 29, 2023, BOEM published the Proposed Final Program covering 2024 to 2029, which outlines three scheduled lease sales in 2025, 2027, and 2029 (BOEM 2023a).

As technology has advanced over the past several decades, oil exploration and development has moved and will continue to move further offshore into deeper waters of the Gulf (Murawski et al. 2020). The development of wells often involves additional activities such as the installation of platforms, pipelines, and other infrastructure. Once operational, a platform will generate a variety of wastes including a variety of effluents and emissions. Each of these wastes can contribute to the baseline. Additionally, although the release of oil is prohibited, accidental oil spills can occur from loss of well control and thus adversely affect sea turtles, sperm whales, and Gulf sturgeon

in the Gulf of America. Previous biological opinions (NMFS 2007) considered the effects resulting from the variety of actions associated with lease sales and development. These opinions determined that oil and gas leasing may adversely affect protected sea turtles, sperm whales, and Gulf sturgeon, but was found not likely to jeopardize their continued existence. However, the opinions issued in 2007 and 2012 did not contemplate the effects of a disastrous blowout and resulting extremely large oil spill event. The DWH incident resulted in exceedance of take limits in the ITS of the 2007 opinion, and alteration of the environmental baseline.

7.4.2 Seismic Surveys

Seismic exploration is an integral, on-going activity throughout the life cycle of oil and gas production in the Gulf of America and contribute to noise impacts on listed species. Seismic surveys are routinely conducted in virtually all water depths, including the deep habitat of the sperm whales. NMFS considered the effects of seismic operations in a biological opinion issued to BOEM on its 2007–2012 OCS Gulf of America program. That opinion concluded that seismic surveys, with BOEM-required mitigation, were likely to adversely affect sperm whales by harassment. Required protective measures can be found in the BOEM NTL 2016-G02 "Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program," which was updated in June of 2020 following the issuance of the 2020 opinion. BOEM implemented the terms and conditions and reasonable and prudent measures of the 2020 opinion, including Attachment 1, "Seismic Survey Mitigation and Protected Species Observer Protocols" that are applied in place of the 2016 NTL in future lease sale stipulations and conditions of approval for permits, plans, and other authorizations approved by BOEM after March 13, 2020. Oil and gas activities are not permitted in the FGBNMS, except for occasional G&G surveys that require approval from the Sanctuary to occur.

The take of marine mammals incidental to geophysical survey activities is further regulated by NMFS under the MMPA. In 2021, NMFS published a rule allowing the issuance of LOAs to survey operators for the incidental take of marine mammals during geophysical survey activities (86 FR 5322; 50 C.F.R. Part 217). In 2024, NMFS reassessed the 2021 rule and incorporated new information to the analysis to determine the existing regulations (which include mitigation, monitoring, and reporting requirements) are consistent with MMPA standards (89 FR 31488; 50 C.F.R. §217.180 *et seq*.).

7.4.3 Oil and Gas Platform Removals

Both the USACE and BSEE permit the removal of oilrigs in the Gulf of America. These removals can use explosives to sever associated piles and well conductors on the structures that can affect a variety of species, including any ESA-listed species, in the action areas. The USACE oversees platform removals in state waters while BSEE permits these activities in federal waters of the OCS. The USACE consults with NMFS on a project-by-project basis for decommissioning activities that use explosives. According to BSEE, the offshore energy industry averaged 127 platform removals per year over the past decade (https://www.bsee.gov/decommissioning).

In regard to platform removals in federal waters, a formal ESA section 7 consultation was completed with BSEE in 2006, and the ITS was amended in 2008 following completion of an MMPA rule. That opinion found that the permitting of structure removals in the Gulf was not likely to jeopardize the continued existence of sperm whales or loggerhead, Kemp's ridley, green, hawksbill, or leatherback sea turtles. Incidental take, by injury or mortality, of three sea turtles per year or 18 sea turtles during the six-year period of the action covered in the opinion was anticipated during detonations associated with removal actions. Most of the takes were predicted to be loggerhead sea turtles. In addition to the Reasonable and Prudent Measures in the ITS that accompanied the opinion, BOEM issued "Idle Iron Decommissioning Guidance for Wells and Platforms" (NTL 2018-G03) to inform lessees about mitigation and reporting requirements. The removal of non-operating oil platforms is expected to continue to affect protected sea turtles.

As discussed in Section 1.1.4.12, the Gulf Rigs-to-Reefs Program provides operators with an option to leave their platform jackets on the OCS, pending acceptance under a state program and conversion to artificial reefs. As of December 2024, over 625 platforms have been converted to reefs within the Gulf of America (BSEE 2024).

7.4.4 Oil Spills

Oil spills are accidental and unpredictable events, but are a foreseeable consequence of oil and gas development and production from oil and gas activities in the Gulf of America. Oil releases can occur at any number of points during the exploration, development, production, and transport of oil. Any discharge of hydrocarbons into the environment is prohibited under U.S. law. Most oil spills are generally small (less than 1,000 barrels) but there are spills that occur that are of larger size (NCCOS 2019). BSEE tracks spills greater than one barrel and posts those data to their website: https://www.bsee.gov/stats-facts/offshore-incident-statistics/spills. Since the issuance of the 2020 biological opinion, oil and gas production has been linked to several incidents, resulting in the release of crude oil into the Gulf's coastal and marine environment. The summary presented here includes examples of recent events, but may not encompass all incidents.

Following Hurricane Ida's landfall in the Gulf of America region in September 2021, NOAA responded to 282 individual discharges of oil from wells, pipelines, and vessels caused by storm damage (NOAA 2021). On December 24, 2022, a pipeline failure at a crude oil terminal in Corpus Christi Bay, Texas, released around 333 bbl of light crude oil, with recorded impacts to green sea turtles (NOAA 2024a). On November 16, 2023, a pipeline crude oil leak off the coast of Louisiana was reported to NOAA and other federal and state agencies, with an estimated 26,190 bbl at risk of spill and an observed slick over 40 mi in length (NOAA 2023a). Part of the reported leak overlapped with habitat for the Rice's whale. For more information, BSEE tracks spills greater than one barrel and posts those data to their website: https://www.bsee.gov/stats-facts/offshore-incident-statistics.

When compared with the rest of the world, more than 50% of the loss of well control events come from the federally regulated waters of the Gulf of America as the Gulf is the most mature (BSEE 2017). Of these events, approximately 45% occurred during drilling (approximately 50% of these events were in shallow waters), 21% during workovers, and 17% during production. According to (BSEE 2017) from 2000-2015, four of the 117 loss of well control events were categorized as a total loss of control. The event with the highest risk is the blowout or surface flow incident.

Under OCSLA, decommissioning regulations require that within one year after lease termination, operators must permanently plug wellbores and remove all platforms (30 C.F.R. Part 250). A study from 2023 estimates that, as of 2020, a total of 7,188 inactive wells or inactive leases in Federal waters of the Gulf of America have not been permanently plugged (Agerton et al. 2023). The Government Accountability Office similarly determined that around 2,700 end-of-lease wells and 500 end-of-lease platforms were overdue for decommissioning as of June 2023 (GAO 2024). Deteriorating structures from delayed decommissioning can become more vulnerable to damage and destruction from storms as their frequency continues to increase, which increases the risk of oil spills and harmful debris releases into species' habitat (GAO 2024). Leakage from inactive sites can pose an ongoing threat to the ocean ecosystem and listed species by potentially introducing hydrocarbons and other pollutants that disperse into surrounding waters.

7.4.4.1 Deepwater Horizon

On April 20, 2010, the semi-submersible drilling rig DWH experienced an explosion and fire while working on an exploratory well approximately 50 mi offshore Louisiana. The rig subsequently sank and oil and natural gas began leaking into the surrounding waters of the Gulf of America. Oil flowed for 86 days, until the well was capped on July 15, 2010. By then, 134 MMbbl of oil were spilled into the Gulf. In addition, approximately 1.84 million gallons of chemical dispersant were applied both subsurface and on the. The DWH event and associated response activities (e.g., skimming, burning, and application of dispersants) have resulted in adverse effects on listed species and changed the baseline for the Gulf of America ecosystem. Effects of the spill went beyond the footprint that was visually detected through satellite. Berenshtein et al. (2020) used in situ observations and oil spill transport modeling to examine the full extent of the DWH spill, beyond the satellite footprint, that was at toxic concentrations to marine organisms. Figure 59 below displays visible and toxic (brown), not visible at the surface (characterized as invisible in the figure) and toxic (yellow) and non-toxic (blue) oil concentrations.

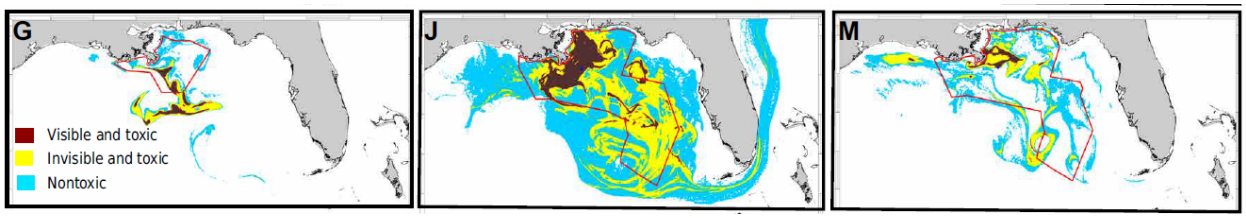


Figure 59. Figure from Berenshtein et al. (2020) showing spatiotemporal dynamics of the spill for dates showing cumulative oil concentrations in figures G- 15 May 2010; J- 18 June 2010; and M- 2 July 2010

What made the DWH spill particularly unique was the formation of a subsurface oil plume, which had never been documented at such a scale in a subsea spill. Unlike typical surface slicks, the oil released at depth formed a lateral plume between 1000 and 1200 meters, where the cold temperatures and high pressure facilitated the formation of tiny oil droplets (BOEM 2021b; Diercks et al. 2010; OSAT 2010). The application of dispersants at the wellhead, which was the first time they were used at depth, likely contributed to the formation of the subsurface plume by breaking the oil into smaller droplets, which remained suspended at depth rather than rising to the surface (Kujawinski et al., 2011). The plume expanded beyond the visible surface slicks, complicating efforts to fully assess the environmental impact (Valentine et al. 2014).

The investigation conducted under the National Resource Damage Assessment regulations of the Oil Pollution Act (33 USC §2701 *et seq.*) assessed natural resource damages stemming from the DWH oil spill. The effort evaluated specific impacts to Kemp's ridley, green, loggerhead, and hawksbill sea turtles, sperm whales, Rice's whales, Gulf sturgeon, and habitats of these species (Trustees 2016). The findings of this assessment provide details regarding impacts to the environmental baseline of listed species and critical habitats in the Gulf of America, as summarized below, and can be found at http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan. The unprecedented DWH spill and associated response activities (e.g., skimming, burning, and application of dispersants) resulted in adverse effects on listed sea turtles, sperm whales, Rice's whales, and Gulf sturgeon.

Over a decade following DWH, multiple studies demonstrate both long-term impacts of the spill on species abundance and community structure, as well as the status of ecosystem recovery from the event (Barron et al. 2020; Frasier et al. 2024a; FWS 2015; McDonald et al. 2017b; NAS 2023; Pine and DWHTIG 2024; Rowles et al. 2020; Schwacke et al. 2017; Smith et al. 2022; Smith et al. 2017; Stacy et al. 2017; Wallace et al. 2015). Despite natural weathering processes over the years since DWH, oil persists in some habitats where it continues to expose and affect resources in the northern Gulf of America resulting in new baseline conditions (BOEM 2016; Trustees 2016). A review of current literature by Patterson et al. (2023) found that, while there were clear impacts of the DWH on shelf taxa at the population level as well as shifts in community structure (especially for reef fish and invertebrates), the shelf ecosystem overall has proven to be remarkably resilient. However, there was a dramatic loss in mesophotic sea life, indicating a decrease in krill abundance from 2011 to 2015, one of the main prey items for *Balaenoptera* species (Frank et al. 2020). The true impacts to offshore megafauna populations

and their habitats may never be fully quantified, though it was necessary to characterize these impacts for response, damage assessment and restoration activities (Frasier 2020).

According to Joye (2015), the oil and gas discharged from the DWH spill were dispersed across the entire water column, affecting both pelagic (open water) and benthic (seafloor) environments. This distribution included deepwater plumes where oil and gas were entrained at depths between 900 and 1,200 m. Figure 60 taken from the Joye (2015) paper shows the percentages of the fate of the discharged hydrocarbons, detailing how they were distributed and affected various marine ecosystems.

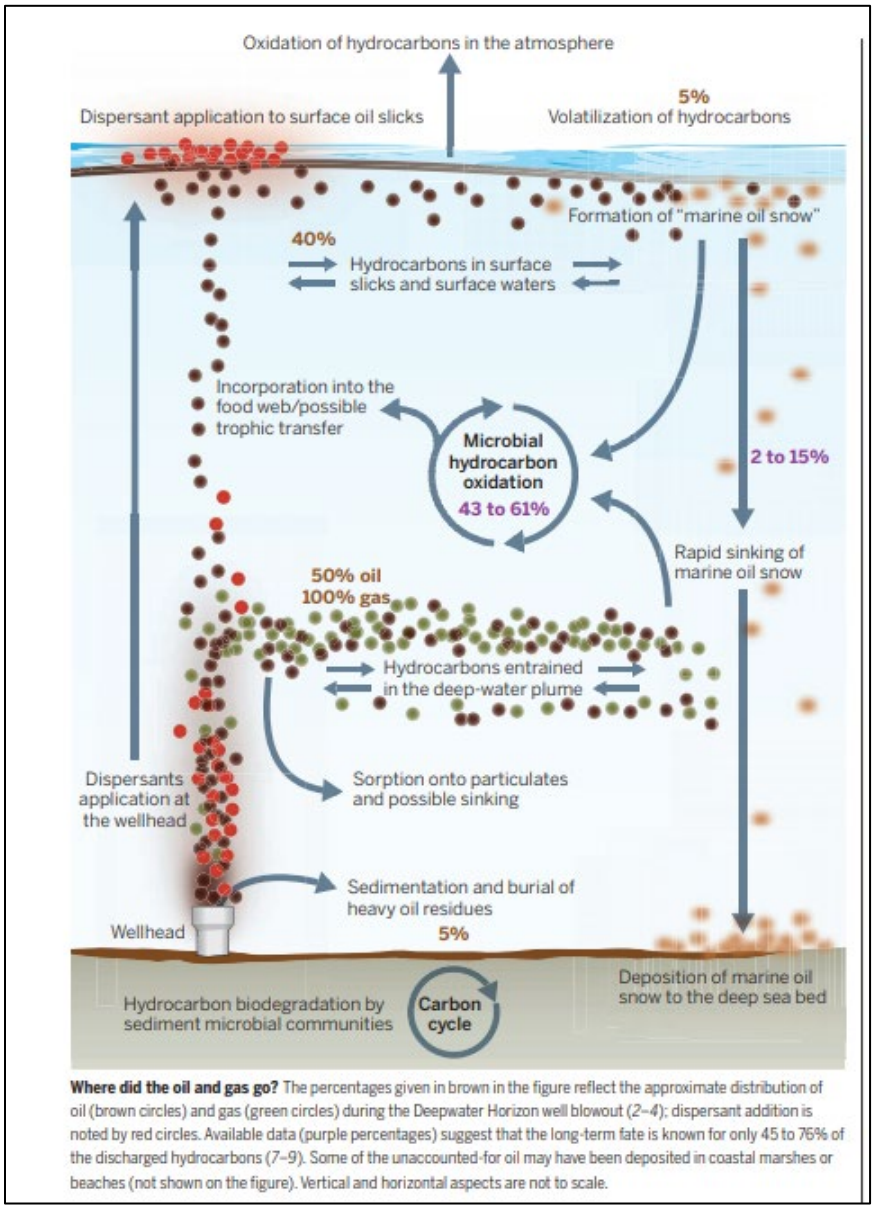


Figure 60. Diagram showing offshore distribution of oil and gas during DWH (Joye 2015)

While post-spill restoration continues, there is uncertainty regarding overall effectiveness of restoration efforts (Wallace et al. 2019). It is also uncertain how these restoration efforts have altered the baseline relative to what it would have been if the efforts had not occurred.

Rice's Whale

The Rice's whale population was likely affected by the DWH spill and response. Population models suggest that nearly half of the population was potentially impacted by DWH oil (Figure 61, resulting in an estimated 22% maximum decline in population size that will require 69 years to recover to the pre-spill population size (Trustees 2016). Note that these results should be interpreted with great caution, both due to model uncertainty and because small populations like the Rice's whales are highly susceptible to stochastic, or unpredictable, processes and genetic

effects. The population models used by the Trustees (2016) did not account for these effects; therefore, the capability of the Rice's whale population to recover from this injury is unknown.

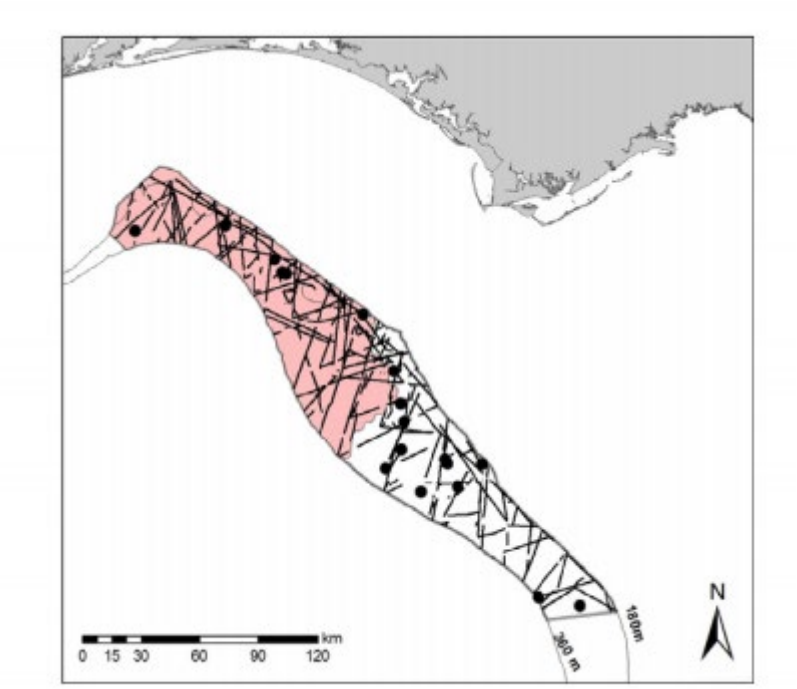


Figure 61. Line transects and sightings of Rice's whales with the red area representing the overlap of DWH oil exposure and the area where Rice's whales are typically found. Figure from MMIQT (2015)

Sperm Whale

Sperm whales could have been exposed to toxic oil components through inhalation, aspiration, ingestion, and dermal exposure. Marques et al. (2023a) found that sperm whales were amongst the cetaceans most heavily impacted by DWH, with an estimated 5% population decline compared to pre-DWH abundances. According to the modeling effort, the sperm whale population is estimated to take over 11 years to recover to pre-DWH numbers. There were 19 observations of 33 sperm whales swimming in DWH surface oil or that had oil on their bodies (Diaz 2015 as cited in Trustees 2016). The effects of oil exposure include physical and toxicological damage to organ systems and tissues, reproductive failure, and death. Sperm whales suffered from multiple routes of exposure at the same time, over intermittent timeframes and at varying rates, doses, and chemical compositions of oil. The estimation of effects to sperm whales is largely based on observed impacts to bottlenose dolphins resulting from exposure to DWH oil. The DWH oil spill occurred in deep water sperm whale habitat. The same routes of internal oil exposure (ingestion, inhalation, and aspiration) would have occurred in sperm whales that have been shown to adversely affect coastal bottlenose dolphins. The surface oil and vapors at the surface were more concentrated offshore near the leaking wellhead that could have exposed sperm whales to high levels of contaminants between dives that were known to have occurred with dolphins.

Sperm whales were likely exposed to harmful toxins during DWH. Corexit 9500 and 9527 were both chemical dispersants used during the DWH response. These dispersant compounds were found to be cytotoxic (kills cells) and Corexit 9527 was found to be genotoxic (damages DNA) to sperm whale skin cells (Wise et al. 2014). A three-year study focusing on DWH-relevant metals found whale skin samples with genotoxic metals (aluminum, arsenic, chromium, nickel and lead) at concentrations higher than global averages, and patterns for DWH-relevant metals decreased with time from the oil spill (Wise et al. 2018).

A study of the causes of an Unusual Mortality Event of bottlenose dolphins occurring from 2010-2014 in Louisiana, Mississippi, and Alabama concluded that the contaminants from the DWH oil spill contributed to the high numbers of dolphin deaths over the four-year period (Venn-Watson et al. 2015). Live animals had a high prevalence of lung disease and were five times more likely to have moderate to severe lung disease compared to a population unaffected by the DWH oil spill (Schwacke et al. 2014b). Dead animals had a significantly higher prevalence of adrenal gland disease (thin adrenal gland cortices) and lung disease (primary bacterial pneumonia) compared to an unaffected population (Venn-Watson et al. 2015). The rare, life-threatening, and chronic adrenal gland and lung diseases identified in the stranded animals were consistent with exposure to petroleum compounds as seen in other mammals such as mink (Mazet et al. 2001; Schwartz et al. 2004). Morbillivirus infections were not the leading cause of death in the northern Gulf of America Unusual Mortality Event of bottlenose dolphins (Fauquier et al. 2017). De Guise et al. (2017) created a conceptual model to explain the documented changes in immune function and the health effects observed in live and dead dolphins associated with the DWH spill. The model included potential relationships starting from PAH exposure to various health effects such as loss of fetus, and susceptibility to secondary bacterial infections like pneumonia or intra-cellular pathogens like *Brucella* (De Guise et al. 2017). Historical northern Gulf of America Unusual Mortality Events (1990-2009) did not result in as many mortalities when compared with the current Unusual Mortality Event, and the most common causes of those prior are unlikely to be associated with the current event (Litz et al. 2014).

A large number of strandings of dead perinatal dolphins (recently born) resulted from exposure to DWH oil (Schwacke et al. 2014b). Compared to unaffected populations, perinatal dolphins affected by DWH were significantly more likely to have died in utero or soon after birth, have fetal distress, and have pneumonia (Colegrove et al. 2016). A multi-year study of animals in Barataria Bay, Louisiana showed calving success in only two of ten pregnant females. (Colegrove et al. 2016) concluded late term pregnancy failures and development of in utero infections were the likely causes of the large number of pre-term dolphins aborted from 2011-2013. The Barataria Bay and Mississippi Sound stocks that inhabit areas that were exposed to oil during DWH had low reproductive success compared with other stocks that were in areas not oiled during the spill, with a two-fold difference in success (Kellar et al. 2017). According to Kellar et al. (2017) these findings are consistent with numerous studies linking PAHs to reproductive abnormalities and early developmental impairments. The Barataria Bay stock saw an increase in mortality for the first three years following DWH and then survival rebounded in

late 2013 (McDonald et al. 2017b). Schwacke et al. (2017) estimated a 39-year recovery for the Barataria Bay stock of common bottlenose dolphins. Similarly, Smith et al. (2017)documented slow recovery of Barataria Bay dolphin health with evidence of persistent lung disease and impaired stress response (low amount of hormones detected even during capture).

The largest number of dolphin deaths occurred in Barataria Bay, Louisiana, the area with the greatest amount of oiling from DWH (McDonald et al. 2017b). The presence of increased coastal PAH levels in Barataria Bay lasted for two years following DWH (Schwacke et al. 2013), which coincided with the longest lasting cluster of dolphin strandings in Barataria Bay through the end of 2011. In a less oiled area, increased rates of fetus and calf strandings also occurred in Mississippi and Alabama following DWH. In these areas, there was an average increase of 34.5% in calf deaths compared to (a 72.5% loss compared to a baseline calf loss of 38% over the years 2000-2005 and 2009-2010) in Mississippi and Alabama (data from NMFS Southeast U.S. Marine Mammal Stranding Program Database, July 9, 2015).

Applying the expected effects from bottle dolphins to sperm whales, (Trustees 2016) determined that 16% of the Gulf population or about 262 whales were exposed to DWH oil. Thirty-five percent of those whales (or approximately 92 whales) were likely killed. In total, an estimated 6% of the Gulf sperm whale population was killed. The initial exposure likely resulted in whale deaths later in time due to adrenal and lung disease as was observed in bottlenose dolphins. In addition to the sperm whale deaths, an estimated 46% of exposed females that survived suffered reproductive failure through aborted fetuses or early calf death. Thirty-seven percent of all exposed whales, including pregnant females, likely suffered adverse health consequences because of DWH oil exposure.

At the population level, the Sperm Whale Seismic Study (SWSS) study (Jochens et al. 2008) reported the overall proportion of calves within the mixed groups of sperm whales prior to DWH to be 11%. The proportion of calves observed in the Gulf was similar to those reported for other stable populations of sperm whales reported off the Seychelles Islands and Sri Lanka in which calves make up 9.8% and 12.6% of those populations, respectively (Whitehead et al. 1997). Chiquet et al. (2013) conducted a sensitivity analysis for sperm whales and concluded that, even under the best-case parameters for vital rates for the stable population of sperm whales in the Gulf, the growth rate of the population is extremely slow (about 0.96% per year) as has been reported for other sperm whale populations with a stable age distribution (Whitehead and Mesnick 2003).

In as assessment of the long-term reproductive effects that DWH is having on the Gulf sperm whale population, Trustees (2016) completed population modeling based on the mortalities associated with adverse health consequences of oil exposure and the reduced reproductive success in pregnant females. It is likely the number of females and calves in the population has been reduced. Sixteen percent of the sperm whale population was exposed to oil. Considering these effects at the population level in the Gulf, DWH oil exposure resulted in a maximum population reduction of seven percent requiring 21 years to recover to the pre-spill population

size. The effects of the 21-year recovery period are slowing the recovery of the sperm whale population in the Gulf. At a more subtle, but still crucial, level, the summed negative effects of the DWH oil spill on the Gulf ecosystem across resources, up and down the food web, and among habitats, will continue to impact sperm whales given the long life of marine mammals and their strong dependence on a healthy ecosystem (Bossart 2011; Moore 2008; Reddy et al. 2001).

Sea Turtles

The DWH oil spill extensively oiled vital foraging, migratory, and breeding habitats of sea turtles throughout the northern Gulf of America. *Sargassum* habitats, benthic foraging habitats, surface and water column waters, and sea turtle nesting beaches were affected by DWH. Sea turtles were exposed to DWH oil in contaminated habitats; breathing oil droplets, oil vapors, and smoke; ingesting oil-contaminated water and prey; and by maternal transfer of oil compounds to developing embryos. Translocation of eggs from the Gulf to the Atlantic coast of Florida resulted in the loss of sea turtle hatchlings. Other response activities, including vessel strikes and dredging resulted in turtle deaths.

Three hundred nineteen live oiled turtles were rescued and showed disrupted metabolic and osmoregulatory functions, likely attributable to oil exposure, physical fouling and exhaustion, dehydration, capture and transport (Stacy et al. 2017). Accounting for turtles that were unobservable during the response efforts, high numbers of small oceanic and large sea turtles are estimated to have been exposed to oil resulting from the DWH spill due to the duration and large footprint of the spill. It was estimated that as many 7,590 large juvenile and adult sea turtles (Kemp's ridley, loggerheads, and unidentified hardshelled sea turtles), and up to 158,900 small juvenile sea turtles (Kemp's ridley, green turtles, loggerheads, hawksbills, and hardshelled sea turtles not identified to species) were killed by the DWH oil spill (Table 28 and Table 29). Small juveniles were affected in the greatest numbers and suffered a higher mortality rate than large sea turtles. Leatherback foraging and migratory habitat was also affected and though impacts to leatherbacks were unquantified, it is likely some died because of the DWH spill and spill response (NMFS USFWS 2013; Trustees 2016).

Table 28. Oceanic juvenile sea turtles estimated to have been exposed and killed because of the DWH oil spill

Species	Total Exposed	Heavily Oiled, Dead	Non-heavily Oiled, Dead	Total Dead
Kemp's ridley	206,000	35,500	51,000	86,500
Loggerhead	29,800	2,070	8,310	10,400
Green	148,000	15,300	39,800	55,100
Hawksbill	8,560	595	2,390	2,990
Unidentified	9,960	1,310	2,600	3,910

Species	Total Exposed	Heavily Oiled, Dead	Non-heavily Oiled, Dead	Total Dead
Total	402,320	54,775	104,100	158,900

Source: (Trustees 2016; Wallace et al. 2015)

Table 29. Large juvenile and adult sea turtles estimated to have been exposed and killed because of the DWH oil spill

Species	Total Exposed	Heavily Oiled, Dead	Non-heavily Oiled, Dead	Total Dead
Kemp's ridley age 4+	21,000	1,700	950	2,700
Kemp's ridley age 3	990	380	30	410
Kemp's, all	22,000	2,100	980	3,100
Loggerhead	30,000	2,200	1,400	3,600
Unidentified	5,900	630	260	890
Total	57,900	4,930	2,640	7,590

Source: (Trustees 2016; Wallace et al. 2015)

Subsequent to the PDARP release and as part of the DWH natural resource damage assessment, McDonald et al. (2017c) estimated approximately 402,000 surface-pelagic sea turtles were exposed with 54,800 likely heavily oiled. Additionally, approximately 30% of all oceanic turtles affected by DWH and not heavily oiled were estimated to have died from ingestion of oil (Mitchelmore et al. 2017).

The DWH incident and associated response activities (e.g., nest relocation) saved animals that may have been lost to oiling, but resulted in some future fitness consequences for those individuals. Nests from loggerheads, Kemp's ridleys, and green turtles were excavated prior to emergence and eggs were translocated from Florida and Alabama beaches in the northern Gulf of America between June 6 and August 19, 2010 to a protected hatchery on the Atlantic Coast of Florida. More than 28,000 eggs from 274 nests were translocated and nearly 15,000 hatchling turtles emerged and were released into the Atlantic Ocean (Table 30).

Table 30. Summary of egg translocation and hatchling release during the DWH response

Species	Clutches	Number of Eggs	Hatchling Released
Kemp's ridley	5	483	125
Loggerhead	265	27,618	14,216
Green	4	580	455
Total	274	28,681	14,796

Source: (Provancha and Mukherjee 2011)

Hatchlings from nesting beaches in the Gulf were released in the Atlantic Ocean. Therefore, the hatchlings imprinted on the area of their release beach. It is thought that sea turtles use this

imprinting information to return to the location of nesting beaches as adults. It is unknown whether these turtles will return to the Gulf to nest; therefore, the damage assessment determined that the 14,796 hatchlings will be lost to the Gulf breeding populations because of the DWH oil spill. It is estimated that nearly 35,000 hatchling sea turtles (loggerheads, Kemp's ridley, and green turtles) were injured by response activities, and thousands more Kemp's ridley and loggerhead hatchlings were lost due to unrealized reproduction of adult sea turtles that were killed by the DWH oil spill.

Kemp's ridley sea turtles were the most affected sea turtle species, as they accounted for 49 percent (239,000) of all exposed turtles (478,900) during DWH. Kemp's ridley sea turtles were the turtle species most impacted by the DWH event at a population level. The DWH damage assessment calculated the number of unrealized nests and hatchlings to Kemp's ridley because all Kemp's ridley nest in the Gulf and belong to the same population (NMFS et al. 2011b). The total population abundance of Kemp's ridley could be calculated based on numbers of hatchlings because all individuals are reasonably expected to inhabit the northern Gulf of America throughout their lives. The loss of these reproductive-stage females would have contributed to some extent to the decline in total nesting abundance observed between 2011 and 2014. The estimated number of unrealized Kemp's ridley nests is between 1,300 and 2,000, which translates to approximately 65,000 and 95,000 unrealized hatchlings. However, this is a minimum estimate because of the overall potential DWH effect because the sub-lethal effects of DWH oil on turtles, their prey, and their habitats might have delayed or reduced reproduction in subsequent years may have contributed substantially to additional nesting deficits observed following DWH. These sub-lethal effects could have slowed growth and maturation rates, increased remigration intervals, and decreased clutch frequency (number of nests per female per nesting season. The nature of the DWH effect on reduced Kemp's ridley nesting abundance and associated hatchling production after 2010 requires further evaluation.

Loggerheads made up 12.7% (60,800 animals) of the total sea turtle exposures (478,900). A total of 14,300 loggerhead sea turtles died as a result of exposure to DWH oil. Unlike Kemp's ridley, the majority of nesting for the Northwest Atlantic Ocean loggerhead DPS occurs on the Atlantic coast, and thus nesting was impacted to a lesser degree in this species. It is likely that affects to the Northern Gulf of AmericaRecovery Unit of the NWA loggerhead DPS would be proportionally much greater than the impacts occurring to other recovery units, and likely included impacts to mating and nesting adults. Although the long-term effects remain unknown, the DWH impacts to the Northern Gulf of AmericaRecovery Unit may include some nesting declines in the future due to a large reduction of oceanic age classes during DWH. However, the overall impact on the population recovery of the entire NWA DPS is likely small.

Green sea turtles made up 32.2% (154,000) of all turtles exposed to DWH oil with 57,300 juvenile mortalities out of the total exposed animals, which removed a large number of small juvenile turtles from the population. Four nests (580 eggs) were relocated during response efforts. While green turtles regularly use the northern Gulf of America, they have a widespread

distribution throughout the entire Gulf, Caribbean, and Atlantic. As described in the *Status of the Species* section, nesting is relatively rare on northern Gulf of America beaches. Although it is known that adverse impacts occurred and numbers of animals in the Gulf were reduced as a result of DWH, the relative proportion of the population that is expected to have been exposed to and directly impacted by the DWH event, and thus a population-level impact to green sea turtles, is not likely.

Available information indicates hawksbill and leatherback sea turtles were least affected by the oil spill. Hawksbills made up 1.8% (8,850) of all sea turtle exposures. Although leatherbacks were documented in the spill area, the number of affected leatherbacks was not estimated due to a lack of information for leatherbacks compared to other species. Potential DWH-related impacts to leatherback sea turtles include direct oiling or contact with dispersants, 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. Although adverse impacts likely occurred to leatherbacks and hawksbills, the relative proportion of the populations of these species expected to have been exposed to and directly impacted by the DWH event is relatively low; thus, a population-level impact is not believed to have occurred due to the widespread distribution and nesting locations outside of the Gulf for both of these species.

Gulf Sturgeon

Gulf sturgeon are found in the coastal waters of Florida, Alabama, Mississippi, and Louisiana that were affected by DWH oil. Gulf sturgeon migrate from coastal waters into freshwater rivers between February and May of each year, and thus sturgeon were not present during the period in which oil was still being discharged from the well or by the time oil reached coastal areas. Oil has been reported in coastal areas in increasingly smaller amounts for years following the release. Sturgeon could have been exposed to hydrocarbons once they returned to marine waters after the fall migration from freshwater rivers back to the Gulf. Adult and sub-adult Gulf sturgeon only feed during the fall and winter when present in estuarine and marine waters. After the spill, the riverine populations were sampled as they traveled back to the estuaries and open water. NRDA Trustees (2016) estimated that between 1,100 and 3,600 Gulf sturgeon were potentially exposed through oil that submerged into nearshore environments. Individuals from six of the eight river systems were found within the spill footprint within two years of the spill. NRDA sampling will compare the pre-exposure, baseline information from sturgeon migrating out of rivers with post-exposure data collected from fish after they have spent a season feeding in the areas affected by DWH oil. Gulf sturgeon would likely be very slow to recover from additional challenges such as an oil spill.

Several studies have shown crude oil can be harmful to larval stages of fish. Macondo crude oil was shown to cause significant defects in embryonic and larval development of zebrafish (de Soysa et al. 2012). DWH oil-exposed samples of embryonic mahi-mahi resulted in

cardiotoxicity, evident from pericardial edema and reduced atrial contractibility (Esbaugh et al. 2016). Similar results were also found for developing hearts of large predatory fish (Incardona et al. 2014) and long-term effects of embryonic exposure may cause future declines in populations (Incardona et al. 2015).

7.4.5 State Oil and Gas Activities

State oil and gas exploration, production, and development are expected to result in similar effects to protected species as reported in the analysis of federal activities for oil and gas lease sale biological opinions, including impacts associated with the explosive removal of offshore structures, seismic exploration, marine debris, oil spills, and vessel operation. State oil and gas programs onshore and in state waters also generate emissions that affect the air quality. These emissions are regulated by State agencies and/or USEPA.

Louisiana is rich in crude oil and natural gas both onshore and offshore in state-owned waters, and the state's industrial energy consumption is second only to that of Texas. In 2023, approximately 3.27 MMbbl of crude oil were produced in Louisiana state waters (Resources 2024). Louisiana's production in the federal OCS continues to expand as new offshore technologies allowed companies to access reserves in deeper areas of the Gulf Louisiana's offshore petroleum industry was dealt a serious blow in 2005 when hurricanes Katrina and Rita damaged offshore oil platforms and curbed production for several months. In 2008, hurricanes Gustav and Ike also caused damage offshore and forced refining and production shutdowns. After Hurricane Ida in 2021, the Louisiana oil and gas industry faced massive disruptions in oil production, as refineries in the New Orleans area, which account for about 1.7 MMbbl per day of refinery capacity (9% of the nation's total), remained shut down for five days after the storm made landfill.

Louisiana is also a major importer of crude oil from around the world, typically bringing in about one-fifth of all foreign crude oil processed in the United States. Because Louisiana's infrastructure provides multiple connections to the nation's commercial oil transport network, the U.S. Department of Energy chose the state as a site for two of the Strategic Petroleum Reserve's four storage facilities. State crude oil production and imports that are not sent to other states are processed at Louisiana's 16 operating refineries, clustered mostly along the Lower Mississippi River and in the Lake Charles area. With a refining capacity of more than 2.5 million barrels per day, Louisiana produces more petroleum products than any state but Texas. Louisiana is one of the top natural gas-producing states in the country; excluding OCS production, Louisiana ranks fifth. Over half of the natural gas that is supplied to Louisiana enters the state via pipelines from Texas. The state also receives, stores, and re-ships natural gas supplies from numerous international sources, including Nigeria, Algeria, and Trinidad and Tobago.

Texas leads the nation in fossil fuel reserves, crude oil production, and refining capacity. The state's crude oil reserves account for one-fourth and natural gas account for over three-tenths of the U.S. total. Texas's oil reserves are found in several geologic basins throughout the state.

Major discoveries have been made in the Gulf. Texas's total petroleum consumption also happens to be the highest in the Nation, and the state leads the country in consumption of asphalt and road oil, aviation gasoline, distillate fuel oil, liquefied petroleum gases (LPG), and lubricants.

Texas is the Nation's leading natural gas producer, accounting for approximately three-tenths of total U.S. natural gas production. In the early days of Texas oil production, natural gas found with oil was largely considered a nuisance and was often flared (burned off) at the wellhead. Because Texas demand is high, and because the state's natural gas infrastructure is well connected to consumption markets throughout the country, several LNG import terminals have been proposed along the Gulf Coast in Texas, two of which are currently operational: Freeport LNG in 2008 and Corpus Christie LNG in 2024 (US Department of Energy; Federal Energy Regulatory Commission).

Florida has minor oil and gas reserves and few other energy resources. However, future deposits of oil and gas may be discovered on the OCS off Florida's west coast. Congressional and Presidential moratoria prohibiting energy development in most of the OCS were lifted in 2008, but a separate Act (GOMESA) banning energy development within 100-125 mi off Florida was to be in effect until 2022, but was extended by Presidential withdrawal in September 2020 until June 30, 2032. Florida has no oil refineries and relies on petroleum products delivered by tanker and barge to marine terminals near the state's major coastal cities. Florida receives most of its natural gas supply from the Gulf Coast Region via three major interstate pipelines: (1) the Florida Gas Transmission line, which runs from Texas through the Florida Panhandle to Miami, (2) the Gulfstream pipeline, an underwater link from Mississippi and Alabama to central Florida, and (3) the Cypress Pipeline from Elba Island, Georgia to Jacksonville.

Alabama is rich in onshore energy resources, but not offshore waters. Alabama produces a small amount of crude oil from reserves located in the Black Warrior Basin in the north and the Gulf Coast in the south. One petroleum refinery is located near the Port of Mobile, a second is located in Tuscaloosa on the Black Warrior River, and a third is located in Atmore in the southern part of the state. Most offshore energy is in the form of natural gas. Alabama receives additional supplies of natural gas transported by pipeline mainly from the Gulf, Louisiana, and Texas.

Although Mississippi is not rich in energy resources, the State has substantial oil and gas fields that are found primarily in the southern half of the State. In recent years, new deposits have been discovered onshore and offshore along the Gulf Coast. Mississippi currently produces a small amount of crude oil, and has three oil refineries, which together account for about 2% of total U.S. refining capacity. Mississippi's largest refinery, located along the Gulf Coast in Pascagoula, processes crude oil imported by marine tanker from Central and South America. Mississippi's natural gas processing industry has expanded in recent years to serve growing offshore supplies brought in via pipelines from the OCS. Mississippi will soon begin importing international supplies from LNG import terminals that have been approved near Pascagoula.

7.4.6 Oil and Gas Development in Mexican Waters

Extractive oil and gas production in Mexican waters, in addition to other anthropogenic activities such as fishing and shipping, can affect U.S. migratory marine fauna and resources. According to (BOEM 2017c), Mexico issued rules for seismic exploration in January 2015 and geophysical companies are moving forward aggressively to acquire data in Mexican waters of the Gulf . Investment plans initiated in 2021 project 18 billion USD from 2021 through 2024 to purchase seismic services and exploration, drilling and extraction equipment, including platforms and related services for 794 wells. Oil and gas development in Mexican waters may not be regulated as comprehensively as those in U.S. federal waters. However, in April 2021, the Mexican Congress modified the Hydrocarbons Law to give the Mexican Government broader powers to review and suspend existing import, commercialization, and distribution permits for all hydrocarbons.

Fisheries or other activities in Mexican waters are not well understood, however they can affect U.S. marine fauna and resources. In 1979, the catastrophic Ixtoc oil spill occurred in the Bay of Campeche, releasing approximately three million barrels of oil into the Gulf. During this spill, prevailing northerly currents in the western Gulf of America carried spilled oil toward the United States. A 60-mi by 70-mi patch of sheen containing a 300 ft by 500 ft patch of heavy crude moved toward the Texas coast. The heavy crude affects a relatively small area and contributes to the sheen, tarballs, and other residuals through weathering. On August 6, 1979, tarballs from the spill affected a 17-mi stretch of Texas beach. Within the last several years, USFWS biologists have documented tar balls washing ashore in Padre Island National Seashore that they suspect are from the Ixtoc incident.

7.5 Vessel Operations

The Gulf is a highly active region for maritime vessel activity, including shipping, transit, fishing, and offshore operations, all of which have baseline impacts to listed species and their habitats. Vessels have the potential to affect Gulf sturgeon, sea turtles, Rice's whales and sperm whales through collisions with an animal and the production of sound that cause behavioral and physiological disturbance. Vessels operating at high speeds have the potential to strike Gulf sturgeon, sea turtles or marine mammals with their hulls or propellers. Potential sources of adverse effects from federal vessel operations in the action area include operations of the DoD, BOEM/BSEE, Federal Energy Regulatory Commission (FERC), USCG, NOAA, and USACE. The Gulf of America is known for a high level of commercial shipping activity and many large ports, especially those with transiting bulk carriers (Wiggins et al. 2016).

Vessels are the greatest contributors to increases in low-frequency ambient sound in the sea (Andrew et al. 2011). It is predicted that ambient ocean sound will continue to increase at a rate of ½ dB per year (Ross 2005). 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.

Vessel operations associated with oil and gas activities, as previously described in Section 3.1.4.7 as part of the proposed action, have been considered in previous section 7 consultations. In response to the terms and conditions implementing the RPMs included in the ITS of the previously issued biological opinions for oil and gas activities and to minimize vessel strike risk to marine mammals and sea turtles, BOEM adopted the reasonable and prudent alternative from the 2020 biological opinion and developed a Notice to Lessees and Operators, titled "Vessel Strike Avoidance and Injured/Dead Protected Species Reporting (NTL No. 2016-G01)" (BOEM 2020). These measures are now part of the Oil and Gas Program as described in this opinion. Avoidance measures required include, for instance, maintaining vigilant watch for animals, maintaining a given distance when individuals are sighted, and slowing down the vessel to avoid striking protected species. Industry-related vessel traffic is a part of the current environmental baseline in the Gulf of America and is expected to continue.

Following the COVID-19 outbreak in March 2020, a slowdown in global trade activity led to a reduction in commercial shipping traffic around ports worldwide (Loveridge et al. 2024). Overall, industry-related vessel traffic returned to business-as-usual operation post-pandemic and is expected to continue as part of the current environmental baseline in the Gulf.

7.6 Dredging

Dredging involves the removal and relocation of submerged sediment in waterways, nearshore areas, and offshore, and supports activities such as maintaining coastal navigation channels, beach nourishment, levee construction, and coastal restoration. Twenty-nine of the Gulf lease areas that BOEM manages within the action area host blocks with significant sediment resources that may be dredged (BOEM 2024). Dredging activities can pose significant impacts to aquatic ecosystems by: (1) direct removal/burial of organisms; (2) turbidity/siltation effects; (3) contaminant re-suspension; (4) sound/disturbance; (5) alterations to hydrodynamic regime and physical habitat; and (6) loss of riparian habitat (Chytalo 1996; Winger et al. 2000).

Marine dredging vessels are common within U.S. coastal waters. Dredging may harm Gulf sturgeon and sea turtle species by injuring individuals with the equipment used or degrade and modify their foraging habitat (such as softbottom and seagrass beds), affecting available food resources. Although the underwater sounds from dredge vessels are typically continuous in duration (for periods of days or weeks at a time) and strongest at low frequencies, they are not believed to have any long-term effect on sea turtles, Rice's whales, sperm whales, or Gulf sturgeon. However, the construction and maintenance of federal navigation channels and dredging in sand mining sites ("borrow areas") have been identified as sources of sea turtle and Gulf sturgeon mortality. Hopper dredges can lethally harm sea turtles and sturgeons by entraining them in dredge drag arms and impeller pumps. Hopper dredges in the dredging mode are capable of moving relatively quickly and can thus overtake, entrain, and kill sea turtles and Gulf sturgeon as the suction draghead(s) of the advancing dredge overtakes a resting or swimming organism.

To reduce take of listed species, relocation trawling may be utilized to capture and move sea turtles and sturgeon. In relocation trawling, a boat equipped with nets precedes the dredge to capture sturgeon and sea turtles and then releases the animals out of the dredge pathway, thus avoiding lethal take. Relocation trawling has been successful and routinely moves sea turtles and sturgeon in the Gulf of America. Between January 2005 and April 2006, relocation trawling captured and successfully moved two Gulf sturgeon near Mobile Bay, Alabama: five near Gulf Shores, Alabama, one near Destin, Florida, and eight near Panama City Beach, Florida. Seasonal in-water work periods, when Gulf sturgeon are absent from coastal waters, also assists in reducing incidental take.

In 2003, NMFS completed a regional biological opinion on USACE hopper dredging in the Gulf of America that includes impacts to sea turtles, Gulf sturgeon, and Gulf sturgeon critical habitat via maintenance dredging. NMFS determined that (1) Gulf hopper dredging would adversely affect Gulf sturgeon and four sea turtle species (i.e., green, hawksbill, Kemp's ridley, and loggerheads) but would not jeopardize their continued existence, and (2) dredging in the Gulf would not adversely affect leatherback sea turtles, smalltooth sawfish, or ESA-listed large whales. An ITS for those species adversely affected was issued. The critical habitat analysis concluded that impacts would not have measurable effects on habitat features based on: maintenance only rather than improvements of channels; and remaining sediments would be the same as what was originally in the channel bed.

Numerous other opinions have analyzed hopper dredging projects that did not fall under the scope of actions contemplated by the regional opinion, including the dredging of Ship Shoal in the Gulf CPA for coastal restoration projects in 2005; the Gulfport Harbor Navigation Project in 2007; the East Pass dredging in Destin, Florida in 2009; the Mississippi Coastal Improvements Program in 2010; and the dredging of City of Mexico Beach canal inlet in 2012. Each of the above opinions had its own ITS and determined that hopper dredging during the proposed actions would not jeopardize the continued existence of any ESA-listed species or destroy or adversely modify critical habitat of any listed species.

7.7 Construction and Operation of Public Fishing Piers

Several fishing piers have been rebuilt along the Gulf coast since completion of the 2020 consultation. The Gulf coast experienced an active hurricane season in 2020, as well as a destructive Category 4 hurricane in 2021 that required the reconstruction and repairs of several fishing piers along Mississippi, Louisiana, and Alabama. The USACE permits the building of these structures and, in many of these cases, FEMA provides funding. Six FEMA funded projects along the Gulf coast were authorized in 2022 to repair piers damaged in recent storms. We determined that the activities associated with the demolition/reconstruction/repair of each pier was not likely to adversely affect any ESA-listed species. However, we did conclude that the fishing likely to occur following the completion of each pier project was likely to adversely affect certain species of sea turtles, but was not likely to jeopardize their continued existence. Incidental capture of sea turtles is generally nonlethal, though some captures result in severe

injuries, which may later lead to death. Fishing effort is expected to continue at Gulf piers in the foreseeable future.

7.8 Research Permits

The ESA allows for the issuance of permits authorizing take of certain ESA-listed species for the purposes of scientific research (Section 10(a)(1)(a)). In addition, section 6 of the ESA allows NMFS to enter into cooperative agreements with states to assist in recovery actions of listed species. The number of authorized directed and incidental takes by research permits varies widely depending on the research and species involved but may involve the taking of hundreds of sea turtles annually. Before any research permit is issued, the proposal must be reviewed under the permit regulations (i.e., must show a benefit to the species). The proposal must be reviewed for compliance with section 7 of the ESA since issuance is a Federal activity.

Most directed takes authorized under these permits are expected to be nonlethal, such as collecting biological samples and skin biopsies, photographing, and tagging. Sea turtles and marine mammals are often the focus of research activities authorized by section 10 permits under the ESA. In 2019, NMFS issued biological opinions on the programs for issuance of research permits and enhancement activities for both listed sea turtles and cetaceans and reached conclusions of no jeopardy for ESA-listed species and no destruction or adverse modification for critical habitat (NMFS 2019a; NMFS 2019b). 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. Research permits issued for sperm whales include photographing (photo-identification), tissue sampling, and tagging, and in 2023, the biological opinion on the cetacean research permit was reinitatied by NMFS and concluded no jeopardy to ESA-listed species. There are no federal permits for Gulf sturgeon research; however, state agencies within the species range may issue scientific research permits for Gulf sturgeon, as delegated by USFWS.

7.9 Military Operations

Military testing and training affect listed species and their habitat through activities such as ordnance detonation, active sonar, and live munitions. The air space over the Gulf is used extensively by the DoD for conducting various air-to-air and air-to-surface operations. Nine military warning areas and five water test areas are located within the Gulf of America. The western Gulf of America has four warning areas that are used for military operations. The areas total approximately 21 million acres or 58% of the area. In addition, six blocks in the western Gulf of America are used by the Navy for mine warfare testing and training. The central Gulf of America has five designated military warning areas that are used for military operations. These areas total approximately 11.3 million ac. Portions of the Eglin Water Test Areas (EWTA) comprise an additional 0.5 million ac in the CPA. The total 11.8 million ac is about 25% of the area of the CPA.

Formal consultations on overall U.S, Navy activities in the Atlantic have been completed, including U.S. Navy's Activities in East Coast Training Ranges (June 1, 2011); U.S. Navy Atlantic Fleet Sonar Training Activities (AFAST) (January 20, 2011); Navy AFAST LOA 2012-2014: U.S. Navy active sonar training along the Atlantic Coast and Gulf (December 19, 2011); Activities in GOMEX Range Complex from November 2010 to November 2015 (March 17, 2011); and Navy's East Coast Training Ranges (Virginia Capes, Cherry Point, and Jacksonville) (June 2010). These opinions concluded that although there is a potential for some U.S. Navy activities to affect sea turtles and sperm whales, those effects were not expected to impact any species on a population level. Therefore, the activities were determined to be not likely to jeopardize the continued existence of any ESA-listed species.

On October 22, 2018, NMFS issued a conference and biological opinion on the effects of the Navy's Atlantic Fleet Training and Testing (AFTT) Phase III activities on ESA-listed resources (NMFS 2018a). The AFTT action area includes the Gulf of America Range Complex, which encompasses approximately 17,000 NM^2 of sea and undersea space and includes 285 NM of coastline. The four operating areas (OPAREAs) within this range complex are: Panama City OPAREA off the coast of the Florida panhandle (approximately 3,000 NM^2); Pensacola OPAREA off the coast of Florida west of the Panama City OPAREA (approximately 4,900 NM^2); New Orleans OPAREA off the coast of Louisiana (approximately 2,600 NM^2); and Corpus Christi OPAREA off the coast of Texas (approximately 6,900 NM^2). The AFTT Phase III opinion includes an ITS with exempted take for the following ESA-listed species found in the Gulf: sperm whales, Rice's whales, sea turtles, and Gulf sturgeon.

NMFS has completed consultations on Eglin Air Force Base testing and training activities in the Gulf. These consultations concluded that the incidental take of sea turtles is likely to occur. These opinions have issued incidental take for these actions: Eglin Gulf Test and Training Range (NMFS 2004b), the Precision Strike Weapons Tests (NMFS 2005b), the Santa Rosa Island Mission Utilization Plan (NMFS 2005c), Naval Explosive Ordnance Disposal School (NMFS 2004a), Eglin Maritime Strike Operations Tactics Development and Evaluation (NMFS 2013), and Ongoing Eglin Gulf Testing and Training Activities (NMFS 2017e). These consultations determined the training operations would adversely affect sea turtles but would not jeopardize their continued existence. They further determined that because the activities were to be completed over shallow shelf waters (less than 100 m), that they were not likely to adversely affect sperm whales or Rice's whales.

In April 2023, NMFS published a final rule pursuant to the MMPA regulating the incidental take of marine mammals during testing and training activities conducted in the U.S. Air Force's Eglin Gulf Test and Training Range from 2023 to 2030 (88 FR 24058; 50 CFR Part 218). As part of the final rule, conservation provisions include restricting live munitions at certain distance setbacks from the 100 m isobaths for Rice's whale, and prohibiting inert munitions in areas that fall within the proposed Rice's whale critical habitat area.

7.10 Aquaculture

Aquaculture is an emerging industry in the Gulf of America, though there are currently no active commercial offshore aquaculture operations. In 2020, Presidential Executive Order 13921, "Promoting American Seafood Competitiveness and Economic Growth," identified the U.S. Gulf of America as one of the first regions to be evaluated for offshore aquaculture opportunities (85 FR 28471; May 12, 2020). Farmer et al. (2022b) developed a method to identify aquaculture opportunity areas (AOA's) with the least conflict with protected species, including Rice's whale, sea turtles, smalltooth sawfish, and giant manta ray. In November 2021, NOAA's National Centers for Coastal Ocean Science published a comprehensive spatial modeling study, "An Aquaculture Opportunity Atlas for the U.S. Gulf of America," which identified nine potential options for AOA locations in federal waters in the Gulf of America (Figure 62). These nine locations were identified using spatial suitability modeling intended to minimize conflicts with protected/sensitive species and habitats as well as other ocean user groups, and included data layers relevant to administrative boundaries, national security (i.e., military), navigation and transportation, energy and industry infrastructure, commercial and recreational fishing, natural and cultural resources, and oceanography (i.e., non-living resources)(Riley et al. 2021b).

Aquaculture development may affect vulnerable anadromous and marine protected species, including marine mammals, sea turtles, and fishes, that rely on marine habitats (e.g., surface, mid-water, and benthic environments) for survival and reproductive success. Aquaculture impacts to protected species can vary across a range of activities including environmental and cultural resource surveys, construction, operation and management, and farm decommissioning. Potential impacts can include attraction to farms or displacement from critical habitats, which can result in changes to distribution, behaviors, or social structures (Clement 2013). Physical interactions with gear, vessel traffic, noise, and light pollution can also result in injuries or mortalities (Farmer et al. 2022b).

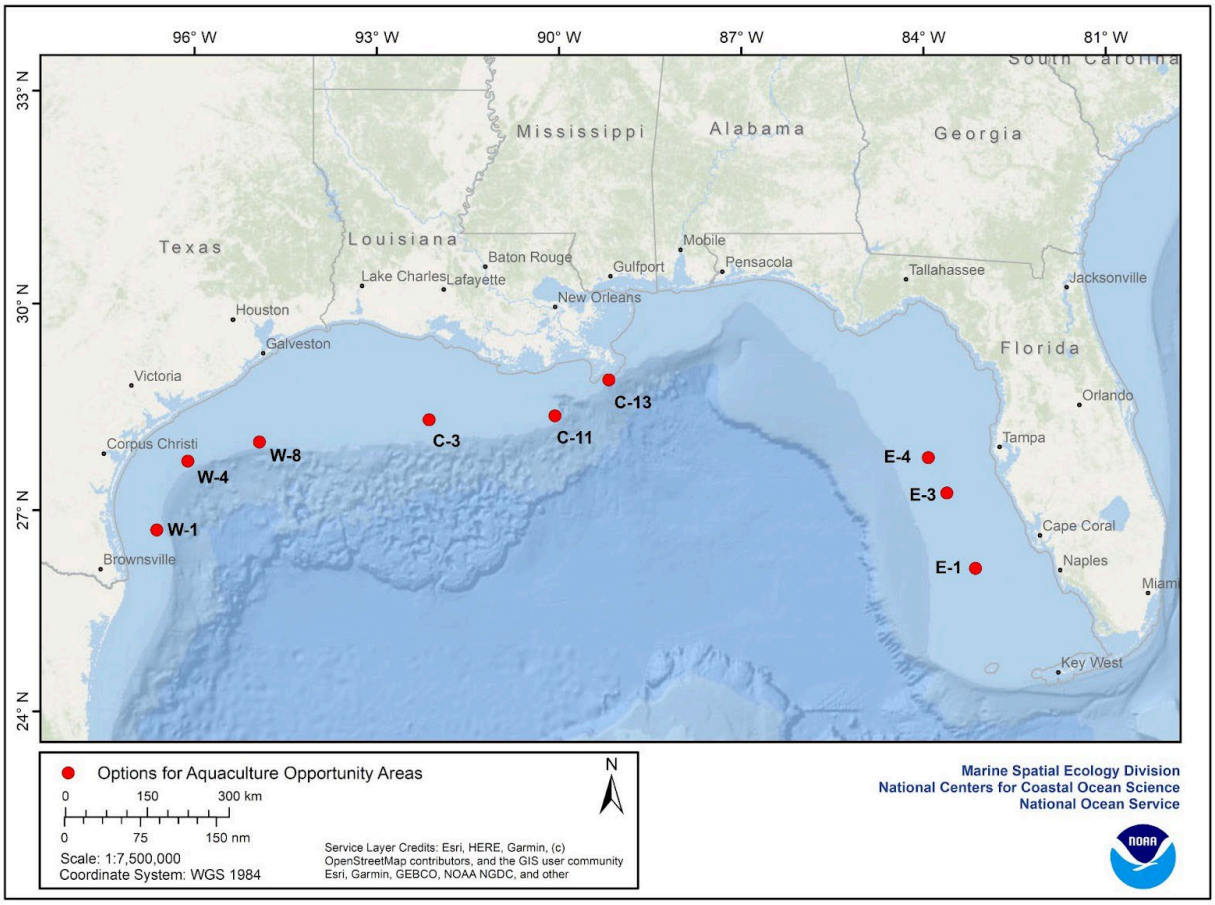


Figure 62. All nine potential location options for AOAs in federal waters in the Gulf of America (Source:(Riley et al. 2021a)

Aquaculture activities for Florida sturgeon can pose potential negative interactions with wild fish species, though the industry is currently limited to native Atlantic sturgeon and a few non-native species. The risk of hybridization between Gulf sturgeon and other sturgeons, as well as escapement of non-native species, are potential threats to Gulf sturgeon in the action area. The geographic location of many farms nearby streams and rivers would allow easy entry of farmed fish into Gulf sturgeon habitat. As many farms use spring-fed wells as their source for irrigation, sturgeon raised in farms have likely acclimated to local water temperatures and would presumably survive in local rivers. While effects of intra-specific competition between native and non-natives sturgeons are unknown, it is likely that habitat overlap would occur as well as a potential for introduction of disease (USFWS and NMFS 2009a). Aquaculture could also have food web effects of non-native/native farmed escapees, either through consumption or predation.

7.11 Marine Debris

The discharge of debris into the marine environment is a continuing threat to the status of species in the action area, regardless of whether the debris is discharged intentionally or accidentally. Marine debris may originate from a variety of sources, from abandoned fishing gear and

industrial waste, to single-use plastics for consumer use and litter. It enters our waterways and oceans mainly from manmade and natural activities on land. Marine debris is categorized as land-based, ocean-based, or disaster debris, depending on its source. Land-based marine debris comes from human activities and waste that take place on land and eventually makes its way to the oceans via coastal waterways, while ocean-based marine debris comes from trash, fishing gear, and other items lost off of vessels or platforms at sea. When a storm, natural disaster, or accident at sea creates large amounts of marine debris, this is called disaster debris, and can include abandoned vessels or pieces of buildings. Using satellite imagery, Hu et al. (2023) estimated a maximum aggregated area of 21.7 km^2 of floating debris (i.e., driftwood, construction lumber, dead marsh plants, plastics and other materials) in the Northern Gulf on August 31, 2005, following Hurricane Katrina. With five U.S. states bordering the Gulf coast and large watersheds draining into the Gulf of America, exact sources of marine debris can be difficult to impossible to discern.

Plastic pollution in the marine environment is of particular concern to endangered and threatened species because plastic materials are highly persistent and can degrade into microplastics rather than fully disintegrating. Globally, between 4.8 to 12.7 million metric tons of plastic waste entered the ocean from 192 coastal countries in 2010 (Jambeck et al. 2015). If current practices continue, the amount of plastics discharged into the ocean could reach up to 53 million metric tons per year by 2030 (NASEM 2022).

Debris can originate from a variety of marine industries including fishing, oil and gas, and shipping. Many of the plastics discharged to the sea can withstand years of saltwater exposure without disintegrating or dissolving. Further, floating materials have been shown to concentrate in ocean gyres and convergence zones, notably in regions with *Sargassum* habitat and consequently where juvenile sea turtles are known to occur, and microplastics have consistently been detected in *Sargassum* mats in coastal ecosystems (Arana et al. 2024; Law et al. 2010). Changing environmental conditions are further exacerbating marine plastic fluxes; increasing storms and flooding can transport large amounts of debris into aquatic systems and microplastics, in particular, are now being transported through the atmosphere as part of biogeochemical cycles (Ford et al. 2022).

Marine debris has the potential to affect protected species through ingestion or entanglement (Gregory 2009). Both of these effects could result in reduced feeding, reduced reproductive success, and potential injury, infection, or death. Plastic ingestion can lead to abrasion, scarring, perforation, dismemberment, restricted mobility, suffocation, gastrointestinal obstruction, and ultimately result in death (Diana et al., 2022). In 2019, a dead adult male Rice's whale washed ashore in the Florida Everglades with a 3 by 2 inch piece of hard plastic in its stomach. The cause of death was attributed to the debris (NMFS 2019c). Sperm whale ingestion of marine debris is a concern, particularly because their suspected feeding behavior includes cruising along the bottom with their mouths open (Walker and Coe 1990). All sea turtles are susceptible to ingesting marine debris, though leatherbacks show a marked tendency to ingest plastic which

they misidentify as jellyfish, a primary food source (Balazs 1985). In a review of global studies evaluating debris ingestion, researchers found that the probability of green and leatherback turtles ingesting debris has increased significantly between 1985 and 2012, and herbivorous or jellyfish-consuming species are at greatest risk of both lethal and sublethal effects (SCHUYLER et al. 2014). Ingested debris may block the digestive tract or remain in the stomach for extended periods, thereby reducing the feeding drive, causing ulcerations and injury to the stomach lining, or perhaps even providing a source of toxic chemicals (Laist 1987; Laist 1997). Weakened animals are then more susceptible to predators and disease and are less fit to migrate, breed, or, in the case of turtles, nest successfully (Katsanevakis 2008; McCauley and Bjorndal 1999).

New research has also demonstrated the health consequences of microplastic accumulation in marine mammals and sea turtles. Microplastics can bioaccumulate in lower trophic marine organisms that lead to toxic exposure for marine fauna that consume fish (Alava 2020). Marine microplastics have been linked to heavy metals and pathogens that can enter an organism's bloodstream and cause potential toxic effects (Nabi et al. 2022).

7.12 Nutrient Loading and Hypoxia

Nutrient loading from land-based sources, such as wastewater treatment plants and agriculture, and hypoxia remain a threat to protected species and their habitats and prey availability, which in turn can affect survival and reproductive fitness Rabalais et al. (2010). Eutrophication in the Gulf, resulting from both point and non-point sources of nutrient pollution, leads to a large area off the Louisiana continental shelf with seasonally depleted oxygen levels (< 2 mg/L) (Rabalais et al. (2010). This 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 America has been approximately 16,000 km^2, 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 km^2, which is larger than the state of Massachusetts. The Mississippi River/Gulf Watershed Nutrient Task Force's 2023 Report to Congress determined that the midsummer extent of the hypoxic zone was 16,400 km^2 in 2021, and 8,480 km^2 in 2022 (US-HTF 2023). For 2024, NOAA measured a hypoxic zone in the Gulf of America of 16,853 km^2, the 12th largest zone in 38 years of measurement (NCCOS 2024; NOAA 2024b). Low-oxygen waters can induce fish kills, alter fish diets, growth, and reproduction (Rose et al. 2018), and reduce habitat use for shrimp species (Craig 2012), and affect the habitat for sturgeon and sea turtles (68 FR 13370). Section 7.1 of this opinion described the potential effects of environmental change on hypoxia; warming waters will likely exacerbate hypoxic conditions along the Gulf continental shelf, resulting in greater exposure to prolonged and sever hypoxic conditions (Laurent et al. 2018). Projected increases in precipitation over the next few decades in the Mississippi and Atchafalaya River Basin are anticipated to result in more water, sediment, and nutrients entering the coasts as well (US-HTF 2023).

In addition to inducing widespread hypoxia in the action area, nutrient loading and changing environmental conditions can trigger the development of harmful algal blooms (HABs) in coastal

waters. The growth of algae that leads to HABs occurs naturally with sunlight, slow-moving water, and nutrients (such as nitrogen and phosphorus). Human activities increase nitrogen and phosphorus levels entering coastal waters. These chemicals, found in agricultural fertilizers and lawn care products, wash into waterways, contributing to nutrient pollution. Excess nitrogen and phosphorus can lead to harmful consequences, including more frequent or intense HABs that can often produce a suite of toxins.

The majority of HAB species that have been observed in U.S. waters are present along the Gulf coast, and there are frequent blooms including, but not limited to, dinoflagellates *Karenia brevis, Alexandrium,* and *Dinophysis*, and diatom *Pseudo-nitzschia* in the Gulf of America (Anderson et al. 2021). Recent assessments and improved ocean monitoring capabilities have shown that the frequency, duration, and toxicity of HABs in the U.S. may be increasing overall (Anderson et al. 2021). Ocean warming has fostered the geographic expansion of new HAB species into the action area, such as Ciguatoxin-producing *Gambierdiscus* dinoflagellates into the northern Gulf of America (Anderson et al. 2021). The various toxins produced by these species of HABs can biomagnify up the food chain, ultimately harming protected species (like sea turtles) when ingested (Perrault et al. 2021). These toxins can affect neurological function, feeding and shelter behavior, and damage other organ systems. In the action area, researchers have determined HABs to be the cause of marine mammal unusual mortality events (Fire et al. 2020), large-scale fish kills (Overstreet and Hawkins 2017), and sea turtle deaths (NOAA 2024c).

7.13 Other Marine Pollution

Chemical-based pollution from a variety of sources may also affect all listed species in the action area. These sources include atmospheric deposition of airborne pollutants such as PCBs, stormwater from coastal or river communities, and discharges from ships and industries. In addition to legacy contaminants such as PBCs, heavy metals, and pesticides, several classes of contaminants of emerging concern also introduce risks to listed species. NOAA's National Status and Trends Mussel Watch Program monitors 85 long-term sites in coastal waters in the Gulf of America, and in 2017 detected elevated concentrations of the following contaminants of emerging concern across the coastline: brominated flame retardants, pesticides such as highly toxic organophosphates, pharmaceutical compounds, and per- and polyfluoroalkyl substances (PFAS) (Swam et al. 2023). PFAS are a class of chemicals known for their persistence, bioaccumulation, and associations with liver damage, cancer, and immune suppression in humans and aquatic vertebrate species. Sources of marine pollution are often difficult to attribute to specific federal, state, local or private actions.

Several studies describe impacts of organic contaminants and trace metal accumulation in green, leatherback, and loggerhead 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 turtle 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 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 sea turtle size were observed in green turtles, most likely attributable to a change in diet with age. Sakai et al. (1995) documented the presence of metal residues occurring in loggerhead sea turtle organs and eggs. Storelli et al. (1998) analyzed tissues from 12 loggerhead sea turtles stranded along the Adriatic Sea (Italy) and found that characteristically, 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. 1991b). PFAS compounds have also been detected in the plasma of loggerhead and Kemp's ridley turtles; adverse impacts could have endocrine and reproductive implications for turtle species (Khan et al. 2023). No information on detrimental threshold concentrations is available and little is known about the consequences of exposure of organochlorine compounds to sea turtles. More research is needed to better understand the short- and long-term health and fecundity effects of chlorobiphenyl, organochlorine, and heavy metal accumulation in sea turtles.

Like sea turtles, marine mammals may be adversely affected by marine pollution originating from federal, state, or private activities. A growing body of literature demonstrates possible long-term and trans-generational effects of exposure to pollutants (Schaap et al. 2023). PFAS compounds have been detected in prey fish and bottlenose dolphins in the Gulf of America (Sarasota Bay and Galveston Bay) (Houde et al. 2005; Nolen et al. 2024). Marine mammals accumulate PFAS at the highest concentrations among marine taxa, especially in liver, blood, and blubber tissues, and studies suggest that these compounds bioaccumulate in individuals over time (Khan et al. 2023). It is not known if high levels of heavy metals, PCBs, and organochlorines found in prey species accumulate with age and are transferred through nursing. Nevertheless, the accumulation of stable pollutants such as heavy metals, PCBs, chlorinated pesticides [DDT, DDE, etc.], and polycyclic aromatic hydrocarbons [PAHs]) is of concern.

Pollution from industrial, agricultural, and municipal activities is believed responsible for a suite of physical, behavioral, and physiological impacts to sturgeon worldwide (Agusa et al. 2004; Barannikova 1995; Barannikova et al. 1995; Bickham et al. 1998; Billard and Lecointre 2000; Kajiwara 2003; Karpinsky 1992; Khodorevskaya et al. 1997; Khodorevskaya and Krasikov 1999). Pharmaceuticals and other endocrinologically active chemicals may also be affecting Gulf sturgeon. Several characteristics of the Gulf sturgeon (i.e., long lifespan, extended residence in riverine and estuarine habitats, benthic predator) predispose the species to long-term and repeated exposure to environmental contamination and potential bioaccumulation of heavy metals and other toxicants. Some of these compounds may affect physiological processes and impede the ability of a fish to withstand stress, while simultaneously increasing the stress of the surrounding environment by reducing DO, altering pH, and altering other water quality properties.

The development of marinas and docks in inshore waters can negatively affect nearshore habitats. 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 of the action area, the species of turtles analyzed in this biological opinion travel between nearshore and offshore habitats and may be exposed to and accumulate these contaminants during their life cycles. Further, Gulf sturgeon use coastal areas during a portion of the year and may be affected by pollution originating from marina facilities. Fuel oil spills could affect animals directly or indirectly through the food chain. Fuel spills involving fishing vessels are common events. However, these spills typically involve small amounts of material. Larger oil spills may result from accidents, although these events would be rare. No direct adverse effects on listed species resulting from fishing vessel fuel spills have been documented.

7.14 Cumulative Anthropogenic Impacts to the Environmental Baseline

A number of activities that may indirectly affect listed species in the action area of this consultation include ocean dumping and disposal, and anthropogenic marine debris. The impacts from these activities are difficult to measure. Where possible, conservation actions are being implemented to monitor or study impacts from these sources. Halpern et al. (2015) scored and additively analyzed 19 common stressors to display areas where global cumulative human impacts were greatest (Figure 63). Impact stressors included artisanal fishing, demersal destructive fishing, demersal non-destructive fishing, high by-catch fishing, inorganic pollution, invasive species, nutrient input, ocean acidification, benthic structures (oil rigs), organic pollution, pelagic high-bycatch fishing, pelagic low-bycatch fishing, ocean-based pollution, population pressure, commercial activity (shipping), changes in sea surface temperature and changes in the ultraviolet index. The selected stressors were not comprehensive for the entire world or for specific regions; however, Figure 63 demonstrates the areas where cumulative impacts are high (i.e., Gulf included) and that there are few areas left that have not been affected by humans. The authors noted that marine ecosystems might exhibit threshold responses to intense and cumulative stress that creates non-linear relationships of cumulative impact to ecological condition; therefore, not only intensity of stressors but also vulnerability or resilience of ecosystems must be accounted for when examining ecosystem condition. (Halpern et al. 2015). Cumulative impact across areas may be much greater (or in rare cases less) than the sum of the individual impacts because of interactive or multiplicative effects (Halpern et al. 2008). In a newer study, Halpern et al. (2019) again combined high resolution, annual data on the intensity of 14 human stressors and their impact on 21 marine ecosystems over 11 years (2003-2011) to assess the pace of change in cumulative human impacts on global oceans. In this study, nearly 60% of the ocean is experiencing significantly increasing cumulative impact, in particular due to changing environmental conditions but also from fishing, land-based pollution, and shipping. The Gulf was not amongst those regions that experienced a significant increase in cumulative human impacts during the 11-year period.

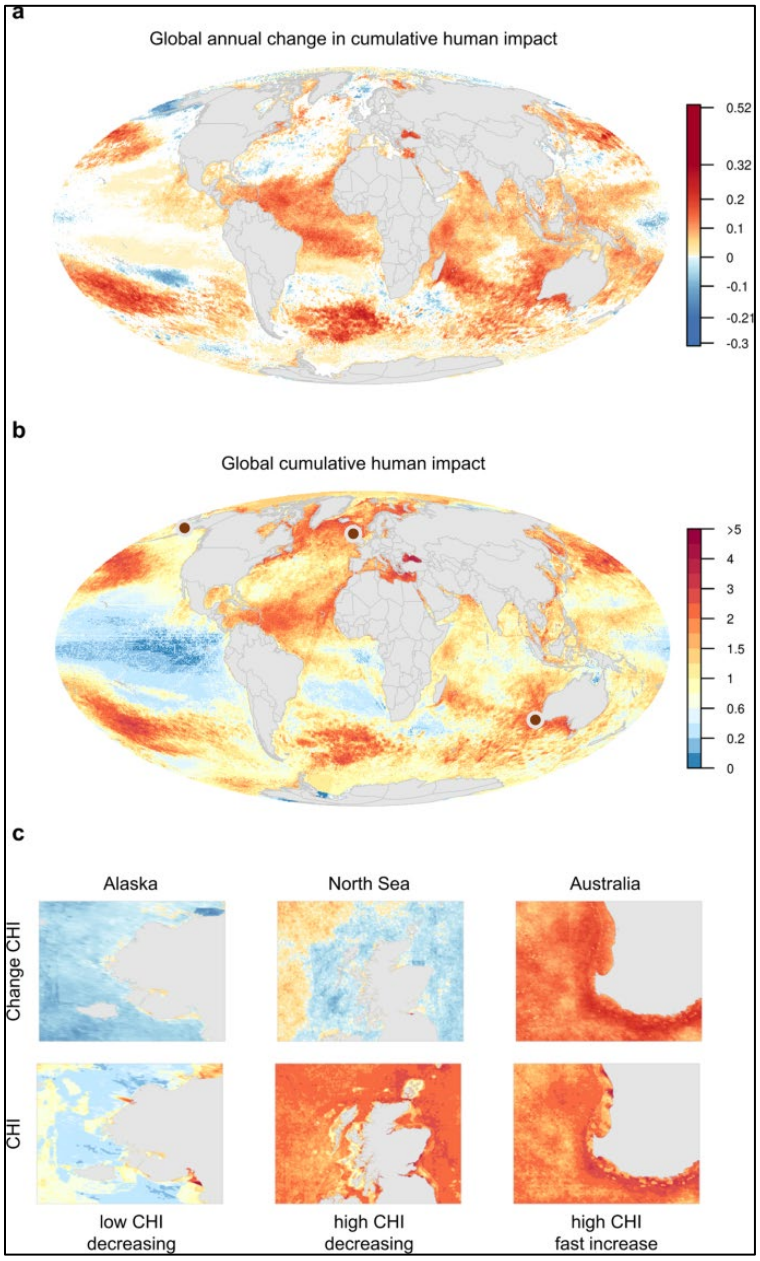


Figure 63. Global patterns of cumulative human impacts. A) Annual change in CHI estimated using a linear regression model from 2003-2013. B) Static map of 2013 CHI. C) Coastal areas displayed for both pace of change and 2013 CHI for regions with dominant patterns. Figure from Halpern et al. (2015)

7.15 Conservation and Recovery Actions

7.15.1 Rice's Whale and Sperm Whale

In December 2010, NMFS published a final recovery plan for sperm whale. In 2019, the Rice's whale was listed as endangered. NMFS has established a long-term monitoring network for the

collection of acoustic data in all federal waters including the Gulf. This information will allow managers to better understand and manage potential sound impacts to these two whale species.

The GoMMAPPS was an ongoing effort between federal partners that collected empirical data during aerial and shipboard vessel surveys, performed satellite tracking of tagged animals, conducted genetic analysis, and developed updated density models (Rappucci et al. 2023).

7.15.1.1 BOEM's Environmental Studies Program

BOEM funds research projects specifically to inform policy decisions regarding development of OCS energy and mineral resources. Some of these studies may benefit marine fauna by providing more information towards understanding those resources.

For example, BOEM collects emissions information related to offshore operations. BOEM is currently conducting a study to perform dispersion and photochemical modelling for the U.S. portion of the Gulf to verify effectiveness of existing air quality emissions exemption thresholds and to ensure annual and short-term NAAQS Standards are being met (https://opendata.boem.gov/BOEM-ESP-Ongoing-Study-Profiles-2017-FYQ1/BOEM-ESP-GM-14-01.pdf; BOEM 2014b).

There are also summaries for current studies on assessing the effects of anthropogenic stressors on marine mammals and discerning behavioral patterns of sea turtles in the Gulf. All of their studies are available through an online system found at https://www.govinfo.gov/collection/boem.

7.15.2 Sea Turtles

NMFS has implemented a series of regulations aimed at reducing potential for incidental mortality of sea turtles from commercial fisheries in the action area. These include sea turtle release gear requirements for the Atlantic HMS, South Atlantic snapper-grouper, Gulf reef fish fisheries, and TED requirements for the Southeast shrimp trawl fishery. In addition to regulations, outreach programs have been established and data on sea turtle interactions with recreational fisheries has been collected through the Marine Recreational Information Program. The summaries below discuss these measures in more detail.

7.15.2.1 Federal Actions

Critical habitat for loggerhead sea turtles was jointly designated by NMFS and USFWS on July 10, 2014 (79 FR 39856; Section 6.2.11).

Reducing Threats from Pelagic Longline and Other Hook-and-Line Fisheries

On July 6, 2004, NMFS published a Final Rule to implement management measures to reduce bycatch and bycatch mortality of Atlantic sea turtles in the Atlantic pelagic longline fishery (69 FR 40734). The management measures include mandatory circle hook and bait requirements, and mandatory possession and use of sea turtle release equipment to reduce bycatch mortality.

NMFS published the Final Rules to implement sea turtle release gear requirements and sea turtle careful release protocols in the Gulf reef fish (August 9, 2006; (71 FR 45428) and South Atlantic snapper-grouper fisheries (November 8, 2011; Lopez-Pujol and Ren 2009). These measures require owners and operators of vessels with federal commercial or charter vessel/headboat permits for Gulf reef fish and South Atlantic snapper-grouper to comply with sea turtle (and smalltooth sawfish) release protocols and have on board specific sea turtle release gear.

Revised Use of Turtle Excluder Devices in Trawl Fisheries

NMFS has also implemented a series of regulations aimed at reducing potential for incidental mortality of sea turtles in commercial shrimp trawl fisheries. In particular, NMFS has required the use of TEDs in southeast United States shrimp trawls since 1989 and in summer flounder trawls in the mid-Atlantic area (south of Cape Charles, Virginia) since 1992. It has been estimated that TEDs exclude 97% of the sea turtles caught in such trawls. These regulations have been refined over the years to ensure that TED effectiveness is maximized through more widespread use, and proper placement, installation, configuration (e.g., width of bar spacing), and floatation. The NMFS continues to work towards development of new, more effective gear specific to fishery needs.

Placement of Fisheries Observers to Monitor Sea Turtle Captures

On August 3, 2007, NMFS published a Final Rule that required selected fishing vessels to carry observers on board to collect data on sea turtle interactions with fishing operations, to evaluate existing measures to reduce sea turtle captures, and to determine whether additional measures to address prohibited sea turtle captures may be necessary (72 FR 43176). This Rule also extended the number of days NMFS observers could be placed aboard vessels, from 30 to 180 days, in response to a determination by the Assistant Administrator that the unauthorized take of sea turtles may be likely to jeopardize their continued existence under existing regulations.

7.15.2.2 State Actions

Under Section 6 of the ESA, state agencies may voluntarily enter into cooperative research and conservation agreements with NMFS to assist in recovery actions of listed species. NMFS currently has an agreement with all states along the Gulf of America. Prior to issuance of these agreements, the proposals were reviewed for compliance with section 7 of the ESA.

7.15.2.3 Other Conservation Efforts

Sea Turtle Handling and Resuscitation Techniques

NMFS published a Final Rule (66 FR 67495) 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 hardshell turtles caught in fishing or scientific research gear.

Outreach and Education, Sea Turtle Entanglement, and Rehabilitation

There is a Sea Turtle Stranding Network with extensive participant coverage along the Atlantic and Gulf coasts that not only collects data on dead sea turtles, but also rescues and rehabilitates live stranded sea turtles.

A Final Rule (70 FR 42508) published on July 25, 2005, allows any agent or employee of NMFS, the USFWS, the USCG, 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. NMFS already affords the same protection to sea turtles listed as threatened under the ESA [50 CFR §223.206(b)].

NMFS has also been active in public outreach efforts to educate fishers regarding sea turtle handling and resuscitation techniques. As well as making this information widely available to all fishermen, NMFS recently conducted a number of workshops with Atlantic HMS pelagic longline fishers to discuss bycatch issues including protected species, and to educate them regarding handling and release guidelines. NMFS intends to continue these outreach efforts and hopes to reach all fishers participating in the Atlantic HMS pelagic longline fishery.

Recovery Plans and Reviews

The second revision to the recovery plan for the loggerhead sea turtle was completed January 11, 2009 (NMFS and USFWS 2009). The recovery plan for the Kemp's ridley sea turtle was published 2011 (NMFS et al. 2011a). Recovery teams comprised of sea turtle experts have convened and are currently working towards revising these plans based upon the latest and best available information. Five-year status reviews were completed in 2013 for hawksbill and leather back sea turtles, and in 2015 for green, and Kemp's ridley sea turtles. A review of the loggerhead sea turtle's status was conducted in 2009 (Conant et al. 2009). These reviews were conducted to comply with the ESA mandate for periodic status evaluation of listed species to ensure that their threatened or endangered listing status remains accurate. Both loggerhead and green sea turtles were reclassified under the ESA (76 FR 58868; 80 FR 15271).

7.15.3 Gulf Sturgeon

7.15.3.1 Federal Actions

Critical habitat for Gulf sturgeon was jointly designated by NMFS and USFWS on April 18, 2003 (50 CFR §226.214) (see Section 6.2.13 for further description). Additionally, a Gulf sturgeon recovery/management plan was prepared in 1995 (USFWS and GSMFC 1995). An updated recovery plan is currently under development by USFWS and NMFS.

Gulf sturgeon may benefit from the use of devices inserted into trawl nets designed to exclude other species, such as sea turtles. Evidence of exclusion from a shrimp trawl net was documented when an Atlantic sturgeon caught off South Carolina by a shrimp trawler in December 2011 exited through the TED alive. NMFS has required the use of TEDs in some Gulf shrimp trawls since 1989 and the regulations have been refined over the years to ensure effectiveness is maximized for sea turtle escapement through more widespread use, and proper placement, installation, configuration (e.g., width of bar spacing), and floatation.

7.15.3.2 State Actions

Cooperative conservation partnerships between NMFS and States can be formalized by entering into agreements pursuant to Section 6 of the ESA. NMFS has established partnerships for cooperative research on Gulf sturgeon via conservation agreements in the Gulf of America with the states of Florida, Alabama, Mississippi, and Louisiana. Prior to issuance of these agreements, the proposal must be reviewed for compliance with section 7 of the ESA.

Implementation of the Florida Net Ban (Amendment 3 of the Florida Constitution) in 1995 has likely benefited sturgeon. The Net Ban made unlawful the use of entangling nets (i.e., gill and trammel nets) in Florida waters and likely benefitted or accelerated Gulf sturgeon recovery given residence of sturgeon in near-shore waters where tangling gear is commonly used during much of their life span. Capture of small Gulf sturgeon in mullet gill nets was documented by state fisheries biologists in the Suwannee River fishery in the early 1970s. Large mesh gill nets and runaround gill nets were the fisheries gear of choice in historic Gulf sturgeon commercial fisheries. Absence of this gear in Florida eliminates it as a potential source of mortality of Gulf sturgeon.

Gulf sturgeon is protected in Alabama and Mississippi. It is illegal to take, capture, kill, or attempt to take, capture or kill; possess, sell, trade for anything of monetary value, or offer to sell or trade for anything of monetary value, for Gulf sturgeon. Collection of Gulf sturgeon is only allowed with a scientific collection permit (AL ADC 220-2-92, MS ADC 40-1-28).

In 1992, the State of Louisiana listed Gulf sturgeon as a state threatened species (76 LA ADC Part I, §317). Currently, the harvest of Gulf sturgeon in state waters is prohibited (76 LA ADC Part XIX, §111), and any modifications to habitat must consider the potential effects on sturgeon. Studies are underway to determine the status, distribution, and movements of this species in Louisiana.

7.15.3.3 Other Conservation Efforts

In 1998, Gulf sturgeon were listed under Appendix II of CITES. Appendix II species are threatened with extinction if their trade is not regulated and monitored. Appendix II species require an export permit, which may be issued for any purpose as long as the specimens were legally acquired and export is not detrimental to the species. The listing of sturgeon in CITES provides managers with a mechanism for regulating the import and export of sturgeon and their products, thereby curtailing the illegal caviar trade and the harm it causes to the wild

populations. The USFWS, Division of Law Enforcement, is responsible for the enforcement of CITES and is the permit and enforcement authority responsible for regulating the importation of sturgeon from foreign countries (USFWS International Affairs 1998, in (Wakeford 2001).

8 EFFECTS OF THE ACTION ON ESA-LISTED SPECIES

The ESA section 7 regulations (50 C.F.R. § 402.02) define *effects of the action* as "all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action but that are not part of the 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."

Under the ESA, the term "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. For this consultation, we are particularly concerned about activities that may kill an animal or result in behavioral and physiological disturbances that may result in the failure of an animal to feed or breed successfully, or otherwise impede animals' ability to complete their life history functions (i.e., a decrease in fitness).

Below we provide key assumptions regarding our effects analysis, estimates of the number of individuals of each ESA-listed species that would be exposed to the stressors, and the potential effects of each stressor on species exposed.

8.1 Estimation of Effects, Including Best Available Data Sources, Analytical Tools and Approaches, and Assumptions

The complexity of the Oil and Gas Program (i.e., multiple simultaneous activities over a broad action area and 45-year period under analysis) required us to make several assumptions to complete our effects analyses. NMFS made key assumptions regarding the duration of the program, the definition of harassment as it relates to marine mammals vs. other ESA-listed species, and species densities and abundance, to evaluate effects of the program.

8.1.1 Program Duration

Our analysis is based on projections provided by BOEM and BSEE of oil and gas-related activity levels, including the effects of potential lease sales occurring up to five years after issuance of this opinion, or through 2029. The exposure scenarios in this opinion include oil and gas activities Gulf-wide. The GOMESA moratorium was set to expire on June 30, 2022, but a 2020 Presidential withdrawal superseded it and extended the closure until 2032. If exploratory activity or new leases are planned or offered in the Presidential withdrawal area following issuance of this opinion, reinitiation of consultation or a separate, stand-alone consultation will be required.

For the vessel strike analysis (Section 8.4), we considered whether there are additional vessel types that were not identified in the action, but that would be an effect of the action (i.e., not occur but for the Oil and Gas Program). As described, service vessels, barges, tankers, G&G

survey vessels, and G&G service vessels are vessels included in the Oil and Gas Program (BOEM 2017a). For tankers, in addition to considering shuttle tankers associated with FPSO systems, we consider and analyze tanker traffic between ports and exported to other countries because this tanker activity would not occur but for BOEM's Oil and Gas Program and is reasonably certain to occur. However, because we are unable to determine the percentage of overall tanker traffic associated with the Oil and Gas Program, we treat our estimate of the program's vessel traffic as a minimum, and qualitatively consider the effects of additional tanker traffic.

8.1.2 Species' Densities and Abundance in the Action Area

In order to estimate exposure of ESA-listed species to the stressors associated with the action, density and abundance estimates were required for the species determined likely to be adversely affected. While the status of the species sections (Section 6.2) provide an overview of the species abundance and distribution, this information is not specific to the action area. Here, we summarize the data on the density, distribution, and abundance of ESA-listed species in the action area, which we then use to estimate exposure of ESA-listed species to each stressor caused by the Oil and Gas Program. Each of these factors may fluctuate over the 45 years of the Oil and Gas Program because of environmental and other conditions.

8.1.2.1 Marine Mammal Density and Abundance

The best available density estimates for listed cetaceans are modeled by NMFS Southeast Fisheries Science Center as part of Rappucci et al. (2023), the GoMMAPPS Volume 1 report, its accompanying Appendix (Garrison et al. 2023), and a peer-reviewed publication (Garrison et al. 2024) for Rice's whales. These estimates account for the most recent visual survey sightings, passive acoustic records, unobserved animals, and environmental variables for habitat availability. The models and descriptions summarized here can be found at https://seamap.env.duke.edu/models/SEFSC/GOM/. These are best available models for the Gulf, and are an update of the Roberts et al. (2016b) density maps cited and used in the 2020 opinion.

Rappucci et al. (2023) and Garrison et al. (2023) developed Gulf-wide spatial density models based on surveys conducted between 2003 and 2019. Seasonal GoMMAPPS aerial survey data were collected during 2011/2012 and 2017/2018 over the continental shelf, and visual line-transect vessel surveys were conducted in 2003, 2004, 2009, and summer 2017 and summer through winter 2018 (GoMMAPPS surveys). Rice's whale abundance estimations were determined differently because they are observed primarily in the northeastern GOA in a relatively small area close to the 200 m isobath. The model therefore examines survey effort within Rice's whale northeastern GOA habitat in addition to Rice's whale sightings from 12 vessel surveys between 2003 and 2019 to supplement the data collected during the GoMMAPPs surveys.

Habitat-based species density maps were generated using monthly environmental parameters for the period 2015 to 2019 to make predictions, by summarizing survey effort and environmental variables with a hexagon grid. Density predictions were summarized into mean monthly densities for the 5-year period, expressed as the number of individual animals per 100 km^2 and resampled into traditional raster grids. For the purposes of our analysis, we used Zonal Statistics in ArcGIS to calculate the average mean monthly density per grid cell in the action area fishnet grid. To estimate monthly abundance per grid cell, the mean density value was divided by 100 to produce a metric for the number of animals per 1 km^2, and then multiplied by 130 km^2 (the area of each grid cell in the fishnet) to produce the total number of animals per grid cell. We further calculated the mean annual density per species from the monthly grids for some of our effects analyses.

For sperm whales, the best available published literature estimated that the Northern Gulf stock consisted of 1,180 individuals for the 2017-2018 period (Garrison et al. 2020b; Hayes et al. 2022) and 1,967 for the entire Gulf (Whitehead and Shin 2022). This is a lower abundance estimate than the best available estimate of 2,128 animals used in the 2020 opinion (Roberts et al. 2016b). The most recent study using post-DWH acoustic data (2010 to 2017) estimated weekly mean densities of 1.3 animals per 1,000 km^2 across 3 sites in the Gulf of America (2.319 per 1,000 km^2 in Mississippi Canyon, 0.868 per 1,000 km^2 in Green Canyon, and 0.379 per 1,000 km^2 in the Dry Tortugas)(Solsona-Berga et al. 2024). This aligns with arlier density estimates of 1.7 animals per 1,000 km^2 estimated from vessel survey results (Garrison et al. 2020, Hayes et al. 2022). As described above, for this opinion we used spatially-explicit density estimates based on habitat modeling by Rappucci et al. (2023) and Garrison et al. (2023) to derive sperm whale exposure numbers in the areas defined for each stressor analysis. The number of sperm whale calves exposed to any stressor was calculated as 0.11 of the total exposures, which is the ratio of calves (one and two-year-olds) to females and immature males in the Gulf (Jochens et al. 2008) and the female:male ratio as 72:28 of exposures (Engelhaupt et al. 2009). To calculate an average density for sperm whales across the action area (in >200 m) used in the pile driving effects analysis, we used the fishnet grid for the month of August and summed the mean density for all grid cells > 200 m, then divided that result with the total number of grid cells.

For Rice's whales, the current best abundance estimate is at 51 animals as reported in the 2023 MMPA stock assessment report (Hayes et al. 2023), but Rappucci et al. (2023) estimate the population may be larger, with an abundance estimate of 121 animals derived from a species distribution model that covers a broader area, including Mexican waters. Population structure information, in terms of calf to adult and female to male ratios, is not available.

8.1.2.2 Sea Turtle Density and Abundance

Five species of sea turtle in the Gulf are considered in the effects analyses in this biological opinion: Northwest Atlantic DPS loggerhead, Kemp's ridley, North Atlantic DPS green, hawksbill, and leatherback. Densities of sea turtles within the Gulf of America vary by species,

life stage, and seasonality. Adult sea turtles are generally more abundant on the continental shelf (in water depths <200 m), while oceanic juveniles can be found on both the shelf and in more pelagic environments. For our analysis, we incorporate: 1) newly available density information for large sea turtles (>30 cm length) occurring in waters <200 m, 2) existing data applied in the 2020 opinion for large sea turtles occurring in >200 m water depth, and 3) separate, newly available density estimates for juvenile sea turtles (<30 cm length). The density data sources and abundance estimates are described in detail below. There are no current density estimates available for hawksbill sea turtles in the Gulf.

As noted in the Status of the Species (Section 6.2.9), hawksbill sea turtles are sparsely distributed in low densities in the Gulf. Hawksbill turtles have highly specialized habitat and diet needs that restrict them to specific coral areas with a small, patchy range in the Gulf of America (NOAA and DOI 2023). Based on expert elicitation, these areas are limited to shallow waters in: southwest Florida, the Dry Tortugas, southern border of Texas, and FGBNMS. Where they have been observed, distribution is patchy so habitat availability does not reliably predict abundance. Aerial surveys such as GoMMAPPS have not detected hawksbills (Garrison et al. 2023) nor have recent small vessel observer surveys conducted in nearshore waters of the central Gulf (Welsh et al. 2023). As a result, there is no spatial density or distribution model available for the species. Expert elicitation confirms that, due to the limited and patchy distribution of few individuals of the species, hawksbills likely do not overlap with most oil and gas activities. NOAA scientific assessments of renewable energy development in the U.S. Gulf of America Farmer et al. (2023) excluded hawksbill sea turtles from the analysis, citing the fact that the primary use area for the species is a narrow migratory corridor through the Straits of Florida, which is isolated from conventional oil and gas activities. In the 2020 consultation, a rough estimate of hawksbill abundance was created by apportioning the hardshell turtle category across hardshell sea turtle species that may occur in the Gulf, including hawksbills. Thus, hawksbill sea turtles are not included in all of the effects analyses because, for some Oil and Gas Program-related stressors, there will be no exposure of hawksbill sea turtles.

Water < 200 m Deep

For large sea turtles (>30 cm carapace length) in waters < 200 m deep, the best available density estimates within the action area were modeled by NOAA's Southeast Fisheries Science Center (SEFSC), as part of BOEM's GoMMAPPS (Garrison et al. 2023; Lamont and Hart 2023; Rappucci et al. 2023). Similar to the whale density modeling, Garrison et al. (2023) developed habitat-based species distribution models using GoMMAPPS seasonal aerial surveys to estimate sea turtle abundance in the northern Gulf of America within BOEM's Western, Central, and Eastern planning areas < 200 m deep. These updated density data are only available for loggerhead, Kemp's ridley, leatherback, and green sea turtles. Density information is not available for the hawksbill sea turtle (see above).

For each modeled species, density data were summarized into mean monthly densities for a 5-year period between 2015-2019. The sea turtle density data are available at

https://seamap.env.duke.edu/models/SEFSC/GOM/ as traditional raster grids, presenting the estimated monthly mean density expressed as the number of individual animals per 100 km^2. For the purposes of our analysis, we used Zonal Statistics in ArcGIS to extrapolate the density values to the action area fishnet grid, by calculating the average mean monthly density per grid cell. To estimate monthly abundance per grid cell, the extrapolated mean density value was first divided by 100 and then multiplied by 130 km^2 (the area of each grid cell in the action area fishnet grid) to produce abundance estimates of total number of animals per cell.

The density estimates for hardshell turtles (excluding leatherbacks) include apportioned estimates of unidentified turtles. Aside from leatherbacks, sea turtles are difficult to identify reliably from the air, and observers are trained to positively identify to species only when they are confident in their identification. In particular, distinguishing between green turtles and loggerhead turtles requires careful observation. Turtles are often observed just below the water surface or diving, making reliable identification more challenging. As a result, many of the observed turtles during the GoMMAPPS aerial surveys were identified only as "hardshell turtles." To include the unidentified observations as part of the density estimate, Garrison et al. (2023) partitioned the unidentified sea turtles among the identified species based upon the relative predicted density of each species in each spatial cell. Total average density and abundance for the action area are summarized in Table 29.

Waters > 200 m Deep

While large, adult sea turtles primarily nest in nearshore habitats, they may also travel large distances through offshore waters on migration routes, between habitats and life stages. Leatherbacks, in particular, spend proportionally more time in deeper waters to forage for jellyfish. According to monitoring studies conducted for seismic surveys between 2002 and 2015, there were 2,975 sea turtle sightings in oil and gas planning areas, at a mean water depth of 323 m and out to the U.S. EEZ (Barkaszi and Kelly 2019). Those sightings encompass all life stages, including adults.

For large (>30 cm carapace length) sea turtles in >200 m water depth, new density information has not been produced since the conclusion of the 2020 consultation. Thus, we used the same data from the Navy's Atlantic Fleet Training and Testing (AFTT) Phase III modeling (U.S. Navy 2017) to represent the best available data within the action area for these deeper areas.[21] We consider these density estimates to represent sea turtles >30 cm in size since they are based on

[21] Note that Navy AFTT Phase IV is currently undergoing formal ESA Section 7 consultation with NMFS, and the Navy adapts the GoMAPPS sea turtle density data for shelf waters <200m as described above. However, Phase IV does not model sea turtle densities for deeper water depths >200m, and assumes the species are absent. From our best scientific judgment and available information, juvenile turtles are known to shelter offshore in Sargassum patches and adults are known to migrate and travel through offshore areas depending on the time of year. Therefore, we cannot assume that sea turtles are absent from the offshore >200m regions, and determined that the Navy Phase III modeling data remains the best available data for our analyses within the action area.

aerial surveys which can only detect larger sea turtles, and were corrected for sighting availability (Epperly et al. 1995; NMFS 2011d).

The Navy Phase III data provide monthly density estimates for each species, based on habitat suitability models and extrapolations for the Gulf and the Atlantic coast. While the models indicate uncertainty related to sea turtle presence and density in some offshore areas as a potential source of uncertainty, this dataset represents the best available science. To further differentiate between sea turtle species groups, the Navy developed an approach to assign sea turtles to guilds, based on whether they are hardshell turtles or non-hardshell (i.e., leatherbacks). This approach helps predict density estimates for sea turtle observations where species-level identifications were not possible. The hardshell turtle guild consists of green, loggerhead, and Kemp's ridley sea turtles (excluding hawksbills for reasons listed above); green turtles are only considered under the hardshell turtle category because this species does not have a separate density estimate. The hardshell turtle guild estimates were further apportioned to individual hardshell turtle species based on each species' known geographic species densities and relative proportions calculated from the <200m density data described above (Kemp's ridley 39%; loggerhead 58%; green sea turtle 2%; Table 29). This provides the best estimation of species abundances in absence of better spatial data describing distribution and habitat usage of deeper waters in the Gulf for each species.

To have full coverage of the entire action area at the finest geographic scale possible for our analyses, we use Zonal Statistics to calculate the mean monthly density value per action area fishnet grid cell. These zonal average monthly densities were then appended to the monthly density layers for the <200m data, such that values were assigned to the action area fishnet grid cells where extrapolated densities from the shallow water GoMMAPPS data were not available. We also calculated average annual densities and abundances using the monthly data. Between the two datasets, large turtles for each species will have complete density data coverage across the action area (Figure 64).

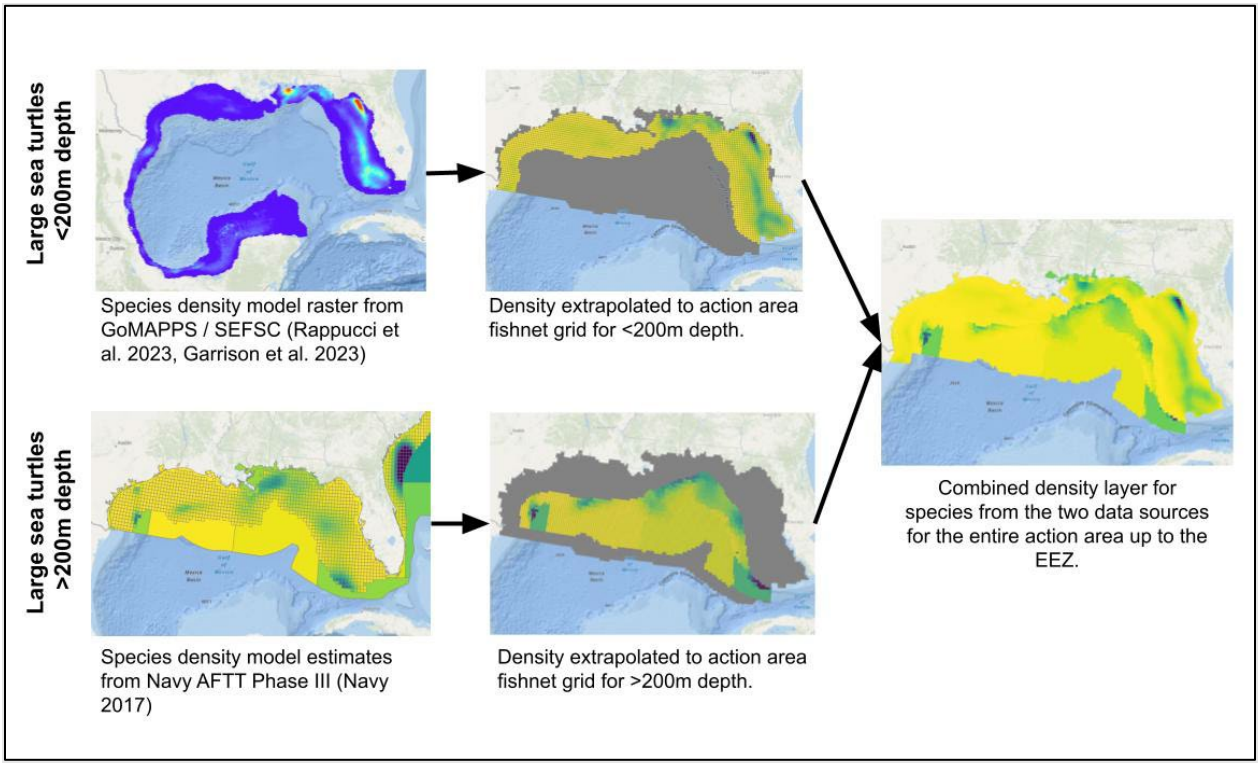


Figure 64. Schematic illustrating the data sources for sea turtle densities on shelf waters <200m (upper panel) and in waters >200m (lower panel). The maps here display leatherback sea turtle data for the month of January as an example.

Small Sea Turtles

When modeled densities and abundance estimates for oceanic juvenile sea turtles are not available, aerial coverage of *Sargassum* habitat may be used as a proxy to estimate total abundance of juvenile sea turtles in the action area. In the Western Atlantic, *Sargassum* is the principal feature that defines habitat for oceanic juvenile sea turtles (less than 30 cm) during the "lost years" life stage. Oceanic juveniles aggregate in *Sargassum* habitats both over the continental shelf and in deeper oceanic waters. *Sargassum* habitat supports abundant prey and provides cover that otherwise would not be available to oceanic stage sea turtles. The diet, high-affinity, and shallow dive behaviors reported for oceanic juveniles associated with *Sargassum* habitat show that *Sargassum* is extremely important for young sea turtles (Witherington et al. 2012). In the eastern Gulf and off the western coast of Florida, juveniles of four species (Kemp's ridley, loggerhead, green, hawksbills) have been found in floating *Sargassum* based on ship surveys conducted between 1992 and 2011 (Witherington et al. 2012). There have not been any oceanic juvenile leatherback sea turtles documented in the Gulf. Leatherback nesting is very rare in the Gulf. It is likely that larger and older age classes of leatherbacks predominantly occur in the Gulf. Considering the high mortality rate of young turtles hatching from the few nests in the entire Gulf, the occurrence of oceanic leatherback juveniles would be so rare we have discounted the likelihood of their occurrence. Density estimates for large leatherbacks observed by surveys best represent the total number of leatherbacks that may be present in the action area.

In this opinion, we use modeled juvenile turtle abundance estimates from (Putman et al. 2019), following the methods of (Farmer et al. 2023) as the best available science to calculate density values for spatial analysis. These data are available for Kemp's ridley, loggerhead, and green sea turtles because, as discussed above, these species are expected to use offshore pelagic habitat in the Gulf as juveniles. The model from Putman et al. (2019) generates spatially-explicit predictions of oceanic-stage juvenile abundance and distribution based on the species' reproductive output from major turtle nesting regions (from 1996-2017), movement, and mortality. Predicted annual mean abundances are summarized for 1° by 1° spatial grid cells within the Gulf and western Atlantic. Then, following the methodology from Farmer et al. (2023), the number of surviving turtles at the median annual survival level (0.817 or 81.7%) was averaged across the years of data available (2015 to 2017) within the 1° by 1° spatial grid cells, to produce a mean annual predicted abundance value of each species per cell. Note that this data was not available at the monthly level. We then calculated the geodesic area of the cells in order to obtain a density value per cell (number of animals per one square kilometer). By overlaying our action area fishnet grid with the juvenile sea turtles 1° by 1° grid, we are able to extrapolate juvenile turtle density values to each cell for full distribution coverage of the entire action area using Zonal Statistics. To estimate total abundance in the action area, the density value was multiplied by 130 km^2 (area of each grid cell) and summed across all cells (Table 29).

Table 31. Summary of sea turtle species densities and abundances in the action area. Estimates of large sea turtle abundances are the combined estimates for sea turtles >30 cm in waters <200 m depth (Rappucci et al. 2023, Garrison et al. 2023) and >200 m depth (Navy 2017). Estimates of small <30cm sea turtle abundances are from Putman et al. 2020 and Farmer et al. 2023.

Species	Mean annual density (large turtles / km^2)	Hardshell species proportion of total large turtles	Mean annual abundance (large turtles)	Maximum seasonal abundance (and month)	Mean annual density (small turtles / km^2)	Mean total abundance (small turtles)
Kemp's ridley	0.183408	39%	133,371	309,237 (Feb)	0.01679	21,998
Loggerhead	0.287298	58%	208,468	320,516 (Mar)	0.125795	115,718
Green	0.006466	2%	4,686	8,665 (Jul)	0.231032	215,551
Leatherback	0.006379	–	4,630	9,334 (Jul)	0	0

8.1.3 Effects Analysis Roadmaps

Table 32 and Table 33 provide "roadmaps" of our effects determinations for each activity (or stressor) and ESA-listed species. Section 9 provides a similar "roadmap" of our effects determinations for each activity (or stressor) and designated and proposed critical habitat. Table

30 displays all activities (or stressors) that we expect would have either no effect (boxes marked as NE) or are NLAA for ESA-listed species. Activity (or stressor), and species combinations we determined to be NE are not discussed further. Activities or stressors we determined are NLAA ESA-listed species being considered in the effects analysis are discussed in Section 8.2.

For stressors that are LAA an ESA-listed species, we provide more information on each activity (and its stressor or stressors), the effects of the associated stressors on ESA-listed species, and our rationale for reaching the effects determinations (Sections 8.4 through 8.8). Table 33 shows those activities or stressors we determined are LAA at least one ESA-listed species.

For some activities, including NUTs, for which information is sparse, we use the best available information to evaluate the effects of the stressors associated with certain activities on ESA-listed species. Detailed effects determinations for these activities will depend on the specifics of the activity evaluated during a step-down consistency review, or tiered consultation, as needed, under this programmatic opinion (see Section 3.4 for details).

Stressors are any physical, chemical or biological change to land, water or air resulting from the Federal action, in this case, the Oil and Gas Program. In Section 5, we identified the stressors created by the action. Here we analyze how those stressors will interact with ESA-listed species (and designated critical habitat in Section 9) in the action area. As shown in the table above, not all stressors are likely to adversely effect each ESA-listed species. Also, many of the activities that will occur across the different stages of the Oil and Gas Program will create similar stressors; i.e., the stressors and their effects on species are expected to be similar regardless of the program phase. Therefore, our analysis considered the stressor rather than the activity. The stressors carried forward for analysis were: vessel operations and collision (vessel strikes), sound (from the use of airguns and boomers during G&G surveys, explosive severance, pile driving, and vessels), entanglement (in site clearance trawls and OBN) and entrapment (in moon pools), marine debris from Oil and Gas Program-related activities, and oil spills from Oil and Gas Program-related activities.

For the effects analyses below, we discuss sea turtles as a group because we expect the effects of each stressor on the five species considered in this opinion to be generally the same. The best available information supports that sea turtle species would respond and be affected similarly. The caveat is that Kemp's ridley sea turtles have a restricted distribution with the majority of the population spending their entire life in the Gulf, and they are the most endangered of the five species. Regardless of this, the five species are biologically similar and we expect responses to stressor exposures will be the same for Kemp's ridley turtles as for the other four species. Therefore, it is reasonable for us to separate out each species for the exposure analyses, where appropriate, and to make generalizations with respect to sea turtle responses to stressors, and to do the same in the discussions of risk.

Table 32. Summary of effects determinations for each activity (or stressor) and species evaluated. The activities and stressors in this table either have no effect (NE) or are not likely to adversely affect (NLAA) ESA-listed species in the Gulf of America.

Activity or stressor	Rice's whale	Sperm Whale	Sea Turtles: Green (N. Atlantic and S. Atlantic DPS); Hawksbill; Kemps Ridley; Leatherback; Loggerhead N.W. Atlantic DPS)	Gulf Sturgeon
CSEM survey activities	NLAA	NLAA	NLAA	NE
Entanglement in other seismic survey equipment (hydrophones, geophones, cables, other)	NLAA	NLAA	NLAA	NE
Other G&G activities producing sound (e.g. HRG, AUV, hazard surveys)	NLAA	NLAA	NE	NE
G&G sediment sampling	NLAA	NLAA	NLAA	NE
Aircraft sound and operation	NLAA	NLAA	NLAA	NE
Construction and operation sound sources other than pile driving	NLAA	NLAA	NLAA	NE
Air emissions	NLAA	NLAA	NLAA	NE
NPDES water discharges	NLAA	NLAA	NLAA	NLAA
Pre-severance activities: sediment disturbance and increased turbidity	NE	NLAA	NLAA	NE

Table 33. Summary of effects determinations for those activities or stressors determined to LAA at least one ESA-listed species in the action area

Activity or stressor	Rice's whale	Sperm Whale	Sea Turtles: Green (N. Atlantic and S. Atlantic DPS); Hawksbill; Kemps Ridley; Leatherback; Loggerhead N.W. Atlantic DPS)	Gulf Sturgeon
Seismic surveys: airguns and boomers	LAA	LAA	LAA	NE
Entanglement in seismic survey equipment in ocean bottom nodes (OBN)	NLAA	NE	LAA	NE
Vessel strike	LAA	LAA	LAA	LAA
Vessel sound and operation	LAA	NLAA	NLAA	NLAA
Offshore Infrastructure/ Pile Driving	NLAA	LAA	LAA	NE
Oil spill < 1,000 bbl	NLAA	NLAA	NLAA	NLAA
Oil spill ≥ 10,000 bbl	LAA	LAA	LAA	LAA
Structure severance: explosives	NLAA*	NLAA	LAA	NE
Post structure removal site clearance trawling	NLAA	NLAA	LAA	NE
Discharge of marine debris during program activities	LAA	LAA	LAA	NLAA
Entrapment in moon pools	NE	NE	LAA	NE

*assumes no explosive removal in EPA

8.2 Stressors Not Likely to Adversely Affect ESA-Listed Species

This section describes stressors from Oil and Gas Program activities that may affect ESA-listed species but that, after further analysis, were determined to have either insignificant or discountable effects (i.e., NLAA) for all ESA-listed species exposed to a particular stressor, or be NLAA for particular species (Table 32). As defined in Section 6.1, discountable effects are those that are extremely unlikely to occur, whereas insignificant effects relate to the size or severity of the impact and include those effects that are undetectable, not measurable, or so minor that they cannot be meaningfully evaluated. Below, we provide our rationale for these NLAA determinations. There are also NE and NLAA determinations for some ESA-listed species in Sections 8.5 through 8.8 for those species/stressor analyses that had at least one combination that was LAA (Table 33).

8.2.1 G&G Surveys using HRG

BOEM provided modeling for the exposure of Rice's whales and sperm whales to HRG surveys under the Oil and Gas Program. HRG surveys have a much smaller acoustic footprint than airgun and boomer surveys because they operate at higher frequencies. Higher frequencies attenuate faster and the sources are often towed at depths close to the sea floor, limiting spreading of the sound. Some sonar sources are attached to the vessel at the surface, but most are deployed at depths 20-50 ft above the sea floor on a towfish or AUV, which limits the directionality of the main power of the signals to deeper depths of the water column.

We reviewed G&G permits from the Gulf of America from 2014-2015 and found the most common types of sound sources used for HRG surveys include side-scan sonars, echosounders, and sub-bottom profilers over a wide range of frequencies between 2-400 kHz. The survey distances covered under the permits ranged from 17-927 miles and surveys lasted for 45 days, on average (3-60 days). Table 34 shows the annual number of exposures to HRG survey sounds that could cause a disturbance response in sperm and Rice's whales, modeled as the percent of sperm or Rice's whales disturbed over 24-hour periods using the (Wood et al. 2012) probabilistic (step) function discussed in Section 8.5.1.

Table 34. Number of disturbance responses of sperm whales and Rice's whales to high-resolution geophysical surveys calculated as the percent of animals responding over daily periods

Year	Number of Survey Days/Year	Sperm Whale Total Harassment Exposures	Rice's whale Total Harassment Exposures
1	94	< 1	< 1
2	95	< 1	< 1
3	98	< 1	< 1
4	95	< 1	< 1
5	95	< 1	< 1
6	103	< 1	< 1

Year	Number of Survey Days/Year	Sperm Whale Total Harassment Exposures	Rice's whale Total Harassment Exposures
7	113	< 1	< 1
8	114	< 1	< 1
9	116	< 1	< 1
10	103	< 1	< 1
10-Year Total	1,026	0.53	0.000816

HRG sound sources include sub-bottom profilers, side-scan sonar, multi-beam and single-beam echosounders, some of which are within the hearing range of sperm and Rice's whales, and may disturb these species. TTS and PTS exposure levels resulting from HRG survey equipment sound levels are only possible at a very close distance to the source for sperm and Rice's whales. Kremser et al. (2005) concluded the probability of a cetacean swimming through the area of sound exposure when such sources emit a pulse is small, because the animal would have to pass at close range and be swimming at speeds similar to the vessel in order to receive multiple pulses that might result in sufficient exposure levels to cause TTS. This finding is further supported by Boebel et al. (2005), who found that, even for echosounders with relatively high source levels, TTS is only possible if animals pass immediately under the transducer. Burkhardt et al. (2013) estimated that the risk of injury from echosounders was less than 3% that of vessel strike. In addition, modeling by Lurton (2016) of multibeam echosounders indicates that the risk of injury from exposure to such sources is negligible, and even behavioral responses are unlikely. Thus, sperm and Rice's whales would only be exposed to TTS and or PTS levels at very close ranges to the sound sources. We do not expect sperm whales and Rice's whales to come close enough to the sound sources to experience TTS or PTS. Animals are expected to hear the sounds (if audible) at much greater distances than the TTS or PTS distances, and, in most cases, avoid a close approach. In addition, PSOs and crew will watch for these species not only to avoid acoustic exposure, but to avoid vessel strikes. If any whale were close, measures would be taken to stop acoustic sources and maximize distance from the animal. For these reasons, we find TTS and PTS of Rice's and sperm whales resulting from HRG and similar acoustic sources to be extremely unlikely to occur and, thus, discountable.

We are not aware of studies specifically on the behavioral response of ESA-listed marine mammals to HRG sound sources. However, there is available information on the effects of these sound sources to other non-listed marine mammals. In the absence of specific information, we use these studies to help characterize potential effects to ESA-listed marine mammals, and describe the generalized hearing range of the marine mammal for comparison. During sound exposure, a marine mammal could be engaging in any number of behaviors, such as migrating, breeding, feeding, or resting. If a marine mammal were exposed to the sound sources, the result would most likely be temporary avoidance of the area with underwater noise louder than the

behavioral harassment threshold for the animal, which is a reaction considered to be of low severity and with no lasting biological consequences (Southall et al. 2007).

Investigations stemming from a 2008 stranding event in Madagascar indicated a 12 kHz multibeam echosounder (EM 120) played a significant role in the mass stranding of a large group of melon-headed whales (Southall et al. 2013). The day before the stranding, the 12 kHz multibeam echosounder was being used down the shelf break roughly along the 1,000-m depth contour for about 6.5 hours, about 65 km from the location of the first stranding. The stranding location was a lagoon system in a relatively shallow water shoal (less than 20 m deep). There is a lack of pathological data indicating a direct physical effect, and the authors acknowledge that the use of this type of sonar is widespread and commonplace globally without noted incidents. However, all other possibilities were either ruled out or believed to be of much lower likelihood as a cause or contributor to the stranding compared to the use of the multi-beam echosounder (Southall et al. 2013). This incident highlights the caution needed when interpreting effects that may or may not stem from anthropogenic sound sources, such as echosounders, because effects are likely to be context-specific (Ellison et al. 2012). Nonetheless, effects such as this have not been documented for ESA-listed species.

Navigational echosounders are operated routinely by thousands of vessels around the world, and, to our knowledge, strandings have not been correlated with their use. Stranding events associated with the operation of naval sonar suggest that mid-frequency sonar sounds may have the capacity to cause serious impacts to marine mammals (Parsons 2017). The echosounders and other HRG sound sources proposed for use in the Oil and Gas Program differ from sonars used during naval operations, which generally have higher source levels, lower frequencies, a longer pulse duration, and more horizontal orientation than the more downward-directed echosounders. The sound energy received by any individuals exposed to an HRG sound source would be much lower relative to naval sonars, as would the duration of exposure. The area of possible influence for the echosounders is also much smaller, consisting of a narrow zone close to and below the source vessels.

The HRG acoustic sources we evaluated are sound sources between 2-1,600 kHz. As noted earlier, the Rice's whale's hearing range is up to 35 kHz and the sperm whale's hearing range is between 150 Hz and 160 kHz. To our knowledge, there are no studies examining avoidance response of Rice's whales or sperm whales to the HRG sound sources proposed for use. To evaluate the potential responses, we use studies looking at the responses of other marine mammals in the same hearing groups as Rice's whales and sperm whales and consider it probable that species in the same hearing group would react similarly.

We do not have studies focusing on each of the specific HRG sound sources proposed for use. For our analysis, we use studies featuring HRG sound sources that have similar specifications or operating frequencies to those proposed for use. The Simrad EK60 splitbeam echosounder operates at a frequency of 38 kHz, putting it in the hearing range of mid-frequency cetaceans, like sperm whales. There have been a few studies examining the effects of the Simrad EK60 on

cetaceans in this hearing group. Cholewiak et al. (2017)examined the effect of the Simrad EK60 on beaked whales (*Mesoplodon* spp, *Ziphius* spp; mid-frequency cetaceans). Beaked whales were significantly less likely to be detected acoustically when the echosounders were transmitting. "*In situ* data from bottom-mounted recorders found that the EK60 [split-beam] echosounders used by the R/V *Henry Bigelow* can be detected at 800m depth out to a distance of at least 1.3km (unpublished data)." Quick et al. (2017)found that short-finned pilot whales (*Globicephala macrorhynchus*; mid-frequency cetaceans) did not change their foraging while a Simrad EK60 was operating, but did find that whales changed their heading more often while the echosounder was active. Vires (2011) found no difference in beaked whale clicks compared before, during, or after the operation of a Simrad EK60 echosounder.

Kates Varghese et al. (2020) conducted a spatial analysis of foraging by Cuvier's beaked whales (*Ziphius cavirostris*; mid-frequency cetacean) during two separate MBES mapping surveys (one in 2017 and one in 2019) off southern California in waters greater than 2,000 m deep. Beaked whale group vocalizations while foraging were examined before, during, and after 12 kHz MBES surveys. The MBES used in the study was a Kongsberg EM 122, a deep-water MBES, the same that was used on the R/V *Langseth* in NSF's airgun surveys. Each of the two surveys took place over approximately two days, where the mapping survey covered an area about 1,800 km^2 in a "mowing the lawn" pattern, typical of mapping surveys. Beaked whales did not leave the area or cease foraging during the MBES surveys.

As such, feeding behavior is not likely to be impacted. Although marine mammal prey such as fish may show avoidance of lower frequency sound sources (e.g., >1 kHz), these species are mobile and are broadly distributed throughout the action area. Other marine mammal prey species that are less mobile such as zooplankton have shown adverse effects to louder anthropogenic noise sources (e.g., airguns; (Tremblay et al. 2019)), but not from the HRG sound sources evaluated here. Therefore, marine mammals are expected to be able to resume foraging once they have moved away from areas with disturbing levels of underwater noise.

While the information is somewhat limited to a few devices and species, it appears that generally, mid-frequency cetaceans exposed to directional sound sources may express a behavioral reaction, but do not abandon essential behaviors like feeding.

We are not aware of any studies of behavioral reactions from low-frequency cetaceans to any directional sound source. For the sound sources that are outside low-frequency cetaceans' hearing range (>36 kHz), we do not expect Rice's whales to perceive that sound or react to it.

The duration of exposure is an important consideration when evaluating the nature and consequences of the exposure. During use, directional HRG sound sources move at the speed of the vessel, which varies based on survey objectives at the time. Broadly, vessel speed during surveys is slow (about 3.5 knots to around 10 knots). Ruppel et al. (2022) estimated certain HRG sound sources (MBES, SBPs) to move through the water at speeds between 2 and 5 meters per second. Given the brief sound pulses (on the order of milliseconds), the speed of the mobile

sound source, and because any marine mammal exposed to the sounds would also be moving, we expect that any sound exposure would be very brief. The low number of disturbance exposures calculated by BOEM (Table 76) to HRG sound sources also indicates a low potential for exposure of Rice's whale and sperm whale over the duration of the action.

Summary

Because of the temporary nature of the disturbance from HRG sound sources used during operations and the availability of similar habitat and resources in the surrounding area, the impacts to marine mammals and the food sources they utilize are not expected to have measurable, long-term impacts on individual ESA-listed marine mammals.

If exposure of ESA-listed marine mammals were to occur during survey activities, it would be temporary due to the characteristics of the sound sources and the fact that the noise source itself will be moving. This means that any co-occurrence between a marine mammal and the source, even if stationary, will be brief and temporary. The noise signals themselves are short and intermittent and the vessel towing the noise source is moving; therefore, exposure is expected to last no more than one to two minutes. Due to the short exposure time, the reaction to sound exposure is expected to be limited to changing course and swimming away from the noise source only enough to get out of the ensonified area. As a result, the potential for disruption of activities such as breeding, feeding (including nursing), resting, and migrating is extremely unlikely given the brief exposure to any noise. Any brief interruptions of these behaviors are not anticipated to have any lasting effects. Given the duration of sound exposure and the expected response of sperm and Rice's whales to HRG sound sources used during surveying activities, the effect of exposure and resulting response will be so small that it will not be able to be meaningfully detected, measured or evaluated and, thus, insignificant.

We conclude that exposure to elevated sound levels from HRG sound sources may affect, but is not likely to adversely affect ESA-listed sperm and Rice's whales in the action area.

8.2.2 Non-Acoustic G&G Survey Sources and Methods

CSEM sources are a continuous, very low frequency electromagnetic signal (0.05-10 Hz, 1,500 amps) towed about 30 m over the receivers on the sea bed. During CSEM surveys, a vessel deploys receiver nodes at pre-defined coordinates and allows them to freefall to the sea floor at a rate of 1 m per second. According to the requirements of the vessel strike NTL, sea turtles and marine mammals will be avoided during all operations and the potential for the equipment to strike an animal during the short freefall of the receiver is considered extremely unlikely to occur, and thus discountable. The receivers remain on the sea floor to collect data and store it until they are released to the surface by an acoustic release device. Once on the surface, the receiver is immediately retrieved by the vessel. Bio-degradable anchors that hold the node on the sea floor dissolve away after a period of six to nine months of exposure to seawater. There is only minimal disturbance of the sea floor due to receiver node deployment, data collection, and

retrieval. Based on the above analysis, NMFS concludes the effects of CSEM to Rice's whales, sperm whales, and sea turtles are discountable.

8.2.3 Construction Sound Sources other than Pile Driving

We compared the threshold levels for sea turtles, whales, and Gulf sturgeon to the sounds produced from oil and gas construction and operation activities to determine if there is any potential for adverse effects to occur. The potential for any source of sound to adversely affect a listed species depends on its source level and frequency range. Construction and operational sounds produced by the oil and gas industry are provided in Table 35. Most of the construction and operational sound covers a broad range of frequencies and can be heard by both sea turtles and whales. For most of the sounds, SEL measurements are not available and we relied on dB peak and rms levels to determine if the response thresholds are exceeded. If our comparison shows that the sound level of a source exceeds the exposure levels for an effect, we will consider that source further in this analysis.

Table 35. Sources of sound produced during the construction of oil and gas structures and operation of equipment associated with oil and gas activities

Source of Sound	Source Level (dB)	Frequency (Hz)
Diver Tools	200 (peak) (approx. 185-190 rms)	broadband
Helicopters[22]	156-175 (rms)	45-7,070
Service, crew, and support vessels	160-180 (rms); 187 (peak)	20-10,000
Tug (4 engine)	173-177 (rms); 188-191 (peak)	broadband
Semi-submersible Pipeline Barge	161 (rms); 171 (peak)	10-10,000
Pipe-laying Vessel	170-182 (rms); 179-191 (peak)	broadband
Drilling from platforms	Up to 137 (rms) at 405 m (approx. 185 (rms) at source); 167-192 (peak)	5-1,200
Producing Platform	162 (peak) (approx. 147-152 rms)	10-10,000

Note: Data from BOEM's 2017-2022 Lease Sale EIS and A Review of Existing Data on Underwater Sound Levels Produced by the Oil and Gas Industry (2008).
Sources and sound levels were provided by BOEM's BA prepared for this opinion and from Genesis Oil and Gas Consultants (2011).

Construction and operational sounds, other than pile driving, will have insignificant or discountable effects on sea turtles, Rice's whales and Gulf sturgeon. For sea turtles, effects would be limited to short-term avoidance of construction activity by individuals rather than the impact of sound produced because of sound levels versus turtle hearing (Section 8.5). The

[22] Aircraft sound discussed in Section 8.2.3.

avoidance response, if it occurs, is expected to be ephemeral and too small to measure, meaning the effects of these sounds on sea turtles will be insignificant. Gulf sturgeon and Rice's whales are not expected to be found close to where construction activities would be occurring, meaning exposure to these sounds will be extremely unlikely to occur and, thus the effects will be discountable.

Our analysis of construction and operational sound sources and predicted sperm whale responses showed that all sound sources could potentially result in a disturbance of individuals of this species. Below, we calculated the number of animals that could be present near individual sources of each sound type (Table 36). Unlike pile driving, these sources are not loud enough to produce levels of sound that would cause temporary hearing loss; therefore, we used the step function of 10% of sperm whales beginning to be disturbed at 140 dB (rms).

While it is unlikely a sperm whale would typically be close enough to any individual sound source to be affected, moving sources such as vessels are more likely to encounter and affect sperm whales, meaning individuals could be affected by sounds from these sources. Sperm whales are also known to occasionally approach and investigate underwater activities where there may be numerous static sound sources. Although the likelihood of these sources affecting sperm whales is low, the potential for effect is not discountable. We consider the following sound sources from platform activities (diver tools, drilling, and production), pipeline installation, and aircraft operations further below for their potential to disturb sperm whales and discuss why their potential effects are insignificant.

Table 36. Examples of sources of sound produced during the construction of oil and gas structures and operation of equipment associated with oil and gas, and number of sperm whales that could be present near each source annually

Source of Sound	Source Level (dB)	ZOI to 150 dB (rms)	Number Exposed
Diver Tools	approx. 185-190 rms	100 m	< 1
Helicopters[23]	156-175 (rms)	18 m	< 1
Semi-submersible Pipeline Barge	161 (rms)	< 4 m	< 1
Pipe-laying Vessel	170-182 (rms)	40 m	< 1
Drilling from platforms	(approx. 185 (rms)	57 m	< 1
Producing Platform	approx. 147-152 (rms)	< 1 m	< 1

Note: Zone of Influence (ZOI) distances calculated by 20 LOGR spreading loss.
ZOI distances were converted to areas and the number of animals exposed = Area of ZOI (km^2) x sperm whale density of 0.002 animals/km^2.

8.2.3.1 Effects of Platform Sound on Sperm Whale

Offshore drilling and production involves a variety of activities that produce underwater sounds. The sound sources are fixed to the immediate platform location. Some sounds such as diver tools

[23] Aircraft sound discussed in Section 8.2.3, below.

are intermittent and infrequent, while other sources such as drilling sound and sound transferred through the platform by machinery occur over longer periods. Sounds emanating from drilling activities from fixed, metal-legged platforms are not considered very intense and generally are at very low frequencies near five Hz. Gales (1982) reported received levels of 119 to 127 dB re 1 µPa-m at near-field measurements, while other measurements have recorded higher levels of sound up to 185 dB (rms) from platforms or 195 dB (rms) from drill ships. Drill ships show somewhat higher sound levels because of mechanical sounds generated through the drill ship hull and by the use of thrusters to maintain position while drilling. Sounds from semi-submersible platforms also have low sound source levels. In general, the sounds associated with offshore oil and gas exploration and production are generally at low levels and typically at very low frequencies (~4.5 to 38 Hz) (Gales 1982). Although drilling sound may contribute to a localized increase in ambient sound levels, it does not produce sound levels over great enough distances sufficient to disturb sperm whales. Due to the stationary and localized effects of platform-associated sounds, sperm whale encounters near platforms would be very brief as they swim by, and the potential effects of these sounds is insignificant.

8.2.3.2 Effects of Pipeline Installation Sound on Sperm Whale

The conventional construction season for pipeline installation is spring through fall (MMS 2006). Construction of offshore pipelines will result in sound and turbidity as pipeline is deployed by one barge and a second barge jets the trenches and buries the pipeline. Sediment disturbance may also occur from jetting and trenching of the sea floor to lay the pipeline. Pipelines installed in water depths greater than 500 m use dynamically positioned barges that do not require anchoring to the sea floor or burying of the pipeline. Any potential disturbance would be associated with short-term avoidance of the immediate construction area. Any minor behavioral avoidance of construction activities is expected to be very short-term and limited to very brief encounters. Sperm whales are likely to avoid the high activity of pipe-laying vessels and would not be exposed to the small area of sound produced. The behavioral effects to individual sperm whales of brief avoidance of localized pipe-laying activities will be ephemeral and too small to measure, thus insignificant.

8.2.4 Effects of Aircraft Operation and Sound

Aircraft associated with the Oil and Gas Program may cause visual or auditory disturbances to ESA-listed cetaceans and more generally disrupt their behavior. Cetacean responses to aircraft depend on the animals' behavioral state at the time of exposure (e.g., resting, socializing, foraging or traveling), as well as the altitude and lateral distance of the aircraft to the animals (Luksenburg and Parsons 2009a). The underwater sound intensity from aircraft is less than that produced by vessels, and visually aircraft are more difficult for whales to locate since they are not in the water and move rapidly (Richter et al. 2006a). When aircraft are at higher altitudes, whales often exhibit no response, but lower flying aircraft (e.g., approximately 500 m or less) have been observed to elicit short-term behavioral responses (Luksenburg and Parsons 2009a; NMFS 2017b; NMFS 2017f; Patenaude et al. 2002b; Smultea et al. 2008a; Wursig et al. 1998).

Thus, aircraft flying at low altitude, at close lateral distances and above shallow water elicit stronger responses than aircraft flying higher, at greater lateral distances and over deep water (Patenaude et al. 2002b; Smultea et al. 2008a). In a review of aircraft sound effects on marine mammals, resting animals seemed to be disturbed the most, with low flying aircraft with close lateral distances over shallow water eliciting stronger disturbance responses than higher flying aircraft with greater lateral distances over deeper water (Luksenburg and Parsons 2009a).

The sensitivity to disturbance by aircraft may also differ among species (Wursig et al. 1998). Several authors have reported that sperm whales react to fixed-wing aircraft or helicopters (Clarke 1956; Fritts et al. 1983; Mullin et al. 1991; Patenaude et al. 2002b; Richter et al. 2006a; Richter et al. 2003a; Smultea et al. 2008c; Wursig et al. 1998). Smultea et al. (2008) studied the response of sperm whales to low-altitude (233-269 m) flights by a small fixed-wing airplane off Kauai and reviewed data available from other studies. They concluded that sperm whales responded behaviorally to aircraft passes in about 12% of encounters. All of the reactions consisted of sudden dives and occurred when the aircraft was less than 360 m from the whales (lateral distance). They concluded that the sperm whales perceived the aircraft as a predatory stimulus and responded with defensive behavior. In at least one case, Smultea and et al. (2008) reported that the sperm whales formed a semi-circular "fan" formation that was similar to defensive formations in sperm whales reported by other investigators. Bowhead whales approached during aerial research surveys only occasionally exhibited short-term behavioral reactions to helicopters (14 % of groups), and most of these reactions occurred at altitudes below or equal to 150 m (Patenaude et al. 2002b). In response to fixed-wing aircraft, only 2.2 % of bowhead whales exhibited a response, and similarly, most of these responses occurred at altitudes below or equal to 182 m (Patenaude et al. 2002b). Based on these studies, and our previous consultations on numerous scientific research permits involving aerial surveys (NMFS 2017a; NMFS 2017b; NMFS 2017c; NMFS 2017f), we expect that the ESA-listed cetaceans considered in this opinion may exhibit no response or short-term behavioral responses to overpassing aircraft. To our knowledge, no physiological responses to aircraft have been documented in the literature, but we conservatively assume that a low-level, short-term stress response is possible.

In summary, while the above review indicates that ESA-listed sperm whales may exhibit short-term behavioral and or stress responses, such responses to aircraft associated with the Oil and Gas Program are expected to be infrequent and minimal. Routine OCS helicopter traffic would not be expected to disturb animals for extended periods, provided pilots do not alter their flight patterns to more closely observe or photograph marine mammals. Helicopters, while flying offshore, generally maintain altitudes above 700 ft during transit to and from a working area, and at an altitude of about 500 ft between platforms. The duration of the effects resulting from a startle response is expected to be short-term during routine flights, and the potential effects will be insignificant to sperm whales. Therefore, we find that any disturbance that may result from aircraft associated with the Oil and Gas Program is not likely to adversely affect ESA-listed sperm whales.

8.2.5 Effects of Air Emissions and NPDES Water Discharges

Under the Oil and Gas Program, air emissions of NAAQS criteria pollutants (e.g. nitrogen oxides, sulfur dioxide, carbon monoxide, ozone, particulate matter, and lead) and other air contaminants, such as hazardous air pollutants (HAPs) and GHGs, and discharges to marine waters of pollutants in drilling fluids, drill cuttings, produced water, and other effluents will be routine. The presence of a pollutant in water or air does not necessarily result in adverse effects. An adverse effect occurs when a pollutant is present at a concentration, duration, and/or frequency sufficient to cause a biological response affecting survival and fitness of exposed individuals or disrupting natural cycles and functions in the ecosystem. The volume and pollutant content of routine emissions and discharges are regulated through permitting that establishes emission and discharge limits that will not result in adverse effects to human health or the environment. Under this action, accidental releases that exceed permit limits are possible, but the probability of these occurring is low given spill response and other requirements.

Toxic pollutants, including VOCs, NOx, and HAPs such as benxene and formaldehyde,can cause direct harm to organisms when inhaled. Once emitted to the atmosphere, pollutants may deposit onto terrestrial and marine surfaces, harm plant life, influence soil and water chemistry, and be incorporated in the food web. In addition, emissions often include GHGs (carbon dioxide [CO_2], methane [CH_4], nitrous oxide [N_2O], and fluorinated gases), which contribute to changing environmental conditions, and ozone-depleting gases such as chlorofluorocarbons (CFCs), though CFC use is largely phased out and unlikely to be a significant emission from current offshore operations (see https://www.epa.gov/ods-phaseout). By altering the intensity of solar radiation retained within the atmosphere, GHGs influence the global temperature patterns, resulting in cascading effects on atmospheric and oceanic currents, the earth's water cycle, and long-term environmental stability (Huntington 2006; Sterling 2012).[24] For the most recent data on GHG emissions and their effects, refer to the EPA's Greenhouse Gas Emissions Overview at https://www.epa.gov/ghgemissions/overview-greenhouse-gases. Any impacts to onshore air quality from offshore emissions must be evaluated under BOEM's air quality regulatory framework (30 CFR 550 Subpart C), and mitigated if predicted onshore ipacts exceed significance thresholds. . The USEPA issues individual OCS air permits under 40 CFR Part 55 for sources located east of 87.5°W longitude (approximately the western border of the Florida panhandle), while BOEM regulates air emissions west of that line through its air quality review process, which is conducted as part of the plan review for exploration and development activities under 30 CFR 550.

The Oil and Gas Program discharges complex mixtures of heavy metals and other pollutants, including petroleum hydrocarbons, to marine waters. Toxic pollutants can cause direct effects on individuals and persistent toxic pollutants, like mercury, could become incorporated into the food web causing effects through dietary exposures. Discharges to water are regulated by USEPA

[24] Additional information is available at: https://www.epa.gov/ghgemissions/overview-greenhouse-gases.

through NPDES general permits that limit the discharge volume and concentrations of certain pollutants and require periodic monitoring of pollutant concentrations and discharge toxicity to marine organisms. A summary of the USEPA Region 4 (Central and Eastern Gulf of America) and Region 6 (Central and Western Gulf of America) NPDES general permits for Oil and Gas Program discharges to the OCS can be found in Appendix E of this opinion. The NPDES permits and their supporting documentation are available on their website at https://www.epa.gov/npdes-permits. The following sections describe the exposure and effects of air emissions and discharges to water permitted by the USEPA and BOEM for Oil and Gas Program activities in the Gulf of America.

8.2.5.1 Effects of Air Emissions

Of the six principal pollutants identified in the NAAQS, Nitrogen Oxides ($NO_{x)}$ are especially important as they serve as key it is considered a precursors to ground-level ozone that forms through complex photochemical reactions in the atmosphere. Exposure to ground-level ozone can cause oxidative stress and inflammation in respiratory tissues, impairing lung function and increasing susceptibility to respiratory diseases in both humans and wildlife (USEPA 2020). A 2008 survey of 3,304 platforms from 103 companies in the Gulf of America region determined emission rates and concluded sources of NO_x and VOCs, which may include toxic compounds that are carcinogenic, are the primary pollutants of concern because both are considered to be precursors to ozone (Wilson 2010). Air pollutant emissions generated from projects include the criteria pollutants nitrogen dioxide (NO_2), carbon monoxide (CO), particulate matter (PM), including $PM_{2.5}$, PM_{10}, and sulfur dioxide (SO_2), as well as other regulated air pollutants including VOCs, NOx, and GHGs. VOC and NOx are the primary precursors for tropospheric ozone, while NOx and SO_2 are precursors to secondary formation of $PM_{2.5}$.

Once pollutants are released into the atmosphere, atmospheric transport and dispersion processes begin circulating the emissions. Transport processes are carried out by the prevailing wind circulations which can vary depending on the time of year. For instance, during the summer, the wind regime in the WPA is predominantly onshore during the day at mean speeds of 6.7-11.2 mph (3-5 m/s). Average winter winds are predominantly offshore at speeds of 8.9-17.9 mph (4-8 m/s). The majority of OCS Program-related emissions occur offshore anywhere from the state/federal waters boundary to 200 mi (322 km) offshore.

There is little information on the toxicity of offshore oil and gas air emissions, especially with regard to marine species. Based on human inhalation risk assessments and the lack of marine species-specific toxicological data, we extrapolated that air-breathing marine mammals and sea turtles could experience similar adverse effects if exposed to sufficiently high pollutant concentrations. Adverse effects can include cancer risk, cardiorespiratory, or pulmonary exposures and disease (Amoatey et al. 2019). Similar to on-land facilities, it is expected that the highest concentrations of chemicals [near the water surface] or area of potential effects to ESA-listed species would be located within a few miles downwind of a facility (Olaguer et al. 2016;

Smargiassi et al. 2014). Close to the facility the pollutant plume would still be in higher in the atmosphere, while farther away from the facility, the pollutant would disperse.

Dispersion depends on emission height, atmospheric stability, mixing height, exhaust gas temperature and velocity, and wind speed. For emissions within the atmospheric boundary layer, the vertical heat flux, which includes effects from wind speed and atmospheric stability (via air-sea temperature differences), is a good indicator of turbulence available for dispersion (Lyons and Scott 1990). Heat flux calculations in the WPA (Barber et al. 1988; Han and Park 1988) indicate an upward flux year-round, highest during winter and lowest in summer. According to Huang (2015) BOEM previously used Version 4 of the Offshore Coastal Dispersion (OCD) model from DiCristofaro and Hanna (1989), which is specifically designed for offshore and coastal air quality modeling and incorporates site-specific meteorological and oceanic parameters[25].

The mixing height is important because it dictates the vertical space available for spreading the pollutants. The mixing height is the height above the surface through which vigorous vertical mixing occurs. Vertical mixing is most vigorous during unstable conditions and is suppressed during stable conditions, resulting in the worst periods of air quality. Although mixing height information throughout the Gulf of America is scarce, measurements near Panama City, Florida (Hsu et al. 1980), show that the mixing height can vary between 1,312 and 4,265 ft (400 and 1,300 m), with a mean of 2,953 ft (900 m). The mixing height tends to be lower in winter, with daily changes smaller than in summer.

This analysis separates out the jurisdictional air permitting due to differences for USEPA under CAA (east of 87.5°W latitude) and for BOEM (west of 87.5°W latitude) under OCSLA.

NMFS has consulted with the Bureaus on whether greenhouse gas (GHG) emissions, including downstream emissions from the proposed action, are an "effect of the action" under 50 C.F.R. § 402.02 that NMFS must analyze as part of the reinitiated consultation. Section 402.02 defines "effects of the action" as "all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action but that are not part of the action." The regulations explain that "[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" (50 C.F.R. § 402.02).

It is generally accepted that despite advances in climate science, global climate models are typically based on global-emission scenarios and not on program-specific scenarios. As a result, global climate model outputs have not identified local or regional effects on resources specifically resulting from emissions from BOEM- and BSEE-approved activities in the Gulf. Therefore, given the best available information at hand, NMFS does not find that GHG

[25] Bureau of Ocean Energy Management (BOEM). (2023). Investigating Shoreline Fumigation Algorithms in Offshore and Coastal Dispersion Model for AERMOD – Part 2. Environmental Studies Program NT-23-07. Retrieved April 4, 2025, from https://www.boem.gov/environment/environmental-studies/nt-23-07

emissions from the proposed action are reasonably certain to cause consequences to listed species. Furthermore, there are accumulated and persisting GHG emissions already in the atmosphere, and the annual volume of GHG emissions will occur globally regardless of whether a particular Bureau lease sale is held, or plan or permit is approved. Because of this data and the projected continued climate change, impacts to listed species from global warming caused by GHG emissions will occur whether or not the proposed action occurs. NMFS concludes that they are, therefore, not consequences that occur "but for the proposed action." 50 C.F.R. § 402.02 (emphasis added).

Air Permitting Under USEPA Jurisdiction

Air-breathing sea turtles, Rice's whales and sperm whales could be impacted by pollutants emitted from OCS Oil and Gas Program activities. Based on current CAA regulations, implementation processes by USEPA, and monitoring, NMFS believes any effects to ESA-listed species from OCS emissions under USEPA jurisdiction have been insignificant to date. Under the CAA, if a facility is expected to exceed 250 tons of regulated emissions per year (per BACT and other provisions), control technology is used, air quality modeling is required, and emissions are automatically mitigated. All USEPA-regulated facilities exceed this threshold, thus all facilities regulated by USEPA are subject to these measures and are required to mitigate in accordance with the CAA. USEPA also requires monitoring offshore. Ultimately, all emissions are mitigated down to CAA requirements offshore. Regulations, monitoring, mitigation, and developing emissions-related control technologies ensure these levels stay within the NAAQS as measured offshore. NMFS believes that these regulated emissions' effects on ESA-listed Rice's whale, sperm whale, and sea turtles will be too small to be measured, and thus insignificant based on the monitoring and applied mitigation to CAA standards offshore. Therefore, emissions under USEPA jurisdiction are not likely to adversely affect ESA-listed species in the Gulf of America.

Air Quality Under BOEM Jurisdiction

As noted above, air breathing sea turtles and whales could be impacted by the types of pollutants emitted from OCS Oil and Gas Program activities. According to BOEM, emissions from the proposed activities are expected to be well within the NAAQS measured onshore, which were designed to protect public health, welfare, animals, and the environment. Under OCSLA, BOEM has the authority to issue regulations for "compliance with the national ambient air quality standards pursuant to the Clean Air Act (42 U.S.C. 7401 *et seq*.), to the extent that activities authorized under this subchapter significantly affect the air quality of any State." 43 U.S.C. § 1334(a)(8). BOEM interprets this to mean they do not have the authority to regulate the air above the OCS if it does not affect the air quality of the states. Because of BOEM's perceived lack of authority to regulate ambient air to meet the onshore NAAQS criteria, BOEM does not monitor offshore emissions to know whether air quality in BOEM offshore areas are within the NAAQS. Given the physical processes that dictate dispersion and transport of emissions, it is uncertain whether offshore facility emissions can cause NAAQS thresholds to be exceeded onshore.

BOEM is currently updating their inventory for Gulf of America emissions and has a study in progress to model offshore emissions scenarios. In the case of BOEM-authorizing activities east of 87.5°W latitude, facilities will be required to comply with USEPA Title 40 of the code of regulation the PSD pre-construction permit program (40 C.F.R. §52.21), and/or the Title V operating permit program requirements (40 CFR part 71), as well as applicable New Source Performance Standards and National Emissions Standards for Hazardous Air Pollutants. Under OSCLA, BOEM is required to assess the potential cumulative impacts and is working on studies to help address effects, based on the Bureaus' interpretation of their inventory. According to BOEM's analysis, air quality emissions under their jurisdiction would have minimal impact on the States. From BOEM's most recent available (year 2017) inventory of air emissions (BOEM 2014c):

> Federally-regulated OCS oil and gas production platform and non-platform sources emit the majority of criteria pollutants and GHGs in the Gulf of America with the exception of SO2 (primarily emitted from commercial marine vessels), and N2O (from biological sources). These production sources account for a large percentage[26] of the overall emissions in the Gulf of America. A comparison of the 2008 and 2011 emission estimates for non-platform sources indicated a significant increase in criteria pollutant emission estimates, with the exception of SO2. This increase was primarily due to the use of updated USEPA emission factors. The updated emission factors and activity data yielded an overall increase in GHG emissions.

Based on available information provided by BOEM during consultation, BOEM focuses on the impact of Program activities on the States. BOEM attests that "human activity within the OCS is transitory at best as would be any marine mammal, sea turtle, or air-breathing aquatic species. Personnel on any platform are not considered to be at any imminent risk because the majority of air emissions exit from a stack that measures several meters high above the work environment." Vent/flaring stacks are required to be set at distances above and away from platform decks/topsides, helipads, gangways, etc. that are protective of personnel. Transport processes are carried out by the prevailing wind circulations which can vary depending on the time of year. Dispersion depends on emission height, atmospheric stability, mixing height, exhaust gas temperature and velocity, and wind speed. The mixing height is important because it dictates the vertical space available for spreading the pollutants. The mixing height is the height above the surface through which vigorous vertical mixing occurs. Emissions from the proposed activity are unlikely to impact marine species because of the atmospheric processes influencing air pollutant transport, as well as stack height, exit gas velocity from the stack, and distance of the marine species from the sources. BOEM asserts that "because of the combination of 2,953 ft mixing height and upward flux of discharged regulated pollutants year-round from stacks, the contribution of routine events and accidental events (flaring or venting) of the proposed action…

[26] 90% of the total CO emissions, 73% of NOx emissions, 68% of PM10 emissions, 42% of SO2 emissions, 63% of VOC emissions, and 85% of the greenhouse gas emissions.

to the air-water interface will have no effect on marine mammals or sea turtles and any associated critical habitat in the Gulf."

Accidental events associated with oil and gas activities could occur, impacting air quality through smoke from fires and releases of volatile components of oil, natural gas, condensate, refined hydrocarbons, hydrogen sulfide, and NAAQS air pollutants. Response activities affecting air quality could include emissions from *in-situ* burning, the flares used to burn gas and oil, and the dispersants applied from aircraft. Unpermitted releases of substantial size during emergency responses applying these methods would require separate consultation.

The Bureaus concluded the effects of air emissions to air-breathing ESA-listed species, including Rice's whale, sperm whale, and all five sea turtle species, are insignificant because air emissions are transitory, diffuse rapidly, and are of limited extent compared to the action area. NMFS concurs with this determination that effects of air emissions will be too small to be measured and, thus, insignificant. Therefore, the air emissions may affect, but are not likely to adversely affect Rice's whale, sperm whale, and all five sea turtle species in the action area.

8.2.5.2 Effects of Discharges to Water

Oil and Gas Program discharges to the Gulf of America OCS may affect protected species by degrading water and sediment quality, which would affect species through exposures to discharge toxicants at harmful levels or because of the impacts of degrading water and sediment quality to habitat used by ESA-listed species. The effects of effluents from oil and gas operations have been analyzed in past Section 7 consultations and will continue to be studied. Waste streams generated by the drilling process include drilling fluids, drill cuttings, produced water, and deck drainage. The platform crew contributes sanitary and domestic wastes. During production, there are additional waste streams including produced sand and well treatment, workover, and completion fluids. Further minor discharges include releases from desalination units, blowout preventer fluids, boiler blowdown, and excess cement slurry.

The USEPA regulates discharges from oil and gas operations to offshore marine waters in the Gulf of America through NPDES general permits and less commonly individual permits. The types and quantities of these discharges are summarized in Appendix E. Because of USEPA regulation, most of the routinely discharged chemicals are not expected to result in exposure intensities that would adversely affect any listed species because they are diluted and dispersed when released in marine waters.

Compliance rates among NPDES permits are tracked by USEPA's "Enforcement and Compliance Online Database" (https://echo.epa.gov/ accessed 6/9/2019). These must be considered when relying on permitting as a barrier to environmental harm. According to the database, there are 205 effective and administratively continued[27] NPDES permits identified within the Gulf of America. Effluent violations are reported for 43 of these facilities over the

[27] A facility with an Administratively Continued permit is discharging under an expired permit that was "Administratively Continued" presumably while permit renewal is underway.

past three years and eight facilities with effluent violations faced formal enforcement actions over the past last five years. Enforcement actions are not the default response to noncompliance. USEPA works with a noncompliant facility to identify causes of noncompliance events and strategies to return to compliance.

Effluent limit violations and accidental discharges have the potential to release chemicals in larger-than-approved volumes or concentrations. In such events, deleterious effects from exposures at harmful levels during the discharge and as it dissipates are expected to occur quickly in organisms quickly within the immediate marine environment. If the discharge contained persistent and bioaccumulative toxicants, longer-term effects are possible over a broader area, due to dietary exposures through the marine food webs.

The USEPA's Biological Evaluation for the 2020 Consultation used data from toxicity tests[28] of sensitive species, such as mysid shrimp *(Mysidopsis bahia*) and inland silverside minnow (*Menidia beryllina*) exposed to produced water at higher concentrations than what would occur in the ocean. A toxicity test exposes different life stages of the test species to a series of effluent concentrations for determining sublethal toxicity in order to estimate toxicity. For example the effect of the effluent is measured by the survival and growth of the larvae. Minnows that are 24 hours old or less are exposed, and growth is measured as the difference in the larvae's average mean dry weight compared to that of the controls with no pollutant exposure. Statistics analyzed include: cumulative mortality, healthy fish numbers at the end of the test, time to start and end of hatching, numbers of larvae hatching per day, length/weight of surviving animals, numbers of deformed larvae, and numbers of fish exhibiting abnormal behavior. The test method requires a semistatic or flow-through exposure system. A final survival count is made and the dead fish are removed when the testing time period is over. Tests are reviewed for quality control or "test acceptability criteria," such as maintaining specific protocols for dissolved oxygen, water temperature, test substance concentrations, survivability of control fertilized eggs, ensuring water standards during testing and "good" test organism cultures. Any test not meeting those criteria is considered invalid (USEPA 1996; USEPA 2006). The test acts as a surrogate for determining effects to ESA-listed species because eggs and especially larvae are more susceptible life stages and may better represent effects to sensitive species.

Produced water will dissipate faster in deeper water, meaning exposure of individuals to toxic concentrations of pollutants as less likely. When a discharge is found to be not toxic to sensitive species (per toxicity testing described above), USEPA expects that the discharge will not be toxic to other species, including ESA-listed species. Toxicity data for some chemical compounds used for development and production are summarized in (MMS 2001a; MMS 2001b).

Drilling fluids, drill cuttings, and produced water discharges contribute heavy metals and other substances, in particular petroleum hydrocarbons, that may be toxic or detrimental (e.g., increase oxygen demand, sediment) to the surrounding environment. Heavy metals include barium and

[28] The USEPA data quality requirements for toxicity tests are specified in USEPA 1996; USEPA 2006.

trace amounts of chromium, copper, cadmium, mercury, lead, and zinc. Several hundred chemical compounds could be part of a total petroleum hydrocarbon mixture, including PAHs benzene, toluene, ethylbenzene, and xylene. The composition of the mixture depends on the source, age, and environmental conditions.

Data from different oceans around the world show that heavy metal and PAH concentrations are present in marine mammal and sea turtle tissues and organs. Elevated concentrations have also been detected in sea turtle eggs and hatchling sea turtles, as well as in the milk of lactating cetaceans. Although these tissue levels provide strong evidence of exposures to these pollutants, we are not able to reliably estimate the contributions of oil industry pollutant loadings to pollutant accumulations in marine species. This is because there are many known and unknown pollutant sources discharging into gulf waters and these species are long lived and travel widely within and outside the Gulf of America over their lifetimes.

Trace metals, including mercury, in drilling discharges have been of particular concern. An analysis conducted by (Neff et al. 1989) looked at the accumulation of mercury and other metals in flounder, clams, and sand worms exposed to barite drilling mud discharges. Flounder did not accumulate any metals during exposure, and the soft-shell clams and sand worms had only slight increases of some metals. The authors noted that most of the accumulated metals were actually in the gut or gills as barite particles, suggesting that metals associated with barite in drilling fluids were not readily incorporated into the tissues of marine organisms.

Produced Waters

Produced water is the combination of the formation water (fresh or saline water trapped in the reservoir with the oil or gas), the hydrocarbon target (oil or gas), and any production chemicals added down well. Produced waters can vary widely depending on the geologic age, depth, and geochemistry of the hydrocarbon-bearing strata as well as the chemical composition of the hydrocarbon within the reservoir and the types of production chemicals added (Neff et al. 2011). As described for the Oil and Gas Program, well completion techniques and chemicals vary depending on the rock properties of the reservoir, and may include fracking and acidizing chemicals. The components of produced water consist of metals, trace elements, monocyclic aromatic hydrocarbons, PAH's, and various other organic chemicals. Petroleum hydrocarbons are the chemicals of the greatest environmental concern (Neff et al. 2011).

Produced water represents the largest volume waste stream from offshore production platforms (Neff et al. 2011; Stephenson 1992). Clark and Veil (2009) estimated that 587 million barrels of produced water were generated in U.S. federal waters in 2007, a rate of approximately 1.6 million barrels per day. Produced waters intended for offshore disposal are treated to remove the majority of oil and gas, solids, and non-aqueous liquids prior to discharge. According to Neff (2002), produced water undergoes a number of changes including dilution, evaporation, adsorption/precipitation, biodegradation, and photo-oxidation following discharge into the marine environment. Collectively these processes reduce the concentration of chemicals in the

discharge plume, thus reducing the toxicity to marine organisms (Neff 1987). In areas like the Gulf of America where large quantities of produced water have been discharged continually over long periods of time, the local water column microbial communities are likely well adapted for biodegradation of organic materials in produced waters (Neff 2002).

The OCS oil and gas produced waters contribute metals (i.e., arsenic, barium, cadmium, chromium, copper, lead, and zinc) to the marine environment. Although all of these metals are natural constituents of clean seawater, barium, iron, manganese, mercury, and zinc from produced water are frequently found in higher concentrations than naturally found in seawater (Neff 1987). However, metals from produced water are not generally associated with toxicity of the receiving waters as they are usually not in high enough concentrations (Neff 2002). Further, the complex geochemistry of these metals affects their bioavailability in the marine environment (Neff 2002). Metals in the form of pure metal, precipitates, or heavy minerals are not bioavailable to marine organisms (Waldichuk 1985).

Metals in discharged produced water mostly accumulate in the benthic sediments close to the discharge site. The accumulation of metal over background concentrations is typically localized to within 492 ft (150 m) of drilling structures (Kennicutt 1995), though statistically significant increases over background levels have been measured as far as 1,640 ft (500 m) from Gulf of America drilling sites (Presley et al. 1992). Generally, offshore discharges of drilling muds and produced waters are expected to dilute to background levels within 3,281 ft (1,000 m) (CSA 1997). Neff (2002) compared concentrations of metals in the tissues of marine organisms in the Gulf of America and in the immediate vicinity of offshore discharges of produced water. This research determined that each were within normal ranges and did not show any evidence of bioaccumulation to potentially toxic levels for the organisms themselves or their consumers (Neff 2002).

Gulf of America produced waters rarely contain more than about 0.1 mg/L total mercury (about ten-fold higher than clean natural seawater). Mercury in produced water is expected to dissipate rapidly following discharge to the ocean. Neff (2002) concluded that the concentration of total mercury in sediments near most of the platforms studied in the GOA is at or near natural background concentrations (about 0.1 ppm) and is rarely over 0.5 ppm. Mercury inputs from offshore oil and gas facilities contributes only 0.3% of Gulf of America relative to inputs from the atmosphere and Mississippi River into consideration (Neff 2002).

Monocyclic aromatic hydrocarbons such as benzene, toluene, ethylbenzene, and xylene are found in produced water; however, because of their high volatility, they are lost rapidly following discharge. Most of these volatile compounds immediately dissipate to background levels within 328 ft (100 m) of the discharge (BOEM 2013). The compounds have a low potential to be bioaccumulated by marine organisms and do not adsorb to sediments. Therefore, they pose a very low risk of harm to marine organisms and human consumers of seafood.

PAHs are the petroleum hydrocarbons of the greatest environmental concern in produced water due to their toxicity and persistence in the marine environment (Neff 1987). Some PAHs bioaccumulate and are often found in sediments near produced-water discharges. PAHs are generally found in low concentrations within produced water (0.04-3.0 mg/l) so the potential to bioaccumulate or present additional risks to marine organisms is considered low (Neff 2002). The major sources of the more damaging PAH compounds are found as a component of soot from various combustion sources. These more damaging PAH compounds do not biomagnify in the marine food web; and therefore they do not pose a hazard to fish that consume biofouling organisms from submerged platform structures (Neff et al. 1987).

A study by Berg (2006) showed that exposure to contaminants containing metals and hydrocarbon components at sublethal levels may result in impaired physiological function and behavior in fish. The range of issues may include endocrine disruption that impacts reproduction and osmoregulation, immune system suppression, inhibition of the olfactory system, inhibition of the nervous system that interferes with behavior, and biochemical changes and developmental interference. All of these on their own may increase mortality and impair the recovery of a population or species (Berg 2006). In a lab study on rainbow trout, Blewett et al. (2017)found oxidative stress in the gills and liver and morphological changes in the gills when exposed to 2.5% and 7.5% produced water samples relative to the activated charcoal, saltwater-matched and control samples for two days. Results of field and laboratory tests from another study show [toxic] alkyl phenols show up in very low levels in fish muscle and liver tissue because both PAHs and alkyl phenols are rapidly metabolized by vertebrates (Bakke et al. 2013). Studies cited in Bakke et al. (2013) document that compounds present in produced water have the potential to exert endocrine disruption effects in fish and the author noted that the exposure levels studied are at concentrations that would be similar to those found in close proximity to discharge points (Bakke et al. 2013).

Drilling Fluids/Muds and Cuttings

Drilling fluids used on the OCS are divided into two categories: water-based and non-aqueous-based. In non-aqueous-based drilling fluids, the continuous phase is not soluble in water. Clays, barite, and other chemicals are added to the base fluid, which can be freshwater or saltwater in water-based fluids (WBFs), mineral or diesel oil-based fluids (OBFs), or synthetic-based fluids (SBFs). Additional chemicals are also added to improve the performance of the drilling fluid (Patel et al. 2003). Discharge of OBFs is prohibited under the NPDES permit nissued by the USEPA for drilling activities. There are also limitations on the release of barite containing higher amounts of cadmium or mercury, which are trace metals of concern.

The discharge of WBFs and cuttings associated with WBFs is allowed almost everywhere on the OCS under the general NPDES permits issued by USEPA Regions 4 and 6, as long as the discharges meet NPDES permit requirements. Discharge of WBFs can result in increased turbidity in the water column, and alteration of sediment characteristics because of coarse material in cuttings and the delivery of trace metals. Occasionally, formation oil may be

discharged with the cuttings, adding hydrocarbons to the discharge. In shallow environments, WBFs are rapidly dispersed in the water column immediately after discharge and rapidly descend to the sea floor (Neff 1987). In deep waters, fluids dispersed near the water surface after discharge would disperse over a wider area than fluids dispersed in shallow waters.

SBFs are manufactured hydrocarbons. Because SBFs are not petroleum-based, they do not contain the aromatic hydrocarbons and PAHs that contribute to OBF toxicity and persistence on the sea floor (International et al. 1995). A SBF mud system may contain additives such as emulsifiers, clays, wetting agents, thinners, and barite. Since 1992, SBFs have been increasingly used, especially in deep water, because they perform better than WBFs and OBFs. SBFs reduce drilling times and costs incurred from expensive drilling rigs. By 1999, about 75% of all wells drilled in Gulf of America waters deeper than 305 m (1,000 ft) were drilled with SBFs (EPA 2000). Although there are many types of SBFs, esters, internal olefins, and linear alpha olefins are most commonly used in the Gulf of America.

A literature review (Neff et al. 2000) discussed knowledge about the fate and effects of SBF discharges on the seabed. Like OBFs, SBFs are hydrophobic, do not disperse in the water column, and therefore are not expected to adversely affect water quality. The SBF-wetted cuttings settle close to the discharge point and affect the sediments in a localized area. The primary effects are smothering of the benthic community, alteration of sediment grain size, and addition of organic matter, which can result in localized anoxia during the time it takes for the SBF to degrade (Melton et al. 2004). Different formulations of SBFs use base fluids that degrade at different rates, thus affecting the duration of the impact. Esters and olefins are the most rapidly biodegraded SBFs.

Tests indicate that SBFs and their degradation products should not bioaccumulate (Neff et al. 2000). In a study to measure degradation rates of SBF on the sea floor and to characterize the microbial populations, the sulfate-reducing bacterial counts increased in sediments incubated with SBFs under deep-sea conditions (Nguyen et al. 2006). Biodegradation proceeded after a lag period of up to 28 weeks influenced by both the SBF type and prior exposure of the sediments to SBFs.

The discharge of SBF is prohibited. Both USEPA regions permit the discharge of cuttings wetted with SBF as long as the retained SBF amount is below a prescribed percentage, meets biodegradation and toxicity requirements, and is not contaminated with formation oil or PAH. Ongoing research is aimed at understanding the relationships between chemical structure in SBFs and environmental fate and effects, which will provide the design basis for fluids with better environmental performance.

Drilling fluids are one of the largest sources of mercury from exploration and production activities in the Gulf of America, though they generally contain mercury in low concentrations. Nearly all the mercury in drilling fluid is associated with barite, which is added to the mud as a weighting agent. The USEPA limits mercury in barite to 1 part per million (ppm). The average

mercury concentration in modern drilling mud barite is 0.5 ppm and most drilling muds discharged to U.S. waters contain less than 1 ppm mercury.

The mercury in drilling mud barite is sequestered in the solid barium sulfate in sulfide minerals, particularly sphelerite (ZnS). It is extremely insoluble and stable in this form, thus trapping mercury and other trace metals in the barite. Therefore, unless mercuric sulfide in the barite can be microbially methylated, this source of mercury is relatively unavailable for uptake into the marine food web. This is true even under mildly acidic conditions, as might occur in the digestive tract of a marine animal (Crecelius et al. 2007). The solubility of barite and the rate at which it dissolves (and thereby releases associated metals such as mercury), the amount of metals released from the barite, and the rate of dissolution of barite and release of metals after burial under simulated sea floor conditions was studied (Crecelius et al. 2007). The solubility of the associated mercury in seawater at two different pH concentrations tended to increase with time for at least several months, but remained well below the USEPA water quality criterion. The study concluded that very little (less than 0.1%) of the mercury in barite became biologically available (Crecelius et al. 2007).

Another study (Neff 2002) showed that surface sediments collected 20-2,000 m (66-6,562 ft) away from four oil production platforms in the northwestern Gulf of America contained 0.044-0.12 micrograms per gram (µg/g) total mercury. Because concentrations of total mercury in uncontaminated estuarine and marine sediments are generally 0.2 µg /g dry weight or lower, these measured amounts are essentially equivalent to background concentrations for mercury in surficial sediments on the Gulf of America OCS (Neff 2002).

Like produced water, drilling fluids also contain barium and trace amounts of chromium, copper, cadmium, mercury, lead, and zinc. Although levels of these metals can become elevated within a few hundred feet of drilling structures (Kennicutt 1995), dilution to background levels occurs within 3,281 ft (1,000 m) of the discharge point CSA (1997). Sea turtles may bioaccumulate chemicals such as heavy metals that occur in drilling mud, given samples from stranded turtles in the Gulf of America carry high levels of organochlorides and heavy metals (Sis et al. 1993).

Other Discharges

While produced waters and drilling fluid/cuttings comprise the most harmful effluents discharged from oil and gas activities, a variety of other wastes comprise a large proportion of discharges, which include chemically treated water[29], non-contact cooling water, excess seawater from pressure maintenance and secondary recovery projects, water released during training of personnel in fire protection, ballast or bilge water, treated sewage, treated wastewater, engine waste, biodegradable food waste, desalination brine, boiler blowdown fluids, blowout preventer fluids, excess cement slurry, subsea production fluids and uncontaminated freshwater and saltwater. Wastes and discharges will result from operation of offshore structures and support vessels. These waste streams have the potential to affect the receiving waters by modifying the

[29] Fresh or seawater with added corrosion inhibitors, scale inhibitors, biocides, and/or other chemicals.

temperature or salinity, increasing or modifying the phytoplankton community due to increased nutrients, and/or contributing to the potential for toxicity.

The NPDES general permit limits the maximum concentration of treatment chemicals in discharge not to exceed the most stringent concentration of the following three: 1) the maximum concentrations and any other conditions specified in the USEPA product registration labeling if the chemical is an USEPA registered product, 2) the maximum manufacturer's recommended concentration, or 3) 500 mg/l. A 500 mg/l concentration is equivalent to about 0.05% of chemical in the discharged water and the discharge will be further diluted by seawater. The permit also requires that the discharge must pass a 48-hour acute toxicity test prior to discharging. Unlike the discharge of produced water, most of these miscellaneous discharges are intermittent. The permit action does not authorize discharge of wastewater that does not comply with the permit conditions.

Analysis and Conclusion

During consultation we reviewed the best scientific information available, and the descriptions and restrictions of each proposed discharge type (Appendix E), and NMFS agrees with USEPA's determination that the discharge of effluent under conditions of the NPDES general permits is not likely to adversely affect sperm whales, Rice's whales, sea turtles, and Gulf sturgeon.

Discharges of produced water, drilling fluids, drill cuttings, and chemically treated miscellaneous discharges under the NPDES general permit will be required to meet the whole effluent toxicity requirements. We rely on the USEPA toxicity tests performed on sensitive species under controlled laboratory conditions to evaluate survival growth and fertility under ideal laboratory conditions such that effects are not influenced by real-world factors like predation, competition, disease, other stressors in the field, and fluctuations in natural water quality parameters. However, in the wild effects on swimming speed, predator detection or evasion, and nest tending influence survival. Toxicity test durations may not be long enough detect any lags in responses that may occur (e.g., delayed mortality, metabolism to more toxic form, cascading effects) and full lifecycle and generational tests are not typically conducted, so important effects not manifested at the exposed life stage or that have generational influences may not be detected. In the wild, effects on swimming speed, predator detection or evasion, and nest tending influence survival. Finally, toxicity test results are usually expressed as endpoints that can be difficult to interpret in terms of biological relevance. The typical endpoints reported include:

- LC50: the concentration of effluent dilution at which half (50%) of the exposed organisms die
- NOEC or NOEL: the lowest tested exposure concentration or effluent dilution at which an effect did not differ from controls
- LOEC or LOEL: the lowest tested exposure concentration or effluent dilution at which an effect differed significantly from controls

- EC50 or other EC##: the effect concentration or dilution (EC) at which a certain proportion of an effect was observed (e.g., EC10 = concentration at which 10 % of test organisms show an adverse response).

A 50% mortality rate is clearly not an acceptable level of effect for imperiled species and NOECs and LOECs are not ideal measures of effects because they are influenced by study design. Depending on the number and distribution of exposures tested and underlying variability in responses, a NOEC could actually represent a 35% difference in response from controls in a poorly designed study. An EC## reflecting a biological response threshold (i.e., 1%, 5%) would be a more suitable endpoint. Unfortunately, rigorously derived EC## data are rare and dose-response relationships of existing toxicity tests often have very broad confidence intervals. Toxicity tests are not conducted in field trials to incorporate real-world conditions and extrapolations from effects in other species are necessary because ESA-listed species are not used in toxicity tests. These tests, using standard lab species under ideal conditions, are the best available data for representing toxicity to ESA-listed species, despite the identified shortcomings.

Well treatment fluids are not permitted for discharge if they contain priority pollutants. Well treatment fluids are also subject to oil and grease limits (under the effluent limitations guidelines). Oil and grease is an indicator pollutant for toxics; thus by limiting oil and grease, the permit also limits discharge of toxic pollutants. The general permit reissuance will not relax any current permit conditions ensuring adverse effects to water quality of the ocean are avoided. The permit also has monitoring requirements and fish/shellfish impingement/entrainment control measures. According to USEPA, these discharges are authorized under the general permit are at low levels of toxicity and will quickly be diluted. Sufficient controls will be required to protect the environment and reduce potential effects on ESA-listed species.

NMFS believes that these regulated discharges' effects on ESA-listed species will be insignificant based on the following: (1) discharges must meet permit requirements for toxicity levels that do not cause harm to tested sensitive species (as described above) and other restrictions set forth in the permit, which according to USEPA, are intended to protect all aquatic life, including protected species and prevent unreasonable degradation of the marine environment; (2) discharges are expected to quickly dilute and disperse in the vast receiving waters; (3) restrictions will limit many chemicals and nutrients from entering the receiving waters (i.e. no free oil, no floating solids, no garbage, no foam, phosphate free soap and detergents, sanitary waste treated with chlorine); (4) the standard use of curbs, drip pans, and other pollution prevention equipment on offshore structures; (5) toxicity limits are required for facilities intending to discharge drilling fluids, drill cuttings, and/or produced waters to the sea; and (6) based on the USEPA, BOEM, and bioaccumulation studies cited previously, there have been no reported significant adverse environmental impacts including no bioaccumulation resulting from the proposed types of discharges from oil or gas platforms within the Gulf of America, and no adverse effects to NMFS' protected resources have been reported.

The feeding behaviors and habitat use patterns of our protected species influence their exposures and responses to the pollutant discharges under this action. While recent data show Rice's whales are occasionally found in the Gulf outside the core areas in the Presidential withdrawal area, they predominantly occur and, thus, feed in that area, which is currently not near oil and gas structures, so exposures to discharge toxicants through prey would be extremely unlikely to occur, and therefore discountable. Sperm whales and sea turtles are wide-ranging animals that feed on prey over great distances; any prey consumed near oil and gas discharge structures is an insignificant portion of their diet. Therefore, the effects from any exposure to contaminants accumulated in the discharges will be too small to measure, and thus insignificant. Gulf sturgeon have more localized feeding habits and are generally not found far enough offshore to forage in waters near oil and gas activities, so exposure to toxicants in discharges would be extremely unlikely to occur and therefore discountable. While some chemicals occur in higher concentration within a few hundred feet of discharging structures, exposure of ESA-listed sea turtles, sperm whales, Rice's whales, Gulf sturgeon to toxicants from these discharges are either insignificant or discountable.

Because our analysis of the best available scientific and commercial data available leads us to conclude that exposures to toxicants in discharges from oil and gas activities are either insignificant or discountable, we conclude that these discharges are not likely to adversely affect ESA-listed species in the action area.

8.2.5.3 Effects of Other Potential Sources of Water Quality Degradation

Several of the activities that are part of the proposed Oil and Gas Program will likely cause disturbances to the ocean floor and/or result in increased water turbidity. G&G permits for sediment sampling are used to assess a possible pipeline route and determine sediment characteristics of development areas. The common methods used to obtain sediment samples include box cores and piston cores. Coring methods typically involve a box measuring 1 x 1 m or use of a piston core that is a 3-in-diameter, 9-m-long pipe. Shorter piston cores are also used depending on the sampling needed. A box core samples surface sediment by lowering a steel box to the sea floor, closing it full of sediment, and raising it back to the vessel. A piston corer is a long, heavy tube allowed to freefall to the bottom and plunge into the bottom to extract samples of mud sediment. Sampling typically takes two to three hours per sampling site. According to the requirements of the vessel strike NTL, sea turtles and marine mammals will be avoided during all operations, and the potential for the equipment to strike an animal during the short freefall of the piston core or lowering of a box core is considered extremely unlikely to occur, and thus discountable. BOEM implements requirements to ensure protection of any sensitive benthic resources, including setbacks from sensitive benthic communities. The deployment of any sediment sampling equipment on or near coral reefs is prohibited and no impacts are expected to occur in coral habitat. Minor, localized turbidity is expected, but it would quickly dissipate when sampling ends. The minor sea floor disturbances from sediment sampling will have immeasurable, and thus insignificant effects on sea turtles, Rice's whales, and sperm whales.

Pre-severance activities will cause sediment disturbances and increased turbidity within at least a portion of the water column. The area and depth of disturbed sediment depends on the number and size of service vessels and the number of anchors set, the size of the excavated area, the depth of the below mudline cut, the method of explosive severance (internal or external) and size of the charge. The site-specific characteristics of the sediment would further influence the amount of disturbance that will occur.

Water jetting occurs with installation of structures as well as with decommissioning. Jetted or disturbed sediments may contain trace concentrations of persistent organochlorine pesticides and metals from inland agricultural and industrial practices. These sediments were transported by the Mississippi River and other rivers and deposited in coastal/marine waters. The presence of pollutants carried by river discharges is much more common in the sediments of coastal waters and is less likely in deeper waters where the structure removals will occur. Sediments close to oil and gas wells may contain residuals of drilling muds and cuttings that settle to the sea floor adjacent to the point of discharge. Levels of barium, total mercury, and other metals above background levels may be present from drilling muds released at the site.

Trace amounts of hydrocarbons may also be present in sediments adjacent to wells from past practices or spills. Sediment disturbance will occur in a limited area over a time period of less than a week, or month for the most extensive removal projects. Therefore, the suspension of any sediment caused by anchoring, sediment excavation, or removal of severed structure will result in a temporary increase of suspended matter, which will rapidly disperse and resettle on the sea floor.

Explosive severance could cause seafloor disturbance depending on the placement of the charges. Additionally, some non-explosive methods could cause increased turbidity. We expect the amount of increased turbidity caused by both explosive and non-explosive installation and removal methods to be localized and temporary, and the effects to be too small to be meaningfully measured in the action area, thus insignificant.

Submerged pipeline installation, flushing (decommissioning), removal of a severed structure from the seafloor, artificial reef creation and site clearance trawling associated with decommissioning may affect the water quality by increasing turbidity or releasing minimal amounts of oil or waste products in localized areas where the activity occurs. We expect effects from these activities will remain localized, temporary, and be too small to be measured in the action area. Therefore, we consider the effects of these activities to be insignificant.

Analysis and Conclusion

Due to the dispersion of suspended sediments, any exposures of ESA-listed species that occurs would be brief and at low exposure levels. The impacts to water quality from turbidity and suspension of drilling muds is expected to be temporary and limited to the immediate area of the removal site. The potential for ingestion, skin absorption, or other exposure to contaminants is very low for any single animal. Due to the temporary and localized effects from disturbed

sediments during decommissioning and other activities described above, the effects on highly mobile species such as whales and sea turtles will be insignificant. In summary, sediment disturbances and increased turbidity resulting from sediment sampling, pre-severance decommissioning and installation activities under the Oil and Gas Program are not likely to adversely affect Rice's whales, sperm whales, and sea turtles.

8.3 Effects of Conservation Measures

As discussed in Section 3, Description of the Action, BOEM, BSEE, USEPA, and NMFS Permits and Conservation Division propose various conservation measures to either minimize adverse effects to ESA-listed species or help monitor those effects. These include existing measures such as active NTLs and lease stipulations, and current environmental laws and regulations, as well newly proposed NTLs and MMPA mitigation measures that are considered part of the action for this opinion. In evaluating the effects of the action for each stressor or activity below, we make full consideration of the programmatically applied conservation measures for this consultation. As such, we consider the effects of the various stressors on ESA-listed or proposed species and designated critical habitat in the context of these conservation measures, including the degree to which we anticipate the mitigation measures will reduce or in some cases eliminate potential adverse effects. When supported by the available data, we quantitatively consider the proposed conservation measures when estimating the exposure of ESA-listed species and designated critical habitat to the stressors created by the action. However, in many cases we are only able to qualitatively evaluate the effectiveness of the proposed measures due to the paucity of data on their effectiveness or because such quantitative consideration is not warranted.

The conservation measures that we anticipate would either minimize adverse effects of the action on ESA-listed species or could be used to monitor such effects are summarized in Table 37. For each measure we: 1) identify the stressor(s) or activity from which impacts would be minimized, 2) briefly describe the measure and how we anticipate adverse effects would be reduced, 3) provide the ESA-listed species affected by the conservation measure, 4) indicate whether the measure is designed to monitor or mitigate potential adverse effects, and for mitigation how the measure was incorporated into our effects analyses (i.e., either quantitatively or qualitatively), and 5) provide references (either to sections within this opinion or other source documents) for more detailed information about each conservation measure.

Table 37. Conservation measures expected to either minimize adverse effects of the action on ESA-listed species or that could be used to monitor such effects

Conservation Measure	Description	Stressor(s) and/or Activities Affected	ESA Listed Species Affected	For more information refer to:
BOEM use of NAAQS under OCSLA	OCSLA mandates that DOI prescribe regulations providing for compliance with the NAAQS established pursuant to the CAA, to the extent that the OCS oil and gas activities authorized under OCSLA significantly affect the air quality of any state (43 USC §1334(a)(8); see also 30 CFR §550). All new or supplemental EPs and DOCDs, and revised DOCDs must include air emissions information sufficient to determine whether an air quality review is required (30 CFR §550.218 and §550.249).	Air emissions west of 87.5˚W longitude	sperm whale, sea turtles	Section 3.2.2
USEPA use of NAAQS under CAA	The USEPA has set NAAQS for six principal pollutants called "criteria" pollutants: carbon monoxide, lead, nitrogen dioxide, ozone, particle pollution (listed as $PM_{2.5}$ and PM_{10}), and sulfur dioxide.	Air emissions east of 87.5˚W longitude	Rice's whale, sperm whale, sea turtles	Section 3.2.2

Conservation Measure	Description	Stressor(s) and/or Activities Affected	ESA Listed Species Affected	For more information refer to:
USEPA Water Quality Standards	Section 301(a) of the CWA, 33 USC §1311(a), makes it unlawful for any person to discharge any pollutant, except in compliance with other CWA provisions that may apply, including compliance with an NPDES permit. NPDES permits must include effluent limitations for authorized discharges that: (1) reflect pollutant reductions achievable through statutorily-specified levels of technology, (2) comply with applicable USEPA-approved state water quality standards, (3) comply with other state requirements adopted under authority retained by states under CWA section 510, 33 USC Section 1370, and (4) are evaluated to determine the degree of degradation to the territorial seas, waters of the contiguous zone, or the oceans. Water-quality based whole effluent toxicity limits are included to ensure certain discharges do not cause unreasonable degradation of the marine environment.	Discharges to the waters of the OCS	All	Section 3.2.1
BOEM/BSEE Protected Species Stipulations	Applied after a lease sale occurs and is issued for any lease block sold. Lessee and operator requirements include flotsam removal, posting signs regarding marine debris, vessel speed and distance protocols when marine mammals and sea turtles are observed, seismic survey mitigation measures including use of an exclusion zone, addressing important habitats in oil spill contingency plans, and immediate reporting of stranded animals.	Marine debris, vessel strike, vessel sound, seismic survey sound, oil spills	Rice's whale, sperm whale, sea turtles, and Gulf sturgeon (oil spills only)	Section 3.1.6.1
BSEE NTL No. 2024-G05 Managed Pressure Drilling Projects Using a Subsea Blowout Preventer	Guidance on the use and maintenance of the equipment and materials when conducting managed pressure drilling (MPD) projects for wells with subsea blowout preventers (BOPs).	Oil spills	All	BSEE NTL web page

Conservation Measure	Description	Stressor(s) and/or Activities Affected	ESA Listed Species Affected	For more information refer to:
BSEE NTL No. 2024-G06 Pollution Inspection Intervals for Unmanned Facilities	Clarification how District Managers will determine the appropriate pollution inspection intervals for unmanned facilities.	Pollution	All	BSEE NTL web page
BSEE NTL No. 2024-N02 Revised Well Control Equipment Failure Reporting Guidelines	Guidance on how to report failures of well control equipment under 30 CFR §250.730.	Oil spills	All	BSEE NTL web page
BOEM NTL No. 2022-N01 2023 "OCS Emissions Inventory Western and Central Gulf of Mexico and Adjacent to the North Slope Borough of the State of Alaska"	Guidance and information for submitting the activity and emissions reports necessary for compliance with BOEM's regulations 30 CFR §§550.303(k) and 550.304(g).	Pollution (Emissions)	Rice's whale, sperm whale, sea turtles	BOEM NTL web page
BSEE NTL No. 2021-G01 Incident, Oil Spill, and Permit Notification	Describes the procedures you may use to make submissions of incident, oil spill, and other pollution events to BSEE GOMR to fulfill certain covered requirements during and after office hours. Supersedes BSEE NTL No. 2018-G02.	Oil spills, pollution	All	BSEE NTL web page
BOEM NTL No. 2020-N02 BOEM's Approved Air Quality Models	Guidance on the approved air quality models for air quality assessments in the areas that BOEM regulates on the OCS.	Pollution (Air Quality, Emissions)	Rice's whale, sperm whale, sea turtles	BOEM NTL web page
BOEM NTL No. 2020-N03 2021 "OCS Emissions Inventory Western and Central Gulf of Mexico and Adjacent to the North Slope Borough of the State of Alaska"	Guidance and information for submitting the activity and emissions reports necessary for compliance with BOEM's regulations 30 CFR §§550.303(k) and 550.304(g).	Pollution (Emissions)	Rice's whale, sperm whale, sea turtles	BOEM NTL web page

Conservation Measure	Description	Stressor(s) and/or Activities Affected	ESA Listed Species Affected	For more information refer to:
BOEM NTL No. 2020-G01 "Air Quality Information Requirements for Exploration Plans, Development Operations Coordination Documents, and Development and Production Plans in the Gulf of Mexico Region"	Guidance and information for air quality and emissions information to be included in Exploration Plans, Development Operations Coordination Documents, and Development and Production Plans. This NTL cancels and supersedes the Air Emissions Information portion of NTL No. 2008-G04.	Pollution (Emissions)	Rice's whale, sperm whale, sea turtles	BOEM NTL web page
BOEM NTL No. 2020-G02 Air Dispersion Modeling Information for Exploration Plans, Development Operations Coordination Documents, and Development and Production Plans	Guidance and information to conduct air quality modeling when an emission exemption threshold is exceeded. The lessee or operator must use the approved air quality model for projected air emissions to be included in Exploration Plans, Development Operations Coordination Documents, and Development and Production Plans.	Pollution (Emissions)	Rice's whale, sperm whale, sea turtles	BOEM NTL web page
BSEE NTL No. 2020-N04 Flaring and Venting Requests	Guidance for requesting approval to flare or vent natural gas and clarification about BSEE's approval of such requests.	Pollution (Emissions)	Rice's whale, sperm whale, sea turtles	BSEE NTL web page
BSEE NTL No. 2019-N05 Incidents and Spills Reporting	Clarification on the types of incidents to be reported and how those incidents, oil spill, pipeline damage and other pollution events should be reported to BSEE. This NTL supersedes BSEE NTL No. 2018-G17.	Oil spills, pollution	All	BSEE NTL web page
BSEE NTL No. 2019-G05 Site Clearance and Verification for Decommissioned Wells. Platforms, and Other Facilities	Guidance how to conduct site clearance trawling to clear the seafloor of all obstructions created by your lease and/or right of way following decommissioning. Trawl times are limited to 30 minutes to allow for the removal and release of any sea turtles captured in the net in compliance with the NMFS 2006 BiOp. This NTL supersedes BSEE NTL No. 1998-G26.	Capture in trawl gear	Sea turtles	BSEE NTL web page

Conservation Measure	Description	Stressor(s) and/or Activities Affected	ESA Listed Species Affected	For more information refer to:
BSEE NTL No. 2019-G04 Requesting Approval to Consider External Hydrostatic Pressure Effects When Calculating Internal Pressure Containment Capability for Pressure Containing and Controlling Subsea Equipment	Provides guidance for information needed to analyze alternate equipment requests for consider external hydrostatic pressure in the design and calculation of internal pressure containment capability of subsea equipment. If an operator would like BSEE to approve the use of alternate equipment, an operator must show that the equipment "provide[s] a level of safety and environmental protection that equals or surpasses current BSEE requirements." See 30 CFR §250.141(a). This NTL is related to HPHT equipment.	Oil spills	All	BSEE NTL web page
BSEE NTL No. 2019-G03 Guidance for Information Submissions Regarding Site Specific and Non-Site Specific HPHT Equipment Design Verification Analysis and Design Validation Testing	Guidance for use of well completion, well control & well intervention equipment, and trees and production equipment designed for high pressure/high temperature (HPHT) conditions. This NTL supersedes NTL No. 2007-G07,	Oil spills	All	BSEE NTL web page
BSEE NTL No. 2019-G02 Guidance for Information Submissions Regarding Proposed High Pressure and/or High Temperature (HPHT) Well Design, Completion, and Intervention Operations	Describes voluntary submissions pf plans and information prior to dates required by regulation, in order to aid BSEE's understanding of a DWOP, APD, or APM and thereby facilitate agency review of HPH well design, completion or intervention operations.	Oil spills	All	BSEE NTL web page

Conservation Measure	Description	Stressor(s) and/or Activities Affected	ESA Listed Species Affected	For more information refer to:
Vessel Strike Avoidance and Injured/Dead Aquatic Protected Species Reporting Protocols	Apply to all activities approved by the Bureaus associated with the federally regulated Oil and Gas Program in the Gulf of America	Vessel strike	Rice's whale, sperm whale, sea turtles	BOEM NTL web page[30]
Geophysical Survey Mitigation Protocol	For all geophysical surveys approved by the Bureaus incorporating protocols based on sound source tiers with no mitigation required for de minimus sources	Seismic survey sound	Rice's whale, sperm whale, sea turtles	BOEM NTL web page[30]
Mitigations applied under the NMFS Permits and Conservation Division's MMPA rule	Measures to minimize adverse effects to marine mammals include the following: time-area restrictions on airgun surveys for coastal areas; PAM requirements; visual monitoring requirements involving PSOs; monitoring zone specifications; ramp-up requirements for airgun surveys; specified exclusions zones; and shutdown requirements	Seismic survey sound	Rice's whale, sperm whale, sea turtles	Section 3.3

[30] BOEM Active Notices to Lessees and Operators https://www.boem.gov/Notices-to-Lessees-and-Operators/

Conservation Measure	Description	Stressor(s) and/or Activities Affected	ESA Listed Species Affected	For more information refer to:
BSEE NTL 2018-G03 Decommissioning Guidance for Wells and Platforms	Describes regulations for explosive removal of structures. All explosives use will require NMFS PSOs from the Platform Removal Observer Program. These requirements necessitate different levels of mitigation, monitoring, and reporting for protected species based on the charge size, water depth (species delineations), and use above or below the sea floor. The use of PAM technicians is required when using explosives in water depths greater than 200 m in order to monitor for vocalizations of deep-diving marine mammals.	Explosives used for structural severance	Sea turtles	BSEE NTL web page[31]
BOEM mitigation measures for the risk of entanglement in seismic survey equipment	BOEM has implemented mitigation measures through their permits (as conditions of approval) to reduce the possibility of entanglement in seismic survey equipment. The measures include the use of stiff non-buoyant lines, immediate retrieval of lines following survey completion, and having protected species observers on node retrieval vessels to watch for signs of entanglement. BOEM and BSEE reserve the right to site visit to ensure compliance with all mitigations.	Entanglement in seismic survey equipment	Rice's whale, sperm whale, sea turtles	Section 3.1.3.2
BOEM Effects Avoidance or Minimization Measures for Site Clearance Trawling Requirements under 30 CFR §§ 250.1740-1743	To minimize the effect on sea turtles that may be incidentally captured, a minimum trawl net bag/cod end mesh size (four in) and a maximum trawl time of 30 minutes should be used. Captured turtles must be resuscitated and released following the requirements for shrimp trawlers in the Gulf	Entanglement during site clearance trawling	Sea turtles	Section 3.1.6.6

[31] BSEE Notice To Lessees https://www.bsee.gov/guidance-and-regulations/guidance/notice-to-lessees

Conservation Measure	Description	Stressor(s) and/or Activities Affected	ESA Listed Species Affected	For more information refer to:
BSEE NTL 1998-G26 "Minimum Interim Requirements for Site Clearance (and Verification) of Abandoned Oil and Gas Structures in the Gulf of Mexico"	NTL based on regulations for specific trawling requirements designed to facilitate the removal of any small objects or obstructions (e.g., tools, containers, batteries) that may have been lost or discarded during the operational life of the structure	Marine debris	Rice's whale, sperm whale, sea turtles	BSEE NTL web page
BSEE NTL No. 2015-G03 Marine Trash and Debris Awareness and Elimination	Provides information on BSEE's Marine Debris Elimination and Awareness training video and slide show.	Marine debris	Rice's whale, sperm whale, sea turtles	BSEE NTL web page
USCG and USEPA marine trash and debris regulations	USCG regulations to conform with the adopted International Convention for the Prevention of Pollution from Ships (MARPOL) Annex V (Garbage). Under this rule, the only allowed discharges are certain food wastes, cargo residues, cleaning agents and additives in wash waters, and animal carcasses. Additional USCG and USEPA regulations require that operators become more proactive in avoiding accidental loss of solid-waste items by developing waste management plans, posting informational placards, manifesting trash sent to shore, and using special precautions such as covering outside trash bins to prevent accidental loss of solid waste.	Marine debris	Rice's whale, sperm whale, sea turtles	USCG 2013 Interim Rule 78 FR 13481

Conservation Measure	Description	Stressor(s) and/or Activities Affected	ESA Listed Species Affected	For more information refer to:
Marine Plastic Pollution Research and Control Act (MPPRCA) and the Marine Debris Research, Prevention, and Reduction Act (MDRPRA)	The MPPRCA requires USEPA and NOAA to study the effects of improper disposal of plastics on the environment and methods to reduce or eliminate such adverse effects. MPPRCA also requires EPA, NOAA, and the USCG to evaluate the use of volunteer groups in monitoring floatable debris. The MDRPRA established programs within NOAA and the USCG identify, determine sources of, assess, reduce, and prevent marine debris.	Marine debris	Rice's whale, sperm whale, sea turtles	MPPRCA H.R.4668 — 103rd Congress (1993-1994) MDRPRA S. 362 — 109th Congress (2005-2006)
BSEE NTL 2012-N06 Guidance to Owners and Operators of Offshore Facilities Seaward of the Coast Line Concerning Regional Oil Spill Response Plans	Provides clarification, guidance, and information concerning the preparation and submittal of a regional OSRP for owners and operators of oil handling, storage, or transportation facilities, including pipelines. Some of the clarifications and encouraged practices based on lessons learned from the DWH oil spill response	Oil spills	All	BSEE NTL web page
BSEE NTL 2010-N10 Statement of Compliance with Applicable Regulations and Evaluation of Information Demonstrating Adequate Spill Response and Well Containment Resources	Requires submittal of a signed statement with each application for a well permit stating that the operator will conduct all authorized activities in compliance with all applicable regulations, including the increased safety measures regulations	Oil spills	All	BSEE NTL web page
BSEE NTL 2016-N01 Incident of Noncompliance Response System	BSEE will conduct onsite inspections to assure compliance with the OCSLA, lease terms, rights-of-way, approved plans, and other applicable laws and regulations, including those associated with safety and protection of the environment	Oil spills	All	BSEE NTL web page

Conservation Measure	Description	Stressor(s) and/or Activities Affected	ESA Listed Species Affected	For more information refer to:
BSEE NTL 2015-N06 Clarification of Cementing Requirements Following Indications or Identification of an Inadequate Cement Job	Provides guidance and clarification of the regulations related to cementing requirements and the steps necessary to address indications or identification of an inadequate cement job	Oil spills	All	BSEE NTL web page
BSEE NTL 2015-G02 Hurricane and Tropical Storm Effects Reports	Provides guidance on reporting hurricane and tropical storm effects and includes an oil spill pollution report. BSEE uses the data from the pollution report to identify environmental and man-made assets at risk and provide background data for natural resource damage assessments	Oil spills	All	BSEE NTL web page
BSEE NTL 2012-N07 (and 2014-N03) Oil Discharge Written Follow-up Reports	Provides clarification about the type of information required for compliance with report requirements in 30 CFR §254.46(b)(2). Under this regulation for all oil discharges of one barrel or more a written follow-up report must be submitted to BSEE within 15 calendar days after the spillage has been stopped or has ceased	Oil spills	All	BSEE NTL web page
BOEMRE Safety and Environmental Management System (SEMS) Rule (30 CFR §250, Subpart S)	Establishes a holistic, performance-based management tool that requires offshore operators to establish and implement programs and systems to identify potential safety and environmental hazards when they drill; clear protocols for addressing those hazards; and strong procedures and risk-reduction strategies for all phases of activity, from well design and construction to operation, maintenance, and decommissioning.	Oil spills	All	Sections 3.1.5.1 and 3.1.5.2
BSEE's Final Drilling Safety Rule (77 FR 50855 and 81 FR 61834)	Intended to decrease the likelihood of another extremely large spill by increasing effective measures for spill prevention, and ensuring timely containment should such a spill occur.	Oil spills	All	Sections 3.1.5.1 and 3.1.5.2

Conservation Measure	Description	Stressor(s) and/or Activities Affected	ESA Listed Species Affected	For more information refer to:
Oil and Gas and Sulphur Operations on the Outer Continental Shelf—Increased Safety Measures for Energy Development on the Outer Continental Shelf (77 FR 50856, August 22, 2012)	Implements safety measures for energy development on the OCS. Includes amending regulations regarding drilling, well-completion, well-workover, and decommissioning regulations related to well-control, including: subsea and surface blowout preventers, well casing and cementing, secondary intervention, unplanned disconnects, recordkeeping, and well plugging.	Oil spills	All	77 FR 50856, August 22, 2012
BSEE NTL 2013-N02 Significant Change to Oil Spill Response Plan Worst Case Discharge Scenario	Intended for owners or operators of oil handling, storage, or transportation facilities located seaward of the coast line. Clarifies what BSEE considers a significant change in an OSRP worst case discharge (WCD) scenario that requires submittal of a revised OSRP for BSEE approval	Oil spills	All	BSEE NTL web page
USEPA proposed amendments to Subpart J of the National Contingency Plan on the use of oil spill dispersants	Proposed changes would help to ensure that chemical and biological agents have met efficacy and toxicity requirements, and that product manufacturers provide important use and safety information. Further, this would equip the planning and response community with the proper information to authorize and use products judiciously to effectively mitigate health and environmental effects from oil discharges.	Oil spill response	All	80 FR 3379, January 22, 2015

Conservation Measure	Description	Stressor(s) and/or Activities Affected	ESA Listed Species Affected	For more information refer to:
Information Requirements for EPs, DPPs, and DOCDs on the OCS: specified in 30 CFR §550.211 through 550.228 and explained in BOEM NTL 2008-G04 Shallow Hazards Program, and BOEM NTL 2009-G27 Submitting Exploration Plans and Development Operations, and BSEE NTL 2010-N06	Guidance on information requirements for various stages of the OCS oil and gas program	General oil and gas exploration, development, and transportation activities	All	BSEE NTL web page BOEM NTL web page
BSEEBOEM (MMS) NTL 2009-G39 Biologically-Sensitive Underwater Features and Areas	Provides for the avoidance and protection of biologically sensitive features and areas (i.e., topographic features, pinnacles, live bottoms, and other potentially sensitive biological features) when conducting OCS operations in water depths less than 300 m in the GOA	General oil and gas exploration, development, and transportation activities	General habitat benefits for ESA-listed Species	BSEE NTL web page
BOEM/BSEE NTL 2014-G02 Designation of Operator of an OCS Oil and Gas or Sulphur Lease	When an operator is designated, they become responsible for all wells that have a bottom hole located within the lease	General oil and gas exploration and development activities	All	BOEM NTL web page
Authorization requirements for in-situ burning of an oil spill	Burning agent use is authorized on a case-by-case basis by concurrence of the USCG on-scene coordinator, Regional Response Team, and Natural Resource Trustees	Oil spill response	All	

8.4 Effects of Vessel Strikes

The risk of vessel strike/collision due to oil and gas-related vessel activity within the action area is a serious concern for ESA-listed species over the 45-year period analyzed in this opinion. On-shore, there is a large network of shore-based infrastructure to support oil and gas operations in the Gulf of America (Figure 8), including marine facilities for vessels. An estimated 150 boat owners operate over 850 oil and gas service vessels in the Gulf of America, which service the increasing amount of oil and gas activity occurring in deeper waters.

In addition to potentially disturbing ESA-listed species, vessel traffic associated with the Oil and Gas Program poses a risk of collision or vessel strike to ESA-listed species that inhabit surface waters. Vessel strikes are known to adversely affect ESA-listed sea turtles, some fishes (particularly sturgeon), and marine mammals, especially large whales (Brown and Murphy 2010; Laist et al. 2001; NMFS and USFWS 2008; Work et al. 2010). The probability of a vessel collision depends on the number, size, and speed of vessels, as well as the distribution, abundance, and behavior of the species (Conn and Silber 2013; Hazel et al. 2007; Jensen and Silber 2004; Laist et al. 2001; Vanderlaan and Taggart 2007). If an animal is struck by a vessel, it may experience no injuries, minor non-serious injuries, serious injuries, or death. In most cases, serious injuries are assumed to result in death because of the severity of the wounds (NMFS 2023c), although there is a lack of adequate monitoring to confirm whether animals survive such events (e.g. Vanderlaan and Taggart 2007a).

In this section, we evaluate the level of vessel activity in the Gulf of America and the characteristics of those vessels (e.g., size, speed, etc.) as they relate to the risk of vessel strike to ESA-listed species. Then, by species or taxanomic group, we estimate the number of individuals likely to be struck by vessels associated with the Oil and Gas Program and describe the likely responses. Finally, we provide a brief summary of the overall vessel strike effects analysis. In the Integration and Synthesis (Section 11), we combine information on the likely exposure and responses to evaluate the risk vessel strikes associated with the Oil and Gas Program pose to individuals and the populations to which those individuals belong.

Vessel traffic is associated with all three phases of the Oil and Gas Program. While we do not expect a high number of seismic airgun surveys within BOEM's eastern planning area, there will be some level of activity to include faster-moving support vessels that carry risk of vessel strike. Additionally, geospatial distribution of shipping and commercial fisheries tends to be focused in the northwestern part of the Gulf of America, but there are several shipping lanes that cross the area where Rice's whales are regularly sighted, and some of the vessel densities within those lanes are high enough that they are of concern for the species (Soldevilla et al. 2017).

Vessel strikes are further cited as threats to listed species in the action area in other ESA-related species status reviews and rulemakings. In the last five-year species review, vessel strikes were identified as an emerging threat for Gulf sturgeon. The Rice's whale status review and final listing noted that vessel strikes are a threat to Rice's whales.

This opinion considers information we have synthesized since the last analysis of the effects of vessel strikes on ESA-listed species in the Gulf of America from vessels associated with the Oil and Gas Program in the 2020 opinion. The analysis in this opinion uses updated information about vessel routes, locations, and speeds to produce estimates of exposure to vessel traffic based on more recent and the best available data. These data, described in greater detail below, also include updated stranding data, reported occurrences of vessel injury in live animals, updated species' densities, updated vessel activity levels and information, updated areas of operation, and the incorporation of new methods to better estimate the impacts to Rice's whale. The incorporation of this information enables a more up to date comprehensive estimate of exposure to vessel traffic and analysis of the effects of vessel strikes on listed species in the action area.

8.4.1 Vessel Activity Associated with the Oil and Gas Program

In this section, we summarize information on the nature and level of vessel traffic associated with the Oil and Gas Program. We evaluate data provided by BOEM in its BA from the Marine Cadastre Data Registry (MarineCadastre.gov), as well as other data to provide the most accurate representation of vessel activity as it relates to vessel strike risk for certain ESA-listed species. We also consider the characteristics of the estimated vessel activity (e.g. speed, location) in order to determine the exposure of ESA-listed species to vessel traffic that may result in vessel strikes and the responses associated with those vessel strikes.

In its BA, BOEM provided data on vessel "trips," which are defined as a vessel leaving and returning to port. These data provide a measure of vessel activity near ports. However, estimates of vessel trips provide a coarse estimate of vessel traffic, especially as it relates to vessel traffic further offshore. For example, a vessel may leave a port, travel 1.5 km and return, while another may leave a port, travel 100 km and return. While both of these would be considered a single trip, the latter vessel covered more ground and, as such, may pose a greater risk to ESA-listed species in terms of the potential for vessel strikes. For any given trip, there could be a wide range of vessel movements, with some being relatively short trips (both in time and distance) and others being much longer and further offshore. Because vessel trips provide a reasonable estimate for vessel traffic nearshore, we relied on the number of vessel trips estimated by BOEM to estimate exposure of Gulf sturgeon. This is appropriate based on the distribution of the species near ports and shallow navigation channels that are expected to be the areas of highest risk for vessel interaction with this benthic-dwelling species.

For determining exposure (i.e., co-occurrence of vessels and animals) to vessel traffic of whales and sea turtles, we also used Automatic Identification System[32] (AIS) vessel traffic data to more

[32] AIS is a maritime navigation safety communications system that collects information from shipboard broadcast systems that act like a transponder, operating in the VHF maritime band, that is capable of handling well over 4,500 reports per minute and updates as often as every two seconds (https://www.navcen.uscg.gov/?pageName=aismain). AIS are systems required by the USCG by any self-propelled vessel of 1600 or more gross tons and provide vessel information including vessel identity, type, position, course, speed, navigational status, and other data related to shore-based facilities.

accurately quantify exposure to vessel traffic. These data provide vessel traffic information at a finer temporal and spatial resolution. The AIS data provide information not only on trips, but also about the routes taken by tracked vessels, the distances traveled, and their speeds, which allowed us to produce more realistic estimates of exposure of ESA-listed sperm and Rice's whales and sea turtles to vessel traffic. The AIS data also allow us to estimate the percentage of total vessel traffic the Oil and Gas Program-related vessels represent in a spatially explicit manner, which is particularly relevant for examining exposure of ESA-listed species that show clear heterogeneity in their spatial distribution.

BOEM provided vessel traffic data from 2018 to 2022 as vessel "tracks" from AIS available at the Marine Cadastre Data Registry, which uses publicly available data that are compiled annually. The vessel type categories represented in the AIS Vessel Track datasets included: cargo, fishing, other, passenger, pleasure craft and/or sailing, tanker, tug tow, and "not available." BOEM determined that the most appropriate categories to capture oil and gas activity include the categories of "tug tow" and "other" and thus others were excluded from their analysis. Additionally, BOEM determined that, although tankers transport Gulf of America oil and gas, they are not regulated by BOEM or within the scope of the activities to be analyzed and therefore were excluded from the analysis. Vessel traffic data provided by BOEM were further clipped to the OCS boundary to capture BOEM-regulated oil and gas vessel activity in Federal waters. However, BOEM acknowledged that vessels supporting BOEM-regulated activities mobilize out of and return to multiple ports along the northwestern Gulf of America coast, transiting State waters.

After evaluating the AIS vessel traffic data provided in the BA, we identified several potential limitations in applying these data towards our vessel strike analysis for whales and sea turtles. Notably, the MarineCadastre.gov website states that the AIS data provided is solely intended for marine planning purposes and is not adequate for regulatory or enforcement purposes. Data are not generally available for waters beyond 40 to 50 mi from the shoreline or foreign waters. The AIS data published by MarineCadastre.gov originate from the Nationwide Automatic Identification System (NAIS) by the U.S. Coast Guard, which represents ~200 land-based receiving stations located near navigation routes in the U.S. and U.S. territories. The vessel information (e.g., vessel type, size) in the AIS data contained in the Marine Cadastre database is also manually entered by hand by the vessel's operator, and therefore can lead to errors or omissions and result in an inaccurate representation of oil and gas vessel traffic in the Gulf of America. Marine Cadastre data also do not cover the entirety of the action area (i.e., to the coast and to the outer boundaries beyond the EEZ).

Given the limitations, we supplemented our analyses with AIS data NMFS maintains through a partnership with the Department of Transportation, Volpe Center. These data include AIS information transmitted via satellite, providing better offshore coverage, and make use of the

Information Handling Services (IHS) Maritime World Register of Ships[33], which allowed us to check the validity of the data on vessel characteristics. The IHS database houses an extensive amount of vessel-related data, including detailed vessel types, world merchant fleet of vessels with gross tonnage values of 100 or above. Using the IHS database reduces the error that may be associated with the Marine Cadastre database as vessels are validated by linking the IHS with more detailed vessel information. From a spatial perspective, we utilize AIS data for both state waters and federal waters as targeted vessels would need to travel through state waters to conduct BOEM-regulated activities in Federal waters.

Below we summarize the vessel trip and AIS data used in our exposure analysis for Rice's whale, sperm whale, and sea turtles.

Vessel Trip Information

Using data from historical leasing trends, BOEM (Table 1; 2023) projects that there will be 47,000 – 163,000 service vessel trips annually throughout the total action area. In developing these estimates, BOEM identified four main categories of vessels associated with its Oil and Gas Program. These include service vessels, barges, tankers, and G&G survey vessels (BOEM 2017a). These vessel types differ in their function and in the vessel strike risk they pose to ESA-listed species. For example, barges are not self-propelled and, as such, require tug boats, which typically limits their use to shallow water where ESA-listed whales are unlikely to be found. Based on current data and historical trends, BOEM estimates that barging is expected to account for less than 1% of oil transported as part of the action, indicating that barge traffic associated with the Oil and Gas Program likely does not significantly contribute to overall vessel traffic within the Gulf of America. G&G survey vessels, when actively conducting surveys, travel slowly in many cases (e.g., seismic airgun survey vessels typically travel at speeds less than five knots when surveying), making them less likely to strike some ESA-listed species during survey activities.

BOEM's analysis of vessel traffic from 2018 to 2022 showed consistent trends in vessel traffic across all years, with slight decreases noticed in 2020 and 2021, presumably a result of the COVID-19 pandemic (Table 24; BOEM 2023). The percentage of all vessel traffic (distance traveled and number of tracks) on the Gulf of America OCS (e.g., excluding state waters) that fell within BOEM's identified categories of "tug tow" and "other" was 22% of the total vessel traffic and ranged from approximately 20% to 23% depending on the year (Table 24; BOEM 2023). The overall percentage of vessel tracks on the OCS by tug-tow and other vessels was approximately 18% of the total vessel traffic and ranged from a low of approximately 14% to a high of 28% depending on the year (Table 25; BOEM 2023). BOEM emphasized that these percentages align with BOEM's estimates for contributions to air emissions as described in BOEM's 2017 oil and gas production sources emissions inventory for the Gulf of America OCS.

[33] https://ihsmarkit.com/products/maritime-world-ship-register.html

Based on BOEM (2023), there are expected to be an estimated 1,949 transits for service vessels associated with G&G activities annually through March 2030 on the Gulf of America OCS. When comparing this annual estimate to an estimate of total Gulf of America vessel traffic based on AIS data, BOEM estimates that Oil and Gas service vessel traffic constitutes between 2-7% of the total vessel traffic in the Gulf of America (BOEM 2023).

For barges, BOEM does not provide an estimate of the number of vessel trips nor the relative amount they make up of the greater Gulf of America vessel traffic. BOEM describes barge use to be limited to shallow waters, close to the shoreline as they may be used to transport oil and gas, supplies (e.g., chemicals, drilling mud) or wastes between shore bases and offshore platforms, as well as installation and decommissioning activities. Recently, there has been an increase in barging of oil from deepwater sites during extended well testing. However, there is no information available at this time on the number of barge trips associated with these other types of offshore oil barging operations. Due to the described nature of use, BOEM maintains that barging was used infrequently as an interim transport system before the installation of a pipeline system and estimates about 1% of oil produced in less than 60 m in both the WPA and CPA during the action is expected to be barged to shore. Therefore, over the 40-year life of the leases, less than 1% of the total oil produced is expected to be barged, indicating that it likely does not significantly contribute to overall vessel traffic within the Gulf of America (BOEM 2023).

Shuttle tankers are used to transport oil from floating production and storage and off-loading units (FPSOs). In the Gulf of America, two FPSO systems, one associated with the Cascade Chinook Project, and another associated with the Shell Stones Project, have shuttle tankers currently in operation. These tankers make seven-day round trips to refineries along the Gulf Coast, serving an area from Corpus Christi, Texas, to Pascagoula, Mississippi. As new wells and FPSOs are put in operation, additional shuttle tankers will be put into service and will visit FPSOs every three to five days. BOEM projects that in the next 70 years, at a maximum, one new FPSO system would be put in place (BOEM 2023). For this FPSO, as well as the two currently in operation, BOEM estimates that when operating at maximum capacity, maximum offloading would occur once every 3.3 days, which would equate to 110 shuttle tanker transits across the Gulf of America annually per FPSO (BOEM 2017a).

G&G activities involve the use of both G&G survey and service vessels. BOEM estimates that in total, G&G survey vessels will make 99.3 trips to shore and G&G service vessels will make 1949.4 trips to shore annually through March 2030 (Section 3.1.4.7, Table 8). This is based on estimated annual vessel traffic for all new leases issued in the ten-year period following issuance of the 2020 programmatic opinion (i.e., through March 2030) (BOEM 2023).

Automatic Identification System Vessel Data

As described above, we relied on AIS data linked to information in the Information Handling Services (IHS) Maritime World Register of Ships to estimate exposure of sea turtles and whales to vessel traffic. The IHS database houses an extensive amount of vessel-related data, including

detailed vessel types, world merchant fleet of vessels with gross tonnage values of 100 or above. NMFS found that using the IHS database was more encompassing of oil and gas vessel types in comparison to using the Marine Cadastre database given the lower likelihood of error associated with vessel validation.

For the exposure analyses, it was first necessary to identify those vessels within the AIS database that are associated with the Oil and Gas Program. While vessel type is provided as part of class 5[34] AIS messages, the vessel type detail contained in AIS data is not sufficient to adequately characterize vessels as being associated with the Oil and Gas Program. As such, we used vessel identifiers in the class 5 AIS messages to link the AIS data to in the IHS database. With input from BOEM and BSEE, vessel types associated with the Oil and Gas Program were identified from the set of vessel types contained in the IHS database (Appendix B). Using these selected vessel types, we were able to quantify vessel traffic associated with the Oil and Gas Program, as well as other vessel traffic in the Gulf of America more broadly, following the process detailed below. In a few cases, BOEM and BSEE were uncertain whether or not the majority of some vessel types were associated with the Oil and Gas Program; those vessel types were not included as part of those associated with the proposed action.

Several additional steps were taken to prepare the vessel traffic data for our exposure analysis. AIS data that could link to the IHS database were filtered to remove records with suspect speed values (e.g., a vessel at anchor may read 0 kt, or some aircraft carry AIS and could cause values greater than 50 kt) and then aggregated into transits based on their timestamps. When the time elapsed between successive AIS records for a given vessel was less than two hours, they were considered part of the same transit. Transits were flagged and removed from the analysis if the spatially-computed distance (i.e., geodesic distance between the two point locations) between adjacent records in a vessel transit were found to differ significantly from the speed-time distance (i.e., the distance calculated by multiplying vessel speed by the time elapsed between the two records).

Finally, because our stressor exposure analysis examines a spatial overlap between the stressor activity (i.e., vessel traffic) and animal densities, we summarize the AIS vessel transit data within a grid generated to cover the entire action area, with approximate dimensions of 11.9 km x 10.8 km such that the total area per grid cell is 130 km^2. The selected spatial resolution for the grid roughly corresponds to the spatial resolution of the cetacean density estimates derived from Garrison et al. (2023) (Section 8.1.2.1). The vessel transits were then overlaid with the action area grid and a variety of vessel traffic metrics were calculated for each of the cells in the action area grid and aggregated by month. These grid-level metrics included vessel counts, transit counts, kilometers of travel at all speeds, kilometers of travel at speeds greater than 10 kt, operational hours, and average distance-weighted speeds. The above metrics were calculated for

[34] Static and voyage related data - Scheduled static and voyage related vessel data report, Class A shipborne mobile equipment. More information at https://www.navcen.uscg.gov/ais-messages

all vessels, in addition to the subset of vessels identified by BOEM and BSEE as being associated with the Oil and Gas Program, referenced hereafter as "oil and gas traffic."

Vessel traffic metrics used for our analysis were derived from data from 2022 and 2023, as it is the most recent data and best reflects what is likely to occur in the future. Importantly, these more recent data also reflect BOEM and BSEE's implementation of the measures included in the 2020 Biological Opinion RPA (10 kt day time vessel speed reductions and no nighttime vessel transit through the 2020 Rice's whale area), which they have now included as part of the proposed action here. Furthermore, both the data provided by BOEM from Marine Cadastre (BOEM 2023; Table 24) and the AIS data maintained by NMFS demonstrated deviations in vessel traffic patterns for 2020 and 2021, which are presumed to be related to the COVID-19 pandemic. This is not surprising because, globally, maritime traffic saw a reduction in vessel traffic at the onset of the pandemic (Guerrero et al. 2022; Millefiori et al. 2021), with global declines peaking in April 2020 (March et al. 2021). Specific to the Gulf of America, a study by Mathew and Sidorovskaia (2021) acoustically monitored maritime activity in the Mississippi Canyon region from 2018 through 2020 and found that low-frequency bands (typically associated with large shipping vessels (EU 2008) declined relative to the pre-pandemic baseline, indicating a reduction in overall traffic levels in spring of 2020. Taking the above into consideration, the available data from 2022 and 2023 are most reflective of present conditions and practices, and represent the best available AIS data to inform our analysis of vessel strike exposure for whales and sea turtles for this opinion. A visual representation of these vessel traffic data overall, specifically for oil and gas related vessel traffic, and the relative amount of traffic from oil and gas related vessels, can be seen below in Figure 65, Figure 66, and Figure 67.

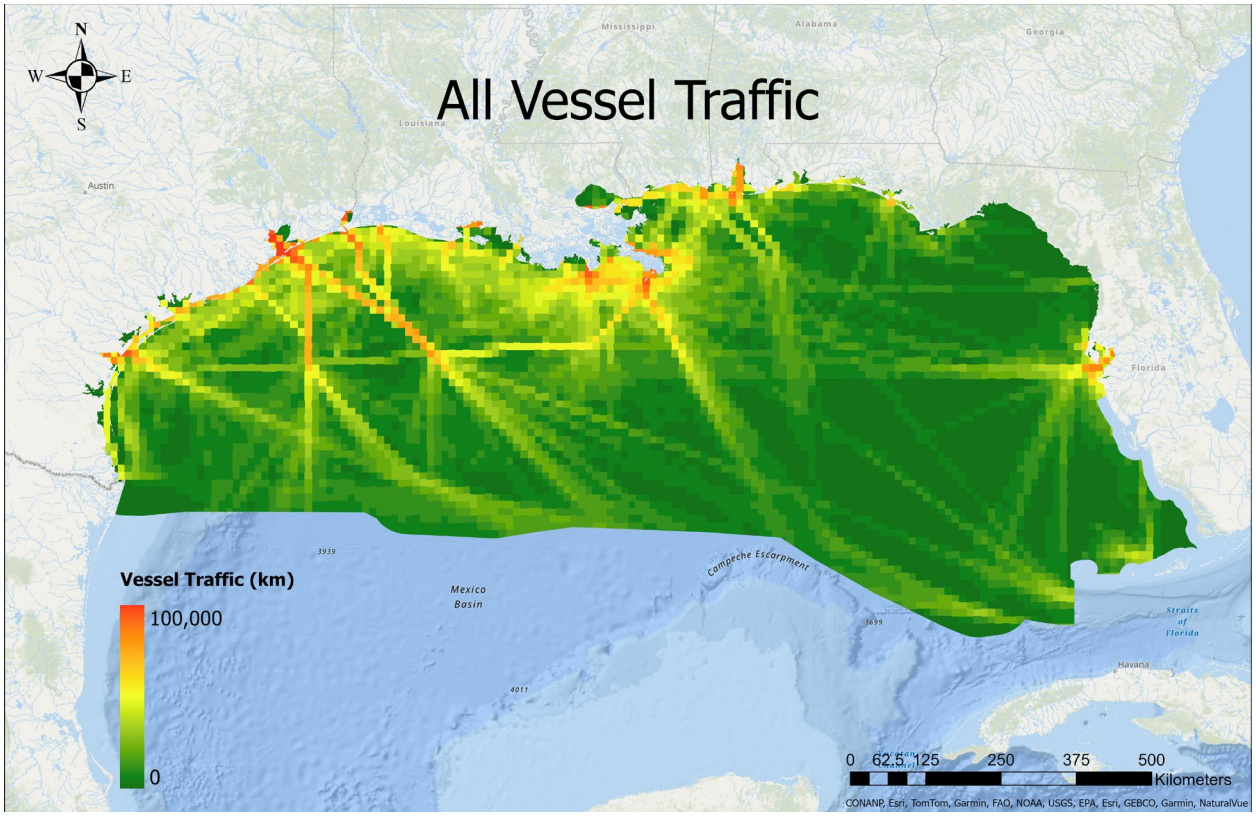


Figure 65. All vessel traffic in the Gulf of America. Data represent average kilometers (km) of vessel traffic from AIS data from 2022-2023.

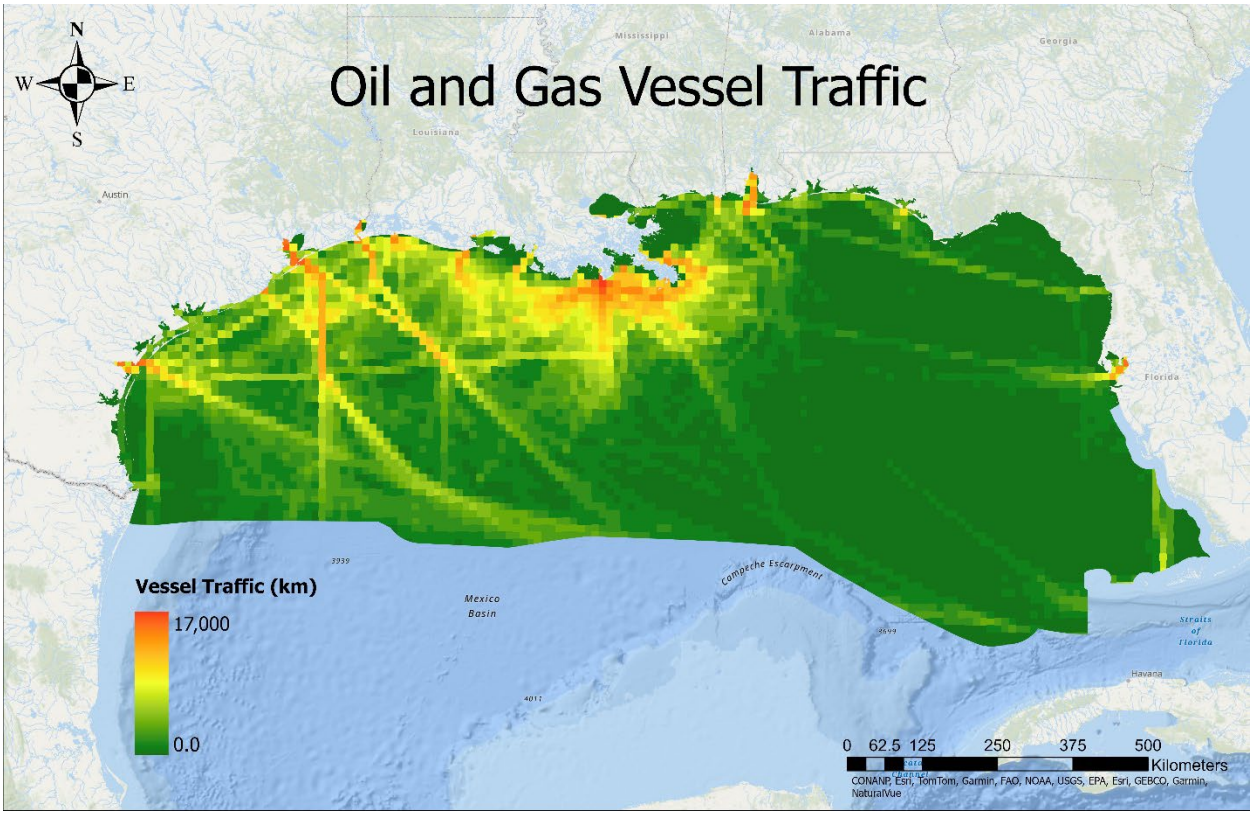


Figure 66. Oil and Gas Vessel Traffic in the Gulf of America. Data represent annual average kilometers (km) of vessel traffic from oil and gas related vessels based on AIS data from 2022-2023.

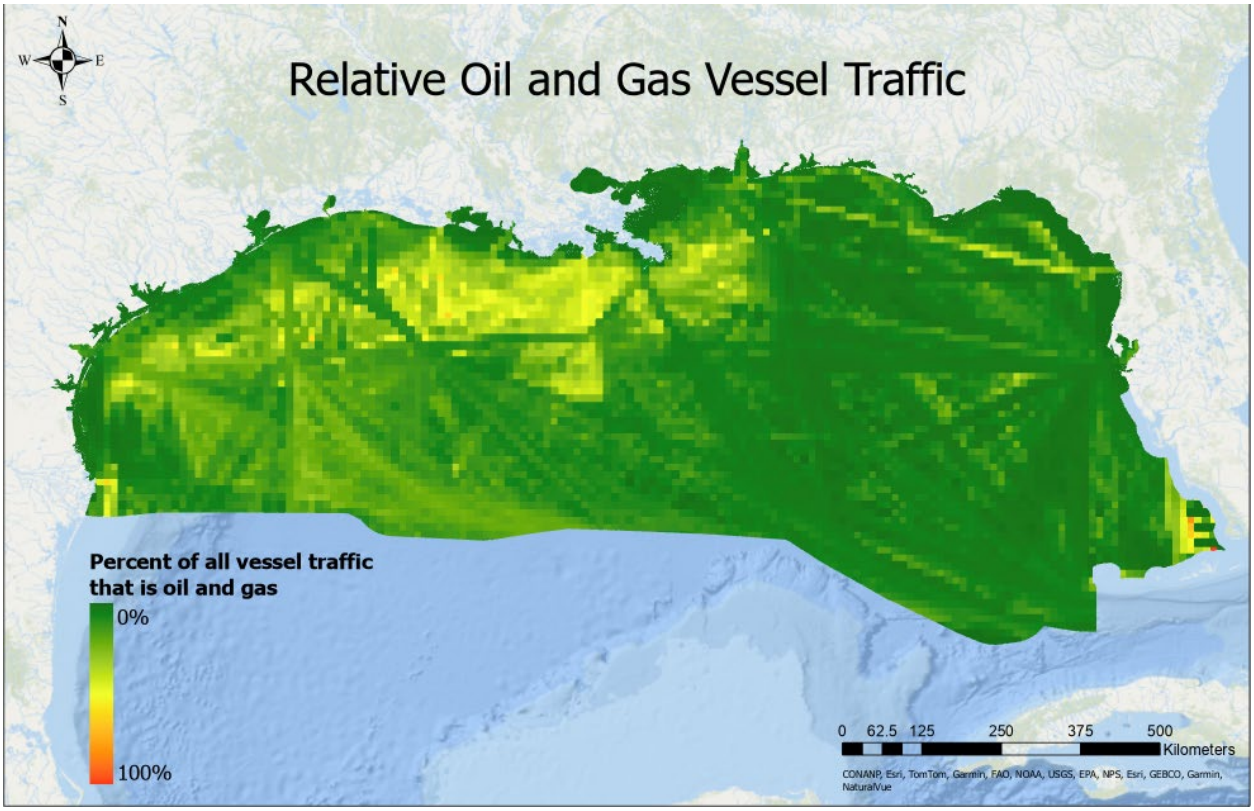


Figure 67. Relative Oil and Gas Vessel Traffic in the Gulf of America. Data represent the percent oil and gas vessel traffic makes up of all vessel traffic in the Gulf of America based on average kilometers (km) of vessel traffic from AIS data from 2022-2023.

Table 38. Summary of vessel traffic in Gulf of America based on AIS data from 2022-2023

Year	All Vessel Traffic (km)	Oil and Gas Vessel Traffic (km)	Oil and Gas Vessel Traffic Percent of All Vessel Traffic
2022	34,577,264	16,491,568	48%
2023	47,065,498	22,905,566	49%
Mean	40,821,381	19,698,567	48%

Several assumptions were made for this exposure analysis given the limitations in available data. First, we assume that the AIS dataset we relied on (2022-2023) is reasonably representative of vessel traffic expected over the course of the next 45 years, including annual fluctuations in activity levels. Second, it assumes that our vessel strike rates calculated from data over a longer time period than the AIS data do not fluctuate significantly, and are similar to the vessel traffic data from 2022-2023. Some of the identified categories in Appendix B may be multi-use vessels used only in part by the Oil and Gas Program. Given the available data, it is not currently possible to parse out the vessel type by activity they are supporting. As a result, several of the

categories may be slightly overestimated for oil and gas. However, this is balanced out by the potential underestimations described in Section 8.1.2.2.

Regarding the first assumption, we currently have no information to suggest vessel traffic patterns will be significantly different in the future than is represented in 2022 and 2023. Furthermore, significant changes in vessel traffic patterns that would alter vessel strike risk could reflect a change in the proposed action or its effects on listed species, and subsequently may trigger reinitiation of consultation. Increases in vessel strike-related stranding events beyond those estimated here could also constitute new information that could trigger reinitiation.

The above AIS dataset is not comprehensive of all vessel traffic, both associated with the Oil and Gas Program and vessel traffic in the Gulf of America overall. This is not only because the data were limited to those vessels that match with the IHS register, but because not all vessels carry AIS equipment. However, we assume that any underestimate of vessel traffic due to these factors is equally represented in all vessel traffic and that associated with the Oil and Gas Program similarly. That is, despite the absolute metrics (e.g., kilometers of vessel traffic) being an underestimate, the relative proportion of oil and gas vessel traffic compared to vessel traffic in the Gulf of America overall is not expected to be biased (displayed in Figure 67). Therefore, the relative proportion of oil and gas related vessel traffic compared to overall vessel traffic in the Gulf of America (Figure 67) is the best estimate that can be produced given the available information.

Despite the assumptions and the limitations noted above, we determined that our vessel strike exposure analysis and preliminary model run represent the best available information on the number of ESA-listed whale and sea turtle species likely to be struck by vessels associated with the Oil and Gas Program.

8.4.2 Whales

The northern Gulf of America is an area with a high level of vessel traffic, which increases the risk of vessel-whale collisions (Rosel et al., 2016). NMFS' final listing of Rice's whale as endangered under the ESA states that vessel collisions are a significant source of mortality for a variety of large coastal whale species (Laist et al. 2001, as cited in 81 FR 88639). Notably, several important commercial shipping lanes cross the primary Rice's whale habitat in the northeastern Gulf of America, particularly vessel traffic from ports in Mobile, Pensacola, Panama City, and Tampa (Figure 17 in Rosel et al., 2016).

The majority of reported lethal vessel strikes of large whales worldwide have occurred when vessels are traveling at speeds greater than approximately 10 knots (Conn and Silber 2013; Jensen and Silber 2004; Laist et al. 2001; Vanderlaan and Taggart 2007a). When a whale is struck by a vessel, responses can include death, serious injury, minor injury, and no apparent effects, with the associated response depending on numerous factors, most notably the size and speed of the vessel (Conn and Silber 2013; Garrison et al. 2025; Jensen and Silber 2004; Kelley et al. 2020; Laist et al. 2001; Vanderlaan and Taggart 2007a). It is important to note that many

strikes may occur and go unnoticed, while others may occur and subsequently go unreported. For example, we are aware of at least one unpublished report from a protected species observer on a seismic vessel that suggests that unreported strikes from Oil and Gas-related vessels could be occurring in the Gulf of America on a fairly regular basis (detailed below).

Both Rice's whales and sperm whales are vulnerable to vessel strikes in the Gulf of America, evidenced by the documented strikes of both species in the region. Based on NMFS' most recent stock assessment reports, there is at least one confirmed vessel strike related mortality of a Rice's whale, which occurred in 2009. The whale was found floating in the Port of Tampa, Tampa Bay, Florida and had evidence of pre-mortem and post-mortem blunt trauma. The cause of death was determined to be vessel strike and the animal was carried into port draped across the bow of a vessel unbeknownst to the crew (Figure 68). In addition, in 2019 there was a sighting of a free-swimming Rice's whale with a spinal deformation consistent with a vessel strike at some point in the past (Rosel et al. 2021). There was another Rice's whale that stranded in the Everglades in 2019, and while it was determined to have died from hemorrhaging and acute gastric necrosis in its second stomach chamber caused by a sharp piece of plastic the whale ingested, experts at the Smithsonian report evidence of a ship strike to the specimen found in a healed break in its scapula and one of its ribs (Leclerc 2021).



Figure 68. Photograph of Rice's whale on bow of cargo ship (source: http://www.professionalmariner.com/October-November-2013/whale-zones/ accessed June 26, 2019)

For sperm whales, there have been two recorded instances of lethal vessel strikes over the past 34 years. Most recently on December 10, 2020 an oil and gas vessel operator reported that they fatally struck a sperm whale in 1,100 meter water depths in transit back to Galveston, Texas. The vessel was travelling at 12 kt. While the operator did not observe a whale prior to collision, once the vessel circled back to evaluate, there were two or three other sperm whales observed logging

in the area. Prior to 2020, there is one possible lethal strike which occurred in 1990, and we are aware of at least one non-lethal vessel strike of a sperm whale based on photographs of likely vessel strike wounds (see further discussion and photo below (ACCOBAMS 2005)). In addition, the U.S. Navy USS BUCKLEY reported striking a whale in the Gulf of America (report to NMFS on June 25, 2001). The animal was determined to be a sperm whale due to the location of the event and the presumed size of the animal struck, but its ultimate fate was unknown.

Whale behavior and life history also factor into the risk of collision with vessels. For instance, sperm whales often exhibit a lack of response to oncoming vessels, which suggests the whales may not hear or see vessels approaching, or are habituated to the high level of vessel activity in the Gulf of America. On September 6, 2013, a protected species observer on a seismic survey vessel reported seven sperm whales directly ahead of the vessel. After a shallow dive of several minutes, the whales resurfaced near the same position of their dive about 1,500 m off the vessel's bow. The whales continued to log and blow at the surface as the vessel approached within 500 m. The vessel shut down its airgun array, but the whales continued to log directly off the vessel's bow. The vessel took evasive action and made a hard turn to port to avoid striking the group of sperm whales. The avoidance maneuver was successful and a strike was avoided based on subsequent sighting of the whales 40 m off the starboard side of the vessel. Photographic evidence taken during the close approach indicated a healed injury on one of the whales that could have been the result of a vessel strike (Figure 69).



Figure 69. Photograph from the Keathley Canyon Area of the Gulf of America of a sperm whale with a healed wound likely caused by a vessel strike. (Photo credit: RPS)

Rice's whales may be at risk for vessel strikes because of their unique foraging behavior. Tagging studies show that this species spends the majority of the nighttime near the surface, where they may be susceptible to collision with vessels. Diving behavior was the focus of a

study by Soldevilla et al. (2017) in which a Rice's whale was suction tagged with an acoustic and kinematic data-logger in 310 m water depth. A diel dive pattern with deeper dives during the day and shallower dives at night was recorded. This whale spent 47% of its time during daylight hours and 88% of its time during nighttime hours within 15 m of the surface, with 70% of total time within 15 m of the surface. Kok et al. (2023) found similar results by tracking the movements of individually tagged whales to evaluate foraging behavior. Notably, the whales stayed close to the sea surface at night, spending between 45-52% of the time within 2 m of the surface and 85% of the time within 15m of the surface, and making shallow dives <10 m with occasional deep foraging lunges (Soldevilla et al. 2023). The amount of time Rice's whales spend at or near the water surface makes them vulnerable to being struck by vessels, although perhaps not as vulnerable as some other species that spend even more time near the surface, such as North Atlantic right whales (Blondin et al. 2025). Field biologists frequently characterize Bryde's whales and Rice's whales as displaying erratic and strange behavior compared to other baleen whales because they surface for irregularly spaced time intervals and can unexpectedly change directions. These behavioral factors make Rice's whales vulnerable to being struck by vessels, especially at night in lower visibility conditions.

BOEM and BSEE currently require oil and gas operators to take evasive actions to avoid hitting any marine mammal and report any strikes that occur in the Gulf of America NTL 2016-G01 (reissued on June 19, 2020) as required by previous biological opinions. Operators are also required to maintain a vigilant watch for marine mammals and sea turtles to avoid collision, and to report any injured or dead protected species. BOEM has proposed to continue this NTL as a programmatically applied protocol (see Attachment 3) for all oil and gas operations in the Gulf of America and, as such, we consider this aspect of the proposed action in our analysis of the effects of vessel strikes on ESA-listed whales. Although there have been few reports or observations of vessel strikes of whales by oil and gas related vessels since the issuance of the 2020 opinion, this should not be interpreted to mean that no strikes have occurred as the vast majority of marine mammal vessel strikes go undetected (Jensen and Silber 2004). With the sperm whale strike that was reported (December 2020), the vessel crew did not observe the animals in advance, and experienced the collision as if it was "similar to hitting a big wave," which could go unnoticed on other vessels depending on circumstances.

8.4.2.1 Whale Vessel Strike Risk

We estimate the total number of sperm and Rice's whales likely to be struck by vessels associated with the proposed action. In general, sperm and baleen whales are expected to exhibit a range of responses to vessel strikes ranging from instantaneous mortality in the most severe cases, to no injuries and perhaps a short-term behavioral reaction in response to being merely "bumped" by a vessel. Many factors likely affect the ability of whales to detect and avoid oncoming vessels and these same factors likely influence a whale's response. The amount of time an animal spends at the surface, its awareness of an approaching vessel, reaction time, and behavioral response, or lack of a response, are important factors to consider. In some cases,

animals may respond to an oncoming vessel in ways that allow it to entirely avoid being struck. Any avoidance of vessels by whales is considered an advantageous response to avoid a potential threat, such as may occur in response to a predator such as killer whales.

If a whale does not respond with avoidance and ends up being struck by a vessel, severity of the response is likely to vary with a variety of factors related to the vessel and animal in the particular circumstance, but most notably vessel speed. Researchers have found that the lethality of the collision increases with vessel speed. Vanderlaan and Taggart (2007b) found the probability of a lethal strike increased from 20% to 100% at speeds between nine and 20 kt, and that lethality from vessel strike increased most rapidly between 10 and 14 kt. Similar results were reported by Conn and Silber (2013), as well as in a recent study by Garrison et al. (2025), which builds on and corroborates this earlier work and also found that vessel size and whale species influence the lethality of a strike. In addition, Silber et al. (2010b) found that increased vessel speed increased the hydrodynamic draw of vessels that could result in right whales (and likely other species) being pulled towards vessels making them more vulnerable to collisions and increasing the magnitude of impact. Therefore, slowing vessel speeds in areas frequently occupied by whales is likely to be an effective mitigation measure to reduce vessel strike risk.

To estimate the number of vessel strikes of Rice's and sperm whales that will result from the Oil and Gas Program, we combined information on vessel traffic from the aforementioned AIS dataset with data on Rice's and sperm whale distribution and density as described in Section 8.1.2.1 in order to quantify the co-occurrence of whales and vessels. By accounting for vessel speed, we quantified the total expected number of vessel strikes as well as the number of strikes expected to result in mortality or serious injuries.

In general, our analysis follows the following basic steps (species specific details are broken down below for sperm whales and Rice's whales):

1. Calculate the amount of oil and gas related traffic and all vessel traffic (kilometers of vessel traffic) in the standardized grid within the action area (Figure 65 and Figure 66), by month and year.
2. Calculate the predicted abundance of the species within the same grid cells within the action area (based on density data described in Section 8.1.2.1). For each species, the raw monthly density rasters were interpolated to the action area grid cells using Zonal Statistics, resulting in a mean density value for each grid cell. This was completed through an ArcGIS script model.
3. Multiply the total kilometers of all vessel traffic and oil and gas vessel traffic by mean species density in each grid cell in order to derive a metric that quantifies vessel strike risk (i.e., co-occurrence of vessel traffic and animals) of each species based on both types (oil and gas and all) of vessel traffic.
4. By year, sum vessel strike risk associated with all vessel traffic and oil and gas vessel traffic across all grid cells in the action area to provide Gulf-wide measures of vessel

strike risk. Importantly, these measures of vessel strike risk are spatially explicit and take into account the amount of vessel traffic (oil and gas related or all) and its geographic distribution relative to the distribution and abundance of the species.

5. Estimate the relative proportion of vessel strike risk of each species associated with oil and gas vessel traffic by dividing the estimated vessel strike risk associated with oil and gas vessels by the vessel strike risk associated with all vessels.
6. Estimate incidents of historic vessel strikes of each species using data on stranded animals where the cause of death was likely a vessel strike, information on carcass recovery rates, and information on the relative proportion of strikes likely to result in death compared to minor/no injuries.
7. Estimate the proportion of historic incidents of vessel strikes associated with oil and gas vessel traffic in the action area by multiplying the relative proportion of vessel strike risk associated oil and gas vessel traffic (from Step 5) by the estimated historic incidents of vessel strikes (from Step 6), assuming these historic estimates are representative of what is likely to occur in the future under the proposed action.

All steps of the analysis were carried out per month, per year, and summarized annually, and no rounding occurred until the final estimates were produced. To use as the best estimate of vessel strike risk from oil and gas-related vessel traffic that may occur in any given year, final annual estimates were based on the mean vessel strike risk associated with the Oil and Gas Program for each species.

We conducted the analysis incorporating vessel speed to assess strikes resulting in serious injury and/or mortality, and strikes resulting in minor or no injuries. We examined information on vessel strikes that resulted in serious injury or mortality as a function of speed. The best available scientific data indicate that vessels traveling faster have an increased likelihood of causing serious injury or mortality of large whales (Conn and Silber 2013; Pace and Silber 2005; Silber et al. 2010a; Vanderlaan and Taggart 2007a). Thus, when estimating the number of vessel strikes likely to result in serious injury or mortality of sperm and Rice's whales, we focused on vessel traffic traveling at speeds greater than 10 knots. According to the data presented in Conn and Silber (2013); Jensen and Silber (2004); Pace and Silber (2005); Van Waerbeek and Leaper (2008); Vanderlaan and Taggart (2007a), Kelley et al. (2020), and Garrison et al. (2025) vessels traveling equal to or less than 10 knots are capable of causing serious injury or mortality, but such events represent a relatively small proportion of known lethal vessel strikes. Therefore, it is reasonable to use a 10 knot threshold to estimate vessel strikes likely to result in serious injury or mortality of sperm and Rice's whales. In using a 10 kt threshold, we assume that all vessel strikes occurring at speeds of 10 kt or greater are likely to result in serious injury or mortality. This approach may underrepresent vessel-related mortality at speeds equal to and below 10 kt, while potentially overestimating such mortality at speeds greater than 10 kt. Given this balance, we determined that 10 kt was an appropriate cut off speed for estimating the risk of serious

injury or mortality to sperm and Rice's whales from vessel strikes that are reasonably certain to occur because of the Oil and Gas Program.

When estimating the number of vessel strikes likely to result in minor or no injuries, we used vessel traffic of all speeds because the available data suggest that vessel strikes resulting in minor or no injuries occur both above and below 10 kt at reasonable levels, though clearly, as vessel speed increases, the occurrence of less severe effects diminish (Pace and Silber 2005; Vanderlaan and Taggart 2007a). In addition, because stranding data primarily provide information on lethal vessel strikes, we relied on literature reports of the proportion of all documented vessel strikes where the fate of the animal was known that caused minor or no injuries. We relied on Laist et al. (2001), Van Waerbeek and Leaper (2008), Peel et al. (2018), Garrison et al. (2025), and a database of global vessel strikes of cetaceans from the (IWC 2010) which provide the best available information on the percent of all vessel strikes likely to result in minor or no injuries. A summary of these data is presented in Table 39. Van Waerbeek and Leaper (2008) and the IWC database included a category of vessel strikes that resulted in "indeterminate visible injury," which could describe serious or minor injuries. We included these in our calculations of the percent strikes of known fate resulting in minor or no injury. Because we are estimating the incidence of strikes that result in minor or no injury from already derived estimates of strikes that resulted in mortality, excluding these cases would produce a lower estimate of the number of strikes that resulted in minor and no injury, and, in turn, total vessel strikes. Based on the average of these data, we assume that approximately 28% of documented vessel strikes resulted in minor or no injuries, and use this value in our analyses below.

Table 39. Summary of studies reporting the percent vessel strike resulting in minor or no injuries

Source	Percent strikes of known fate resulting in minor or no injury	Author Description of Fate
Peel et al. 2018 (assumed large whales)	25.00%	unharmed
Laist et al. 2001 (large whales)	21.00%	Minor injuries or no apparent effect
Van Waerbeek and Leaper 2008 (includes all cetaceans)	17.51%	Apparently minor external injury, Indeterminate visible injury
Garrison et al. 2025	60.0%	Minor abrasions, no blood observed in water, normal whale behavior post interaction
IWC 2010 Database (mysticetes and large odontocetes only)	15.18%	Apparently minor external injury, Indeterminate visible injury
Mean	27.74%	

Sperm Whale

The first step of our vessel strike risk analysis for sperm whales was to calculate the kilometers of vessel traffic (for both oil and gas-related and all vessel traffic for all vessel speeds and traffic

greater than 10 kt) and abundance of sperm whales in each grid cell in the action area. We relied on the AIS data described above (e.g., Figure 65, Figure 66) and the density estimates described in Section 8.1.2.1. Next, we multiplied the kilometers of vessel traffic in each cell (for oil and gas-related and all vessel traffic and for all vessel speeds and speeds greater than 10 kt) by the abundance of sperm whales in each grid cell to quantify vessel strike risk. To illustrate this process, in Figure 70, we depict the average vessel strike risk to sperm whales associated with oil and gas-related vessel traffic greater than 10 kt. We scaled these data from 0 to 100% by dividing each cell's risk by the maximum risk calculated in the dataset. The figure below depicts a cell's risk relative to the cell with the highest risk.

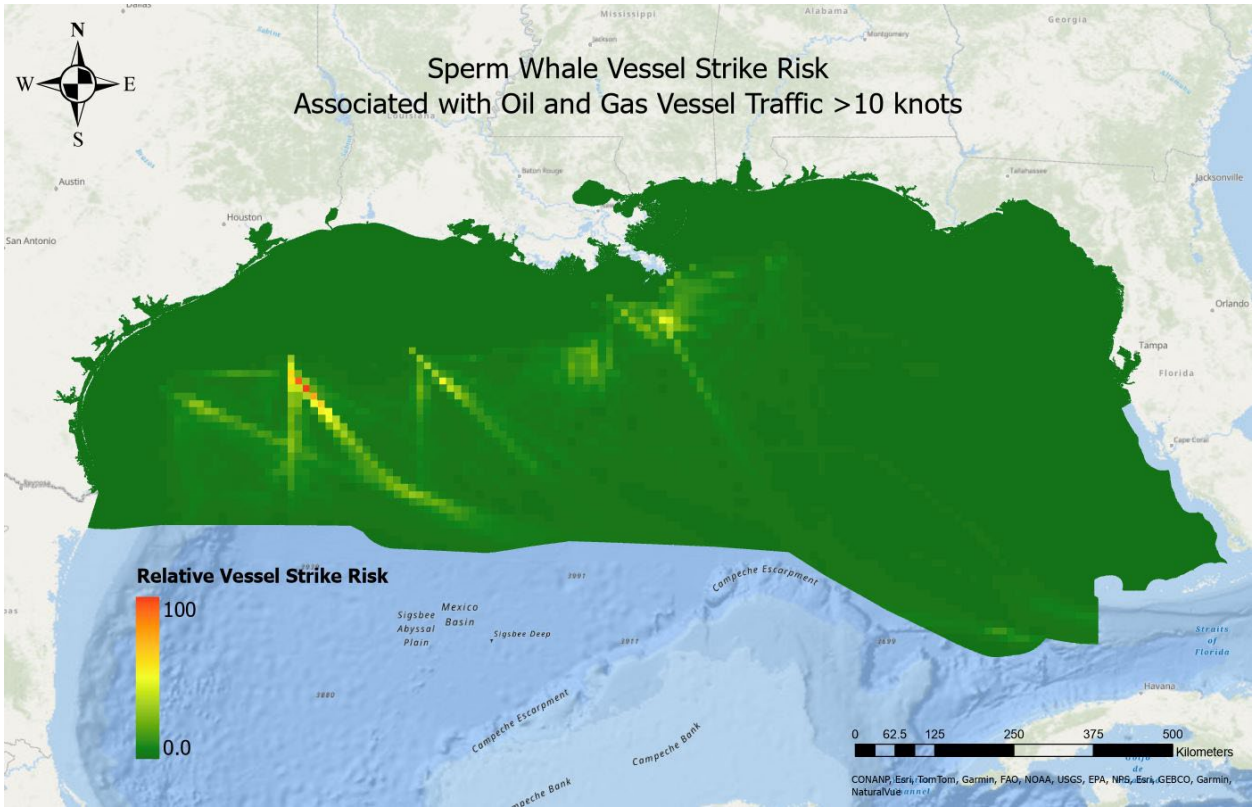


Figure 70. Relative vessel strike risk to sperm whales from oil and gas vessel traffic greater than 10 kt from 2022-2023.

We then summed the vessel strike risk for traffic of all speeds and that greater than 10 kt across grid cells for all vessel traffic and oil and gas-related vessel traffic, and calculated the proportion of vessel strike risk within the action area, per year, associated with oil and gas vessel traffic (Table 40). Based on these data, oil and gas-related vessel traffic accounts for approximately 34% of the vessel strike risk sperm whales face in the Gulf of America from vessels traveling at all speeds and approximately 29% of the risk faced by vessels traveling at greater than 10 kt. Importantly, this risk takes into account the geographic distribution of vessel traffic and sperm whale density, as well as the differential risks associated with vessels traveling at different speeds.

As noted previously, as part of their action, BOEM/BSEE adopted the RPA from the 2020 opinion, which includes a 10-kt speed reduction and no nighttime vessel traffic for oil and gas program-related traffic in an area referred to as the Rice's Whale Area, or RWA, an area in the eastern Gulf of Americawhere Rice's whales have frequently been observed. Because this measure has been in place since 2020 and we only rely on AIS data from 2022 and 2023, the effects of this measure are already accounted for in the above analysis. That is, any slowing down of vessel traffic or reduced traffic at night that has resulted from the current restrictions is already reflected in the vessel traffic patterns in this area from 2022 and 2023, and, because there are no changes proposed to these measures, we assume the traffic in the RWA is representative of what it will be like in the future for the timeframe considered in this opinion.

Table 40. Vessel strike risk of sperm whales associated with oil and gas vessel traffic

Year	Proportion of Vessel Strike Risk due to Oil and Gas Vessel Traffic All Speeds	Proportion of Vessel Strike Risk due to Oil and Gas Vessel Traffic > 10 knots
2022	32%	27%
2023	35%	30%
Mean	34%	29%

Next, we apply information relevant to observed strikes and the vessel strike risk proportions to estimate the total number of sperm whales likely to be seriously injured or killed due to oil and gas traffic in the action area. First, we estimate the total number of vessel strikes of sperm whales in the Gulf of America that have occurred to date based on the best available information. As noted previously, we are aware of two incidents of a likely lethal vessel strike of a sperm whale in the Gulf of America, which occurred in 1990 and 2020. However, the vast majority of whales struck by vessels are likely not observed because they may sink, be eaten by scavengers, or be transported far away by ocean currents. As such, we divided the two documented lethal strikes by a carcass recovery rate of 3.4%, that is, the estimated percent of animals that die at sea that are actually recovered via stranding and response efforts, as estimated by Williams et al. (2011) to correct for the unobserved lethal vessel strikes. This results in an estimated total of 58.83 vessel strikes between 1990 and 2024 (35 years), which is the date range for the best available data of stranding records for sperm whales in the Gulf of America, and an estimated annual rate of 1.68 lethal sperm whales vessel strikes per year. To estimate the proportion of this annual rate likely associated with oil and gas vessel traffic, we multiplied the annual rate of 1.68 by the mean proportion of vessel strike risk due to oil and gas-related vessel traffic greater than 10 knots (29%, Table 37), which results in an estimated annual rate of 0.49 lethal sperm whale strikes per year from oil and gas-related vessel traffic. Over the course of the 45-year time period covered by this opinion, this would amount to approximately 22 sperm whales being killed or

seriously injured (as noted before, serious injuries are assumed to result in mortality and, thus, would be represented in stranding records), as a direct result of oil and gas vessel traffic.

To estimate the number of vessel strikes of sperm whales likely to result in minor or no injuries, we relied on our above estimate of the number of vessel strikes of sperm whales likely to result in serious injury or mortality, and estimates of the percentage of vessel strikes likely to result in different types of injuries. Previously, we estimated 58.83 vessel strikes of sperm whales between 1990 and 2024 that likely resulted in serious injury or mortality and, from our review of the literature, approximately 27.74% of documented vessel strikes result in minor or no injuries. From this information, we can estimate the number of vessel strikes likely to have resulted in no or minor injuries according to equation (1):

(1)

$$VS_{ni/mi} = \frac{VS_{si/m}}{1 - P_{ni/mi}} - VS_{si/m}$$

where VSni/mi equals the estimated number of vessel strikes likely to have resulted in no injury or minor injury, Pni/mi is the percent of documented vessel strikes that resulted in minor or no injuries (27.74%), and VSsi/m is the estimated number of vessel strikes likely to have resulted in serious injury or mortality (58.83). From this equation, we estimate that, between 1990 and 2024, there were approximately 23 vessel strikes of sperm whales that likely resulted in minor or no injuries, which is an annual rate of approximately 0.65 strikes resulting in minor or no injuries of sperm whales per year. To estimate the proportion due to oil and gas-related vessel traffic, we multiplied this annual rate by the maximum proportion of vessel strike risk from oil and gas-related vessel traffic of all speeds (34%; Table 37), which results in an estimated annual rate of 0.22 vessel strikes likely to result in no or minor injuries of sperm whale per year from oil and gas-related vessel traffic. Over the course of the 45 years covered by this opinion, this would amount to approximately 10 sperm whales being struck by a vessel with minor or no injuries because of oil and gas-related vessel traffic.

In summary, for the duration covered by this opinion, the proposed action is likely to result in a total of 32 vessel strikes of sperm whales, with 22 strikes being likely to result in serious injury or mortality and 10 strikes likely to result in minor or no injuries. Based on a 72:28 female to male ratio in the Gulf of America (Engelhaupt et al. 2009), we expect approximately 23 of these strikes to be of females (up to 16 serious injury and mortality and seven minor or no injury) and nine to be of males (up to six serious injury and mortality and three minor or no injury). In addition, based on the DWH injury assessment, which estimated that calves make up approximately 11% of the population of sperm whales in the Gulf of America (Trustees 2016), we estimate that four of these strikes will likely be calves (three serious injury and mortality, and one minor or no injury), but we interpret this as a minimum estimate for calves because they spend considerably more time near the surface than foraging adults and immature whales and, if struck, may be more likely to be killed given their smaller size.

Rice's Whale

The Rice's whale vessel strike analysis followed the approach described above. The first step of our vessel strike risk analysis for Rice's whales was to calculate the kilometers of vessel traffic (for both oil and gas-related and all vessel traffic for all vessel speeds and traffic greater than 10 kt) and assumed abundance of Rice's whales in each grid cell in the action area. The same AIS vessel traffic data described above were used, along with the density estimates for Rice's whale described in Section 8.1.2.1. Next, we multiplied the kilometers of vessel traffic in each cell (for oil and gas-related and all vessel traffic and for all vessel speeds and speeds greater than 10 kt) by the abundance of Rice's whales in each grid cell to quantify vessel strike risk based on both types of vessel traffic. Below is a visual representation of the resulting average vessel strike risk associated with all oil and gas-related vessel traffic greater than 10 kt (Figure 71).

To calculate vessel strike risk in the entire action area, we summed the vessel strike risk for traffic of all speeds and for that greater than 10 kt across grid cells for both all vessel traffic and oil and gas-related vessel traffic, and then calculated the proportion of risk within the action area, per year, associated with oil and gas vessel traffic (Table 39). Based on these calculations, oil and gas vessel traffic accounts for approximately 34% of the vessel strike risk Rice's whales face in the Gulf of America from vessels traveling at all speeds and 27% of the risk Rice's whales face from vessels traveling greater than 10 kt. As for sperm whales, this risk explicitly accounts for the geographic distribution of vessel traffic and Rice's whale density, as well as the differential risk associated with vessels traveling at different speeds.

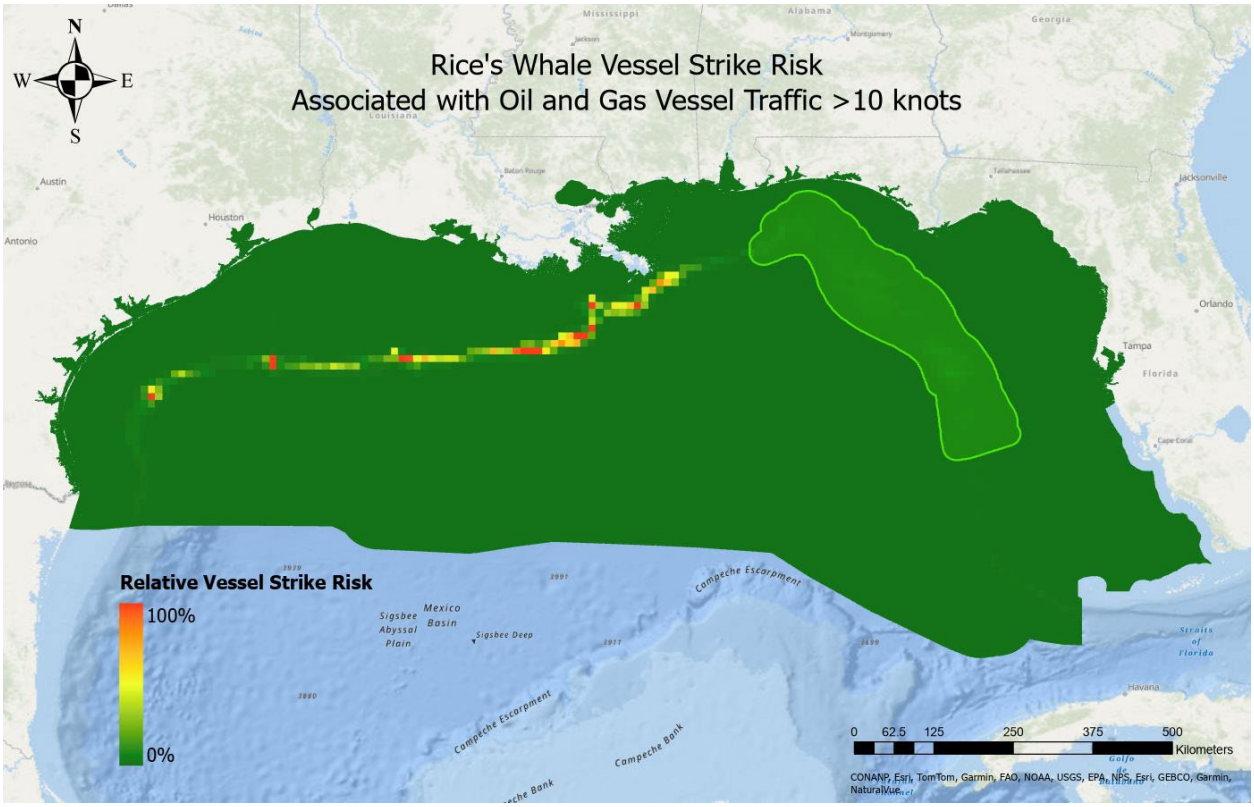


Figure 71. Relative vessel strike risk to Rice's whales from oil and gas vessel traffic greater than 10 kt from 2022-2023.

Table 41. Vessel strike risk of Rice's whales associated with oil and gas vessel traffic

Year	Proportion of Vessel Strike Risk due to Oil and Gas Vessel Traffic All Speeds	Proportion of Vessel Strike Risk due to Oil and Gas Vessel Traffic > 10 knots
2022	35%	27%
2023	34%	27%
Mean	34%	27%

Next, to estimate the number of strikes of Rice's whales, we estimate the total number of vessel strikes of Rice's whales in the Gulf of America that have occurred to date based on the best available information. As noted previously, we are aware of only one reported incident of a lethal vessel strike of a Rice's whale in the Gulf of America, which occurred in 2009 and was reported by a Florida port authority (vessel type unknown). In order to account for unobserved lethal strikes of Rice's whale, we sought information on carcass recovery rates. However, unlike for sperm whales, Williams et al. (2011) did not estimate carcass recovery rates for Rice's whales in the Gulf of America. Carcass recovery rates have been estimated for various other cetacean species, including a rate of 17% for right whales, 6.5% for killer whales, less than 5% for grey whales, and 3.4% for sperm whales. In modelling vessel strike mortality for three baleen whales species off the coast of California, Rockwood et al. (2017) used a recovery rate of 17%, based on right whales, to produce minimum strike estimates and a 5% recovery rate (the mean of grey, killer and sperm whales) as a best estimate. The higher rate for right whales is based on their increased buoyancy compared to other species (Rockwood et al. 2017). In contrast, being a temperate and resident species, the Rice's whale likely has less blubber because they are non-migratory and live in warmer waters.

Therefore, we divided the one known lethal vessel strike of Rice's whales by the Rockwood et al. (2017) 5% carcass recovery rate to account for unobserved vessel strikes for Rice's whales. This results in a total of 20 vessel strikes between 2002 and 2024 (23 years total), which is the date range for the best available data of stranding records for Rice's whales in the Gulf of America, and an estimated annual rate of 0.87 lethal Rice's whale vessel strikes. To estimate the proportion of this annual rate associated with oil and gas vessel traffic we multiplied the annual rate of 0.87 by the mean estimate of the proportion of vessel strike risk to Rice's whales due to oil and gas-related vessel traffic greater than 10 knots (27%; Table 39), which results in an estimate of 0.23 lethal Rice's whale strikes per year from oil and gas program-related vessel traffic. Over the course of the 45-year time period covered by this opinion, this would amount to approximately 11 Rice's whales being killed or seriously injured (as noted before, serious

injuries are assumed likely to result in mortality and, thus, would be represented in stranding records), as a direct result of Oil and Gas Program-related vessel traffic.

In order to estimate the number of vessel strikes of Rice's whales likely to result in minor or no injuries, we relied on the same approach as for sperm whales. From above, we estimated 20 vessel strikes of Rice's whales between 2002 and 2024 that likely resulted in serious injury or mortality. Assuming the same 27.74% of documented vessel strikes that resulted in minor or no injuries as for sperm whales, and using equation (1), we estimate that, between 2002 and 2024, there were approximately 8 vessel strikes of Rice's whales that likely resulted in minor or no injuries, which produces an annual rate of approximately 0.33 strikes per year resulting in minor or no injuries of Rice's whales. To estimate the proportion of these strikes due to oil and gas-related vessel traffic, we multiplied this annual rate by the maximum proportion of vessel strike risk to Rice's whales due to oil and gas-related vessel traffic of all speeds (34%, Table 38), which results in an estimated annual rate of 0.11 vessel strikes likely to result in no or minor injuries per year. Over the course of the 45-year time period covered by this opinion, this would amount to approximately 5 Rice's whales being struck by vessels and experiencing minor or no injuries as a direct result of oil and gas vessel traffic.

As noted previously, our method of estimating vessel strike risk thus far has been based on the co-occurrence of both whales and vessels to estimate vessel strike risk to large whales. Yet other factors such as whale and vessel size and whale diving behavior, among others, are also likely to influence whether or not a strike actually occurs. Some studies have attempted to account for these factors using encounter rate theory (Rockwood et al. 2017), but given the available data when the bulk of the analysis for this Biological Opinion was conducted, we relied on the method described herein based on whale and vessel co-occurrence. However, given Rice's whale's small population size and vulnerability, we supplemented our main vessel strike risk analysis for Rice's whale with a preliminary analysis following the recently published methods of Blondin et al. (2025). Here, we adapted these methods for Rice's whale parameters in the Gulf of America and used density estimates from Garrison et al. (2024) to estimate the number of lethal strikes over the 45-year duration of this opinion. AIS data used for this analysis was limited to 2023 and is similarly derived from the IHS database and defined with BOEM Oil and Gas Program specific vessel types (see above). For this preliminary analysis, we did not derive estimates for strikes likely to result in minor or no injuries.

The most significant difference between the Blondin et al. (2025) method and the co-occurrence method is the incorporation of behavioral characteristics and whale avoidance. Whale body length (mean of 11.6), swim speed (mean of 0.65 m/s), and descent rates (0.9 +/- 0.004 m/s to 2.0 +/- 0.01 m/s) were all incorporated into the probability of whale avoidance to better estimate vessel strike risk for Rice's whale (see model inputs, Figure 72). At this time, there are no data on reaction distance for Rice's whales, so we applied the same whale reaction distances as those used by Blondin et al. 2025 for North Atlantic right whales, which range from 10 to 1,200 m. Because little is known about active avoidance of oncoming vessels by Rice's whales, we also

ran this analysis with the exclusion of the probability of avoidance parameter, which assumes that Rice's whales do not actively avoid an incoming vessel.

It is important to note that we consider the vessel strike output from this model to represent relative risk rather than estimated actual mortality estimates given that at present, we have no way to validate the absolute estimates produced by the model. With this in mind, preliminary model outputs show that in 2023, Oil and Gas Program vessels made up a total of about 2% of all estimated vessel strike risk to Rice's whales in a scenario where whales always attempt to avoid vessels and 11% in a scenario where whales never attempt to avoid incoming vessels.

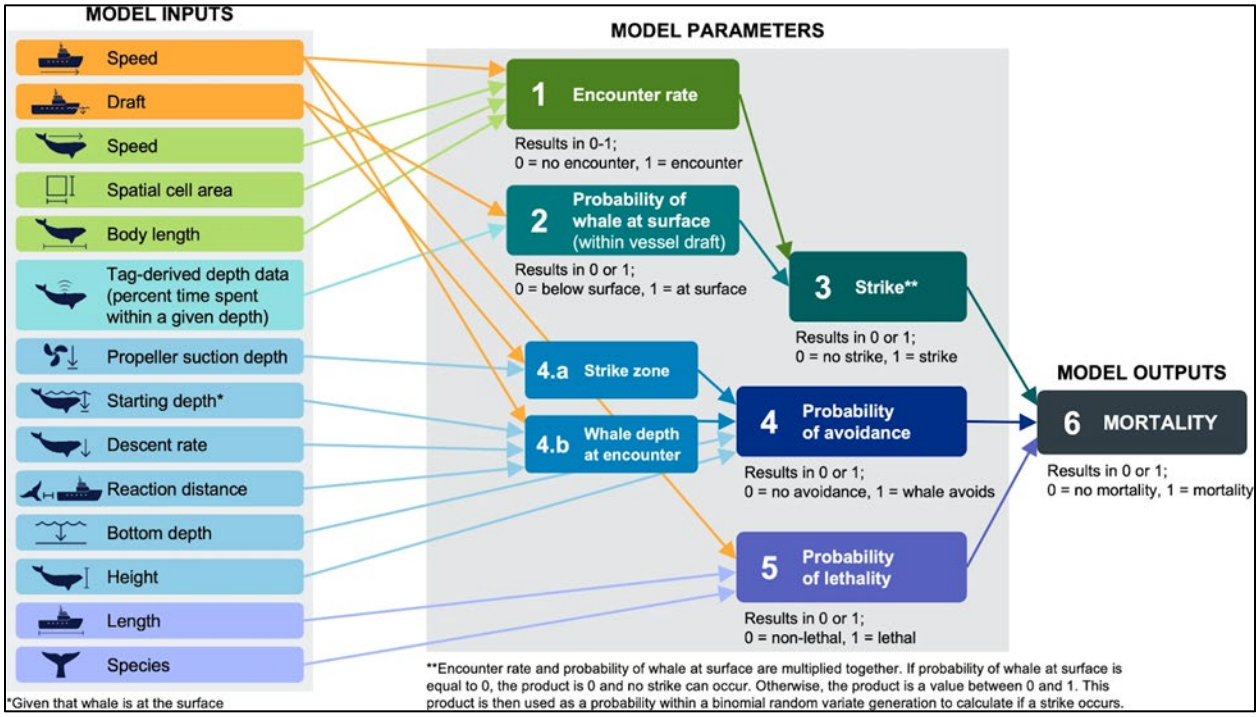


Figure 72. Conceptual diagram from Blondin et al. (2025) displaying how model inputs feed into each model parameter and resulting estimates of mortality.

Utilizing the same calculations used above for both sperm and Rice's whales to approximate number of whales estimated to be struck and seriously injured or killed by vessels as a result of Oil and Gas Program vessel traffic, we substitute the previous estimated risk for Rice's whale (27%) with estimated risk produced by the Blondin et al. (2025) method (2% and 11%). Over the 45 year duration of the Biological Opinion, this would amount to approximately one Rice's whale being struck by Oil and Gas Program vessels if whales were to always avoid vessels and up to five whales being struck assuming no avoidance. Because this was a preliminary run of the model using Rice's whale parameters and is limited to one year of data, this analysis should be rerun in the future using additional data, including refined estimates of swim speeds from more recent tag data and additional years of AIS data. Taken together, based on the outputs from both the co-occurrence method (11 lethal strikes) and the Blondin et al. (2025) model for avoidance (one lethal strike) and no avoidance (five lethal strikes), we estimate that approximately six

Rice's whales (average of the three estimates) would be seriously injured or lethally struck by vessels over 45 years.

In summary, for the duration covered by this opinion, the proposed action is likely to result in a total of 11 vessel strikes of Rice's whales, with six strikes being likely to result in serious injury or mortality and five strikes likely to result in minor or no injuries. These estimates account for the existing speed restrictions for oil and gas program-related vessels in the 2020 Rice's whale area, as these are included as part of the action and are represented in the vessel traffic data from 2022 and 2023.

8.4.3 Sea Turtles

Sea turtles within the action area are at risk of being struck by vessels associated with the action. According to the Northern Gulf Sea Turtle Stranding report for 2015-2019, vessel strike is the dominant injury type for stranded sea turtles in coastal Alabama, Mississippi, and Louisiana, representing between 57.4% and 81.6% of observed stranding injuries depending on the species (Howell et al. 2021). Vessel strike of sea turtles is an increasing concern in the southeastern United States, where development along the coasts has resulted in increased recreational and commercial boat traffic. For instance, Howell et al. (2021) reports an 18% increase in the proportion of loggerhead strandings attributed to vessel strikes from 2010-2014 to 2015-2019. However, compared to the threat of vessel strikes to large whales, much less is known about vessel strike risk for sea turtles, despite collisions being considered a significant source of injury and mortality of sea turtles within the action area.

This analysis only considers Kemp's ridley, loggerhead, green, and leatherback sea turtles. While hawksbills may be sparsely present in the Gulf of America, there are no density data available to estimate exposure of hawksbills to potential vessel strikes (see Section8.1.2). Further, there are only nine hawksbill strandings with evidence of vessel strike in the Gulf from 2015-2013, none of which were in the Northern Gulf, as reported in the Sea Turtle Stranding and Salvage Network (Howell et al. 2021; Howell and Shaver 2021; STSSN 2024). Although lack of stranding data does not indicate that vessel strikes never occur (i.e., a stricken turtle may die in the open ocean and sink to the bottom), given the patchy distribution of hawksbill turtles concentrated in coral reef areas, such as southwest Florida, Dry Tortugas, and Flower Garden Banks, there is likely very limited overlap of areas used by the species and areas frequently used by oil and gas vessels. Therefore, accounting for this best available information, we deem the effect of vessel strike on hawksbill sea turtles to be discountable.

Sea turtles are often injured and killed by collisions with vessels. Based on behavioral observations of turtle avoidance of small vessels, green turtles may be susceptible to vessel strikes at speeds as low as two knots (Hazel et al. 2007). Lethal and nonlethal vessel-strike injuries observed include cracked and crushed carapaces, animals cut in half, missing limbs, propeller cuts, and scars (Chaloupka et al. 2008; Foley et al. 2008b). Although there have been hundreds of thousands of vessel trips in support of offshore operations during the past 40 years

of OCS oil and gas operations, there have been no reports of OCS-related vessels having struck sea turtles. This is likely because a strike with a turtle would go undetected by larger vessels and strikes are not reported. Despite the lack of on-water reporting, stranding records show that interactions between vessels and turtles in the action area are quite common. Vessel strikes affect both juveniles and adults, and can drastically reduce population reproductive rates due to increases in mortality (Foley et al. 2019).

As mentioned above in our vessel strike exposure analysis for whales, BOEM and BSEE currently require oil and gas operators to maintain a vigilant watch for sea turtles and whales to avoid collision, and to report any injured or dead protected species. Because BOEM proposes to continue this NTL for all oil and gas operations in the Gulf of America, we consider this aspect of the Oil and Gas Program in our analysis of the effects of vessel strikes on ESA-listed turtles. To our knowledge, there are no data on NTL effectiveness or compliance, and a lack of vessel strikes of sea turtles by oil and gas-related vessels cannot be interpreted to mean that no strikes have occurred. Thus, while BOEM has mitigation measures to reduce vessel strikes of all ESA-listed sea turtles, we do not have sufficient information to assess their effectiveness at reducing the number or severity of sea turtle vessel strikes. Nevertheless, we concur that they are appropriate measures that should be taken to decrease the likelihood of vessel strikes of ESA-listed sea turtles.

8.4.3.1 Sea Turtle Vessel Strike Risk

To estimate the number of vessel strikes of sea turtles that will result from the Oil and Gas Program, we took the same general approach as described for Rice's and sperm whales above. We combined AIS vessel traffic data with information on the distribution and density of sea turtles (described in Section 8.1.2.2) to estimate the co-occurrence of sea turtles and vessels, i.e., vessel strike risk. Sea turtles may be susceptible to vessel strikes at speeds as low as two knots (Hazel et al. 2007) and even vessels traveling at low speeds pose a substantial risk of mortality (Sapp 2010; Work et al. 2010). Accordingly, in our risk analysis of vessel strikes of sea turtles, we did not differentiate vessel traffic by speed and considered all vessel traffic (i.e., ≥1 knot) to pose a risk of mortality to sea turtles. The same analysis was conducted for all four sea turtle species, we present our vessel strike risk analysis for sea turtles as a group. We conducted separate analyses for large sea turtles (>30 cm in carapace length) and oceanic juvenile sea turtles (<30 cm in carapace length) because the data sources for density data, habitat usage, life history, historic stranding information are different for the life stages (See Section 8.1.2.2).

For both large and small sea turtles, our risk analysis is summarized in the following steps:

1. Calculate the amount of oil and gas related and all vessel traffic (kilometers of vessel traffic) in 10 x 10 kilometer grid cells within the action area (Figure 65 and Figure 66)
2. Calculate the predicted abundance of sea turtles in each grid cell within the action area based on mean monthly density data described in Section 8.1.2.2.

3. Multiply the total kilometers of all vessel traffic and oil and gas vessel traffic in each grid cell by sea turtle abundance (number of animals in each 130 km^2 grid cell) to quantify vessel strike risk (i.e., co-occurrence of vessel traffic and animals) of each sea turtle species based on all vessel traffic and oil and gas related vessel traffic.
4. Sum vessel strike risk associated with all vessel traffic and oil and gas vessel traffic across all grid cells in the action area to provide Gulf-wide measures of vessel strike risk.
5. Estimate the relative proportion of vessel strike risk of each species associated with oil and gas vessel traffic by dividing the estimated vessel strike risk associated with oil and gas vessels by the vessel strike risk associated with all vessels.
6. Estimate incidents of historic vessel strikes of each species using information on stranded sea turtles where the cause of death was likely a vessel strike, and correction factors for unobserved vessel strike mortalities.
7. Estimate the proportion of historic incidents of vessel strikes of sea turtles associated with oil and gas vessel traffic by multiplying the relative proportion of vessel strike risk associated with oil and gas vessel traffic by the estimated historic incidents of vessel strikes. Given the limitations of the data we use as best available science for this analysis, we assume these historic estimates are representative of what is likely to occur in the future under the proposed action.

All steps of the analysis were carried out per month, per year, and summarized annually, and no rounding occurred until the final estimates were produced. Since monthly spatial density estimates for large sea turtles are available, we paired the appropriate abundance estimate with the monthly AIS vessel traffic metrics to quantify vessel strike risk based on temporal changes in both vessel traffic and species density. Monthly density estimates were not available for small sea turtles. To use as the best estimate of vessel strike risk from oil and gas-related vessel traffic that may occur in any given year, final annual estimates were based on the mean vessel strike risk associated with the Oil and Gas Program for each species.

Large Sea Turtles

For steps 1 and 2 outlined above, in our vessel strike risk analysis for large sea turtles, we calculated the kilometers of vessel traffic (for both oil and gas and all vessel traffic for all vessel speeds) and density of large sea turtles of each species in each grid cell in the action area. The same AIS data described previously were used, along with the spatially-explicit, modeled density data for large sea turtles described in Section 8.1.2.2. Next we multiplied the kilometers of vessel traffic in each cell by the abundance of each sea turtle species in each grid cell to quantify vessel strike risk based on both types of vessel traffic. Below are visual representations of the resulting vessel strike risk associated with all oil and gas vessel traffic for large sea turtles of each sea turtle species (Figure 73, Figure 74, Figure 75, and Figure 76).

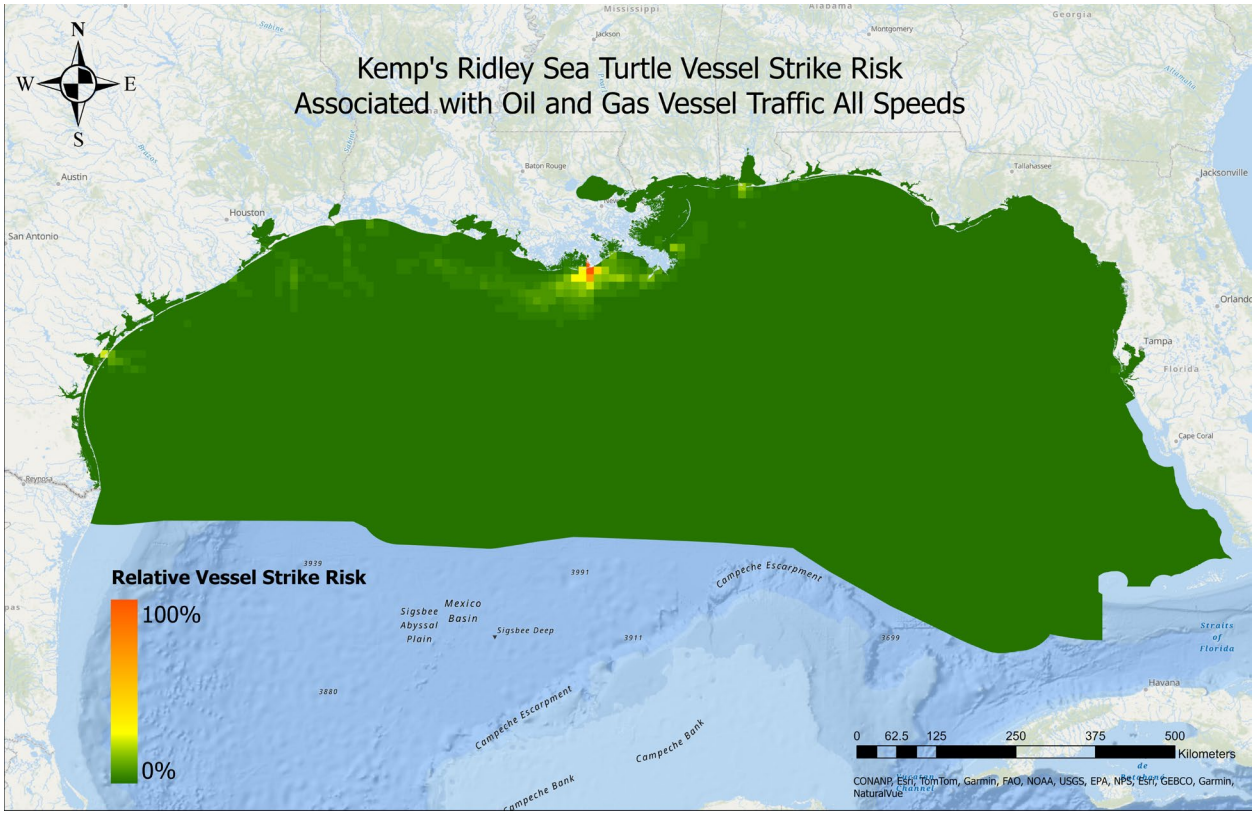


Figure 73. Relative vessel strike risk to large (greater than or equal to 30-cm length) Kemp's Ridley turtles from oil and gas vessel traffic from 2022-2023.

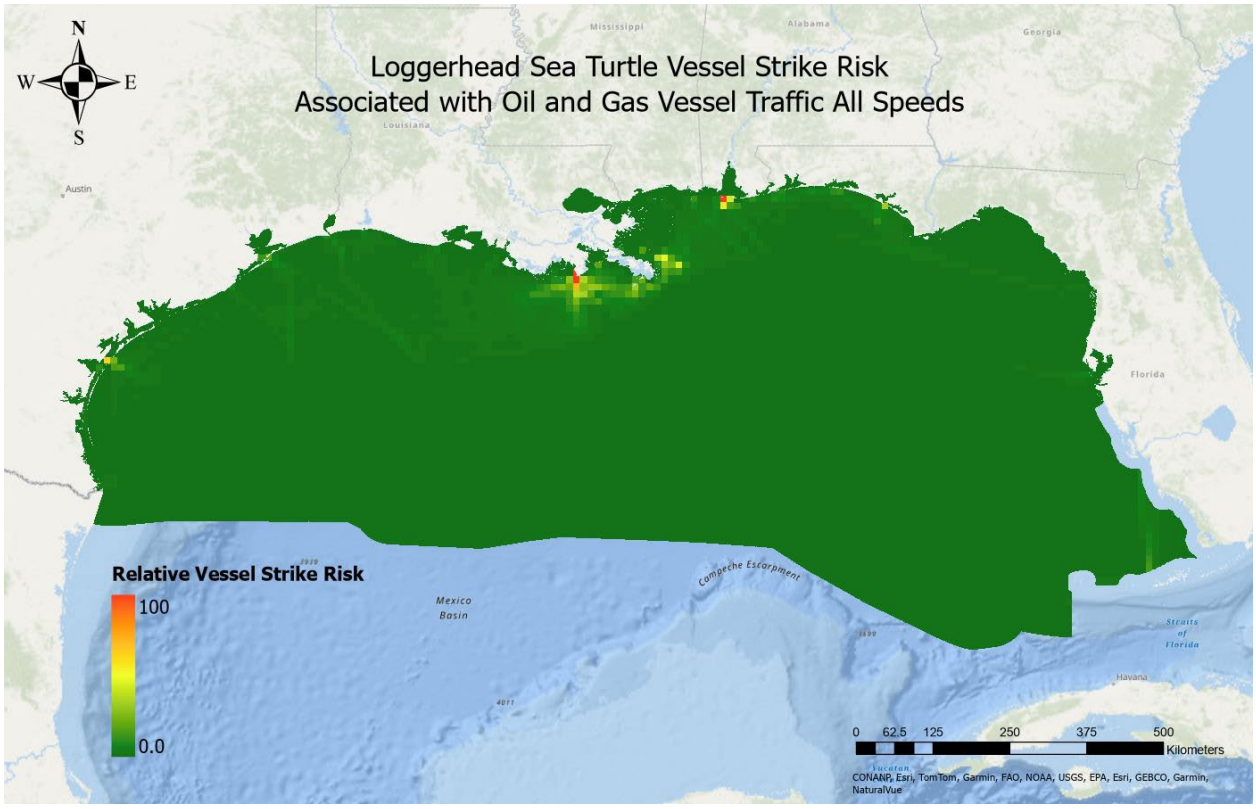


Figure 74. Relative vessel strike risk to large (greater than or equal to 30-cm length) loggerhead sea turtles from oil and gas vessel traffic from 2022-2023.

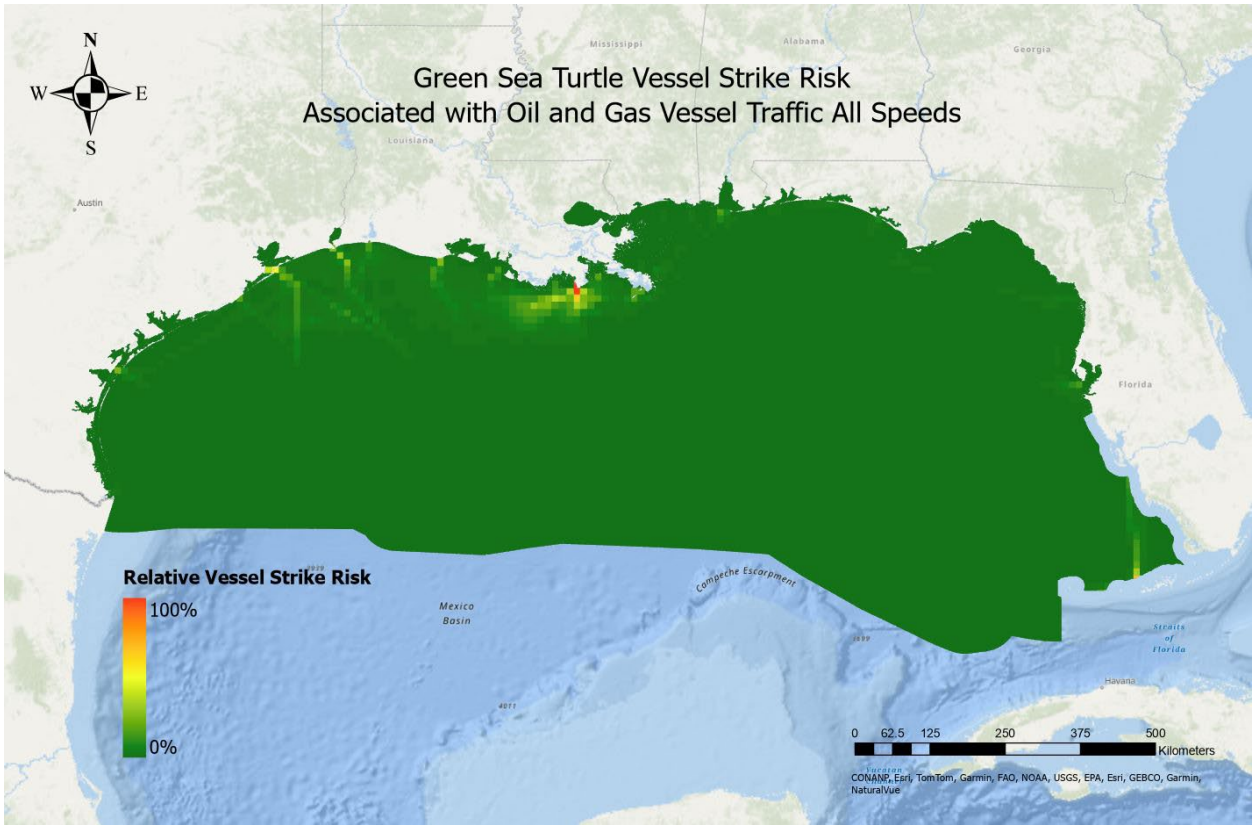


Figure 75. Relative vessel strike risk to large (greater than or equal to 30-cm length) green sea turtles from oil and gas vessel traffic from 2022-2023.

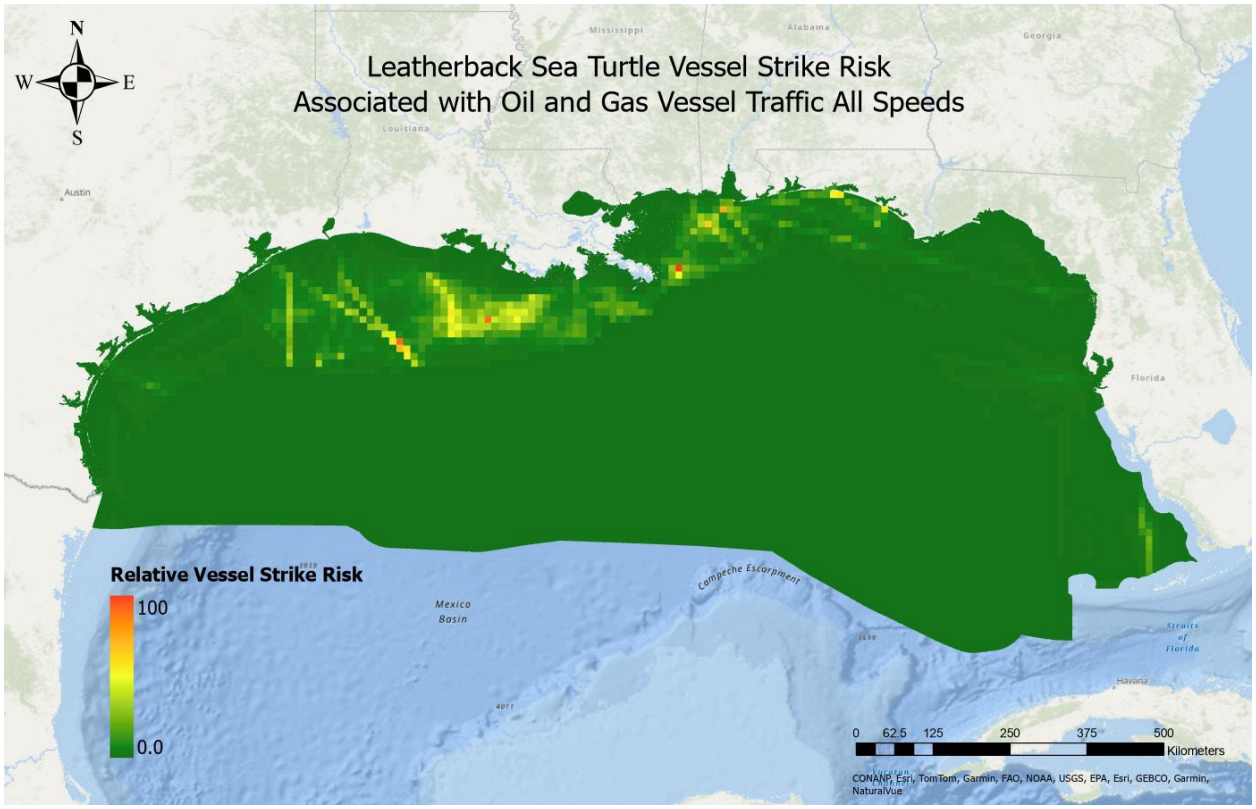


Figure 76. Relative vessel strike risk to large (greater than or equal to 30-cm length) leatherback sea turtles from oil and gas vessel traffic 2022-2023.

Next, we summed the vessel strike risk for traffic of all speeds for: 1) all vessel traffic and 2) oil and gas vessel traffic, and calculated the proportion of vessel strike risk for large sea turtles of each species within the action area, per year, associated with oil and gas vessel traffic (Table 42, Figure 65, Figure 66, and Figure 67). There are likely other factors at play that affect the probability of an actual vessel strike occurring, such as sea turtle and vessel size, turtle diving and encounter/avoidance behavior, and exact vessel speed. We recognize that the analysis may simplify the estimate of risk of turtles to vessels given these data limitations. However, we anticipate that these other factors would equally affect the probability of vessel strikes from oil and gas vessel traffic compared to all vessel traffic, so excluding these factors from our model does not necessarily invalidate the estimates of the relative risk associated with oil and gas vessel traffic alone.

Table 42. Vessel strike risk of large (greater than or equal to 30-cm length) sea turtles associated with oil and gas vessel traffic

Species	Kemp's Ridley Sea Turtles Average = 72%		Loggerhead Sea Turtles Average = 54%		Green Sea Turtles Average = 58		Leatherback Sea Turtles Average = 42%	
Year	2022	2023	2022	2023	2022	2023	2022	2023
Proportion of Vessel Strike Risk due to Oil and Gas Vessel Traffic	72%	72%	54%	54%	57%	59%	42%	42%

To evaluate the likely response of sea turtles to vessel strikes, we reviewed studies evaluating the effect of vessel speed on lethal sea turtle injuries, as well as reported observations of sea turtle behavior in response to oncoming vessels. In tests of carapace damage resulting from vessel strikes of loggerhead sea turtles (Sapp 2010; Work et al. 2010), physical models simulating the shape and strength of loggerhead carapaces were placed in the water and struck at idle speed (3.8 kt), sub-planing speed (7.6 kt), and planing speed (21.6 kt). Vessel strikes at idle speed resulted in lethal damage to the carapace 25% of the time, while all (100%) vessel strikes at planing speed (21.6 kt) resulted in lethal damage. At sub-planing speeds (7.6 kt), the resulting large bow wave helped push the animal out of the way, resulting in no contact with the carapace 38% of the time. Oil and gas vessels may operate at different speeds, but some vessels reach high speeds that could cause death by blunt force trauma if the hull directly hits a turtle. Because the models described above were in a fixed position and directly hit in each test, the actual injury rate in free swimming sea turtles may be different due to the depth, orientation, and behavior in the wild. The studies also did not report the effect of vessel speed on propeller injury, and the results cannot be applied to all vessel-strike scenarios (Sapp 2010; Work et al. 2010). According to Hazel et al. (2007a), sea turtles likely cannot avoid boat collisions unless boats reduce their speed to 2.2 kt, increasing the likelihood that direct strikes on the carapaces from vessels operating at fast speeds will be lethal. Nevertheless, taken together, the best available data suggest that collisions with vessels even at very low speeds can be lethal for sea turtles. Given this, and the lack of data on non-lethal vessel strikes of sea turtles in the Gulf of America, for our analysis we focus on estimating lethal vessel strikes. In doing so we rely on stranding data of sea turtles with evidence of vessel strike and apply a correction factor for unobserved vessel strikes that we believe reasonably captures and corrects for any non-lethal strikes that may be occur as a result of the proposed action.

To estimate the number of vessel strikes of large sea turtles due to the proposed action, we relied on data from NMFS' Sea Turtle Stranding and Salvage Network (STSSN)[35], which consists of

[35] See more information at: https://www.sefsc.noaa.gov/species/turtles/strandings.htm. Data credits courtesy of Alabama Sea Turtle Stranding and Salvage Network, the Florida Sea Turtle Stranding and Salvage Network, the Louisiana Sea Turtle Stranding and Salvage Network, Mississippi Sea Turtle Stranding and Salvage Network, and Texas Sea Turtle Stranding and Salvage Network.

records of stranded sea turtles, primarily large ones, throughout the action area in Texas, Louisiana, Mississippi, Alabama, and the Gulf coast of Florida. Any sea turtle located on land or in the water that is either dead or alive but cannot undergo normal behaviors (e.g., swimming, diving, feeding) is considered "stranded" and is documented by the STSSN. We used the most recent complete 10-year, fully verified dataset from the STSSN from 2015 through December 2023. We queried the STSSN database for records of "traditionally stranded" sea turtles with evidence of definitive vessel strike or blunt force injury. A definitive vessel-strike injury is a discrete linear or curvilinear chop wound. In stranded sea turtles, chop wounds are almost always created by the propeller, skeg, or rudder (all are edged objects) of a motorized watercraft (providing the force necessary to create these wounds). This injury is most often seen in the carapace but can also be found on the head or plastron.[36] Blunt force injuries result in fractures of the head, carapace, or plastron. These injuries often involve large or discrete areas of the body, depressing (crushing) the fractured bone, lacerating (tearing) the skin, and/or resulting in exposure of organs or soft tissue. Such injuries often result from impact with various components of vessels but are inherently less specific. However, vessels are the most common cause of such wounds due to the force required to inflict these injuries and the high probability of vessel strikes relative to other possible causes.[37] Blunt force injuries often accompany definitive vessel strike injuries, but documentation procedures used by the network avoid double counting.

Using these data, we separated the data to large and small sea turtles by evaluating cases where the recorded standard straight carapace length or standard curved carapace length was greater than or less than 30 cm (and assumed that where no measurements were included, the turtles were large sea turtles). We excluded cases in which a vessel strike or blunt force was not recorded (as noted in the stranding event record) and any rare cases where the sea turtle was able to be released shortly after the stranding (i.e., the injury was non-lethal, no rehabilitation was necessary). Thus, only records in which the sea turtle was dead upon stranding, required rehabilitation, or was deemed non-releasable (and thus was removed from the population) were used. While we recognize that some vessel strikes may be postmortem, the available data indicate that postmortem vessel strike injuries are uncommon in stranded sea turtles (Foley et al. 2019). Thus, even for those STSSN records of stranded sea turtles with evidence of vessel strike that did not undergo a full necropsy, the available data indicate that in most cases the cause of death was vessel strike.

Since there were no clear, consistent temporal changes in the number of stranded sea turtles with evidence of vessel strike over the 10-year period for any species, we calculated the annual average number of observed vessel strikes of each species within the action area as the average

[36] A typical example is a series of parallel chop wounds caused by a vessel propeller (although a single chop wound is also common). An important feature is that bone and other tissue are destroyed as the propeller or other sharp components pass through it, leaving a distinct straight or curved wound, as shown in the example cases. Alternately, parts of the head, appendages, or shell may be sheared away (sometimes the body can be cut in half), depending on the location of the wound, angle of occurrence, and size of the vessel components relative to the turtle.

[37] Blunt force injuries may also be from a dredge, but in this case, the injuries typically include deep sediment inundation and excoriative skin trauma.

of the 10-year period. Finally, there were only two records in the STSSN database matching our search query above that were not identified to species; due to this low number, we did not attribute these "unknown" sea turtles to any of the known species counts. The final estimates of the annual average number of documented vessel strikes of each species are presented in Table 56.

We then apply a correction factor to the annual average strikes, because the observed stranding records only represent a portion of the total at-sea vessel strikes of sea turtles within the action area. Animals that die offshore may never strand and many mortalities go unobserved; a recent experimental study in Mississippi determined that sea turtle carcasses only had between 4-50% probability of washing onshore a beach, and less than half of carcasses deposited were then reported to officials (Cook et al. 2021). Although sea turtle stranding rates are variable, they usually do not exceed 20% of total mortality, as predators, scavengers, wind, and currents prevent carcasses from reaching the shore (Koch et al. 2013). Strandings may represent as low as 5% of total mortalities in some areas (Koch et al. 2013). Remote or difficult to access areas may further limit the amount of strandings that are observed. NRC (1990b)estimated boat-related mortalities of sea turtles numbered at about 400 per year for the U.S. Gulf of America and Atlantic Coasts accounting for turtles that are not included in stranding records, assuming only 20% of sea turtles killed by vessels strand. Because of the low probability of stranding under different conditions, determining total vessel strikes directly from raw numbers of stranded sea turtle data would vary between regions, seasonal trends, and other environmental factors.

To correct the annual average vessel strikes documented in the strandings data in Table 43 (column two) to include unobserved vessel strike mortalities, we relied on available estimates from the literature of the proportion of at-sea mortalities of sea turtles that are observed in stranding data (i.e., the carcass recovery rate) within the action area. Cook et al. (2021) tagged 182 sea turtle carcasses off the coast of Mississippi to track the fate of sea turtle deaths. Of these 182 tags, 64 beached (35%) but only 23 of those beached carcasses were reported to the MS stranding network (13%), indicating that stranding data represents approximately 13% of at-sea mortalities. Murphy and Hopkins-Murphy (1989) found that only 6 of 22 loggerhead sea turtle carcasses tagged within the South Atlantic and Gulf of America region were reported in stranding records, indicating that stranding data represent approximately 27% of at-sea mortalities. In comparing estimates of at-sea fisheries induced mortalities to estimates of stranded sea turtle mortalities due to fisheries, Epperly et al. (1996) estimated that strandings represented 7-13% of all at-sea mortalities. Thus, taking the average of the lower, middle, and upperbound estimates from these three studies [7% from Epperly et al. (1996) 7%, 13% from Cook et al. (2021), 27% from Murphy and Hopkins-Murphy (1989)], we assume that the STSSN stranding data represent approximately 16% of all at sea mortalities. While there are additional estimates of the percent of at-sea mortalities likely to be observed in stranding data for locations further outside the action area (e.g.,(Agabiti et al. 2024; Koch et al. 2013; Maruyama et al. 2024; Peckham et al. 2008), we did not rely on these since stranding rates depend heavily on beach

survey effort, current patterns, weather, and seasonal factors among others, and these factors vary greatly with geographic location (Hart et al. 2006; Nero et al. 2013; Santos et al. 2018).

To estimate the annual average number of sea turtle vessel strikes corrected for unobserved vessel strike mortalities, we divided the number of documented annual average sea turtle vessel strikes in column two of Table 43 by 0.16. The resulting, corrected annual average number of vessel strikes of each species within the action area are given in column three of Table 43. In using the 16% correction factor, we assume that all sea turtle species and at-sea mortalities are equally likely to be represented in the STSSN dataset. That is, sea turtles killed by vessel strikes are just as likely to strand and be recorded in the STSSN database (i.e., 16%) as those killed by other activities, such as interactions with fisheries, and the likelihood of stranding once injured or killed does not vary by species.

Finally, to estimate the annual average number of sea turtle vessel strikes that are likely associated with the proposed action, we multiplied column three by the mean percent vessel strike risk associated with oil and gas vessel traffic for each species. The final estimate of the annual number of lethal vessel strike injuries resulting from oil and gas vessels associated with the proposed action are given in column four of Table 43. As noted above, given the susceptibility of sea turtles to being killed by vessels, even small vessels, at low speeds, we assume all of these strikes are lethal.

Table 43. Estimated annual vessel strikes of large (>30 cm length) sea turtles in the action area

Species	Total Large Sea Turtle Strandings (2015-2023) with Evidence of Vessel Strike	Annual Average Vessel Strikes (Observed)	Annual Average Vessel Strikes (Corrected)	Annual Average Large Sea Turtle Vessel Strikes Resulting from Oil and Gas Vessels
Kemp's Ridley	154	17	107	77
Loggerhead	202	22	140	76
Green	562	62	390	226
Leatherback	10	1	6	3

Small Sea Turtles

Recorded information on vessel strike incidences is extremely limited for small sea turtles, which includes oceanic juveniles and hatchlings considered to be less than 30 cm in carapace length (Epperly et al. 1995; NMFS 2011e). For juvenile sea turtles, we are only concerned with Kemp's ridley, loggerhead, and green sea turtles, because those species are ones that have been observed using oceanic *Sargassum* habitat in the action area and have density information available, as explained in the Section 8.1.2.2. However, as there are no stranding records of small loggerhead sea turtles in the action area with evidence of vessel strike, which suggests that such incidents may be rare. Given the lack of studies focused on vessel strikes of small sea turtles, we do not

know if the strike rates of small sea turtles consistently differ from those of larger sea turtles. However, some studies of nearshore foraging areas show that older, benthic-stage juveniles are commonly struck (Blumenthal et al. 2009; Casale et al. 2012). Therefore, we assume vessel strikes are occurring in the surface-pelagic stage as well and rely on some of the information relevant to large sea turtles to estimate risk of small sea turtles to vessel strike from the proposed action.

First, we assessed risk of small sea turtles to potential vessel strikes by evaluating the overlap of oil and gas traffic in the action area with juvenile sea turtle densities to quantify *vessel strike risk.* The same analysis steps were performed as for large sea turtles, and results showing relative strike risk are presented in the maps below.

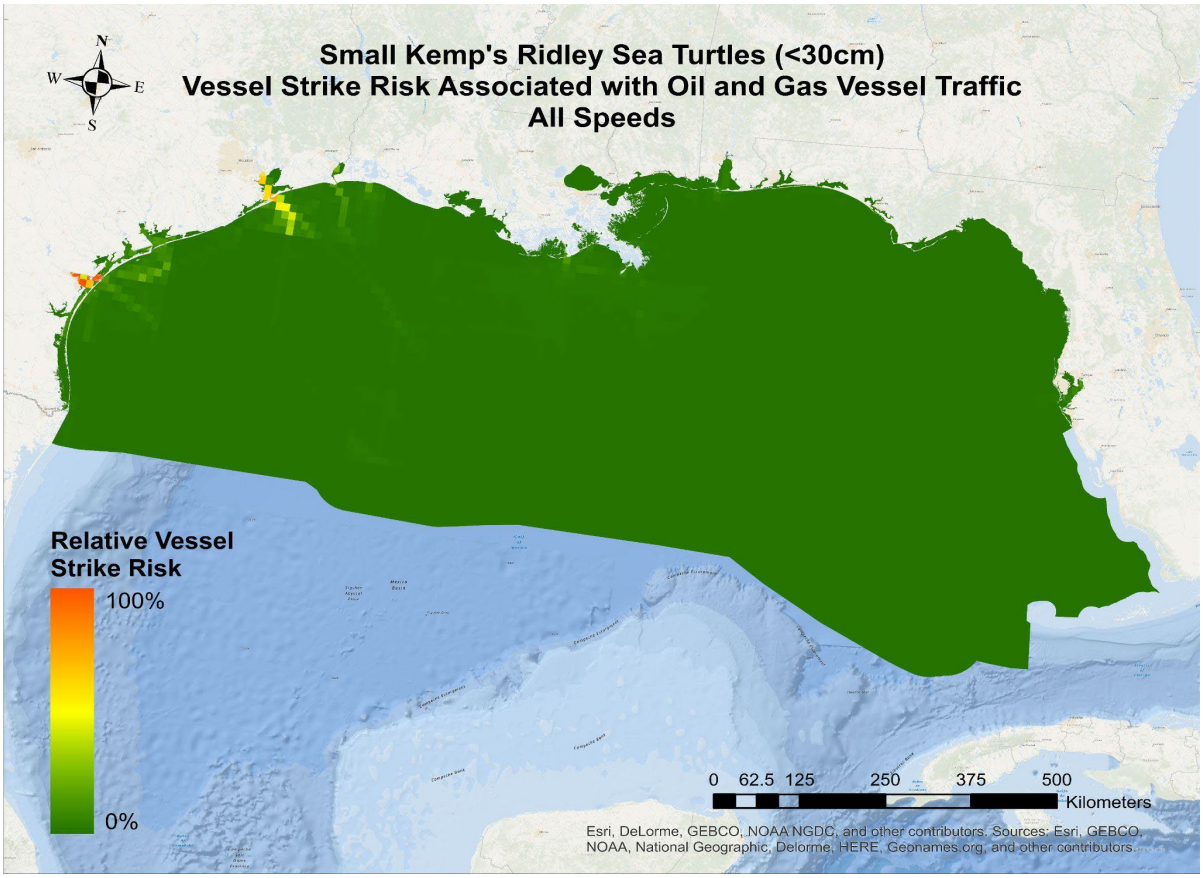


Figure 77. Relative vessel strike risk to small (<30 cm) Kemp's ridley turtles from oil and gas vessel traffic

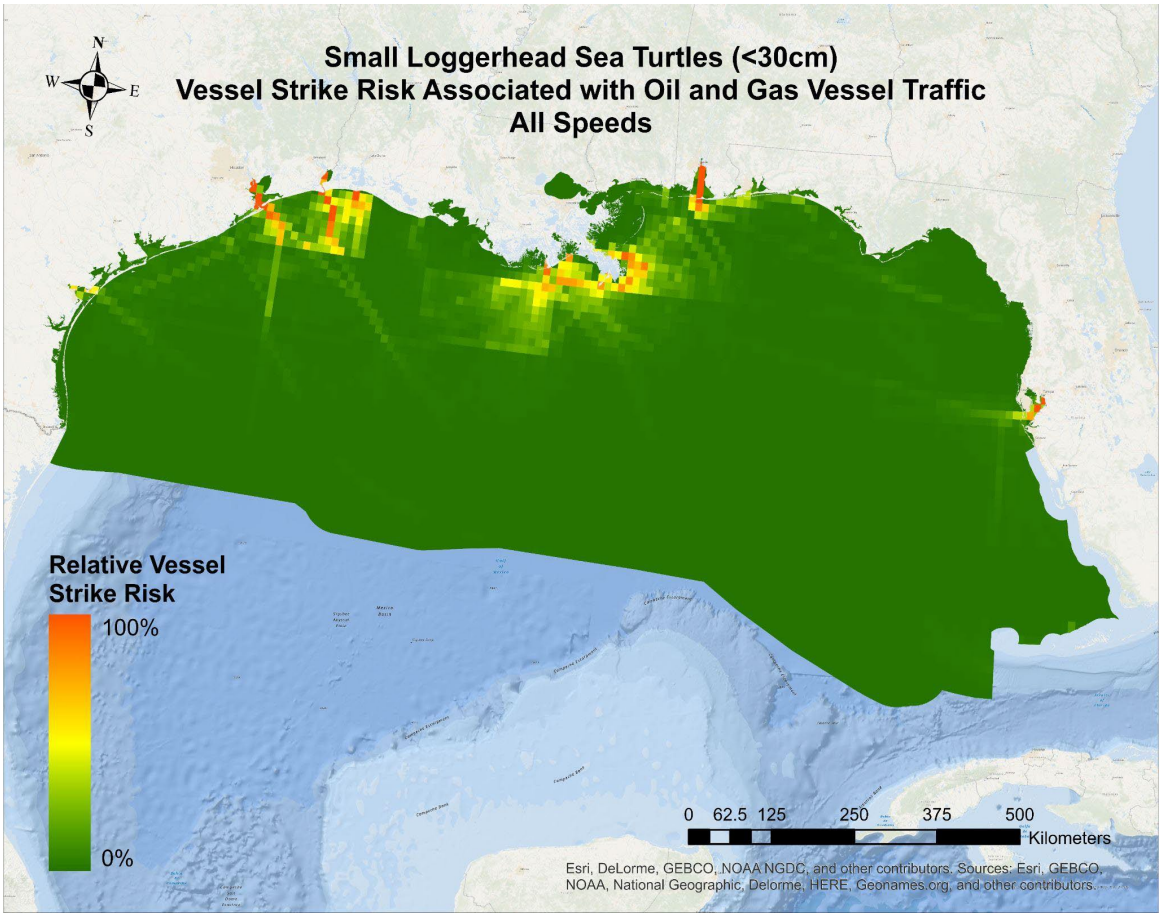


Figure 78. Relative vessel strike risk to small (<30 cm) loggerhead turtles from oil and gas vessel traffic

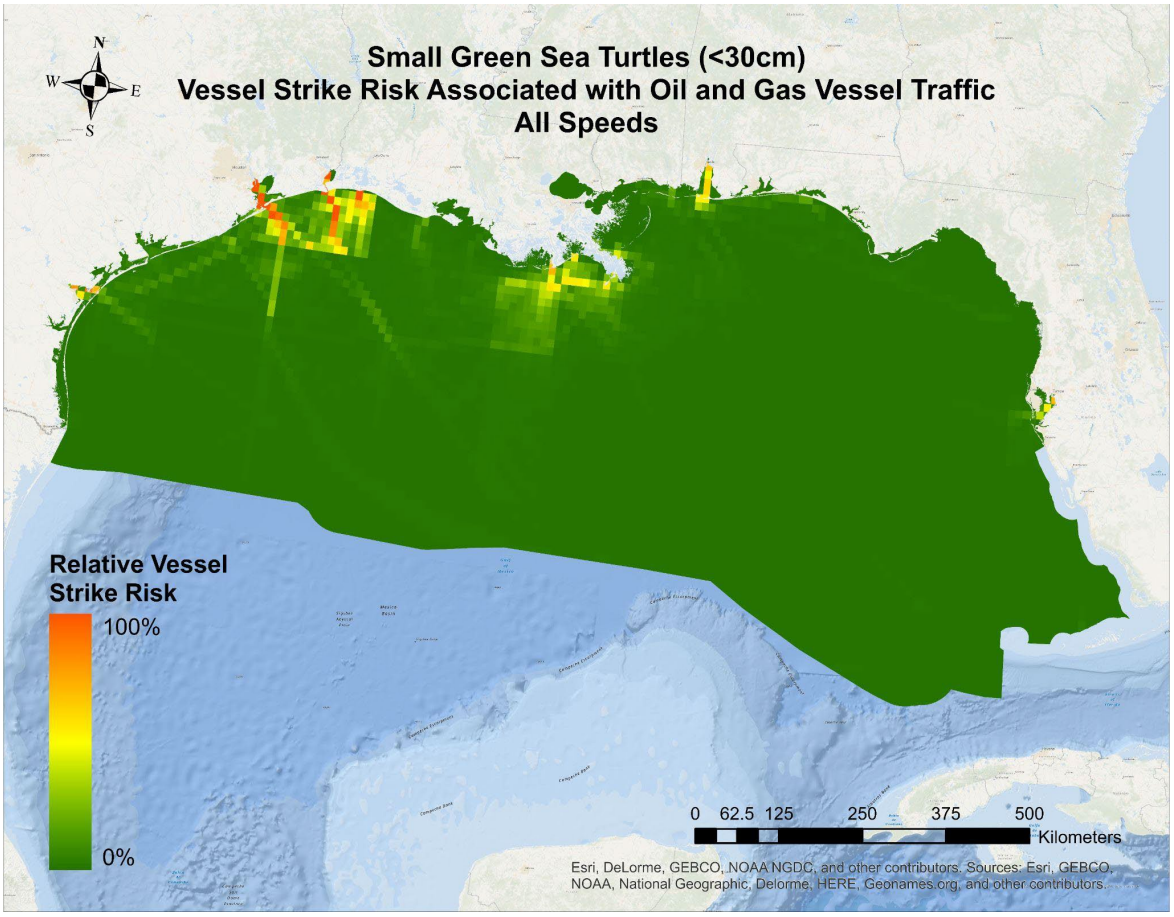


Figure 79. Relative vessel strike risk to small (<30 cm) green sea turtles from oil and gas vessel traffic

Table 44. Vessel strike risk of small (less than 30 cm carapace length) juvenile sea turtles associated with oil and gas vessel traffic.

Species	Kemp's Ridley Sea Turtles Average = 58%		Loggerhead Sea Turtles Average = 49%		Green Sea Turtles Average = 49%	
Year	2022	2023	2022	2023	2022	2023
Proportion of Vessel Strike Risk due to Oil and Gas Vessel Traffic	57%	58%	48%	50%	48%	50%

The STSSN dataset discussed above primarily represents information on larger sea turtles, with records for small sea turtles matching our requirements comprising only ~16% of the overall dataset. However, we are not aware of any other source of data upon which to estimate vessel strikes of small sea turtles and so consider this the best available data on this issue. Thus, to quantify observed small sea turtle vessel strikes we follow the same process as described above for larger sea turtles. Like above, we corrected the number of documented vessel strikes of small sea turtles for each species in the strandings data by dividing by the mean carcass recovery rate

of 0.16. From this we calculate an annual average number of small seal turtle vessel strikes for each species in the action area and, to estimate the number of these that are related to collisions with oil and gas related vessels, we multiplied by the mean percent vessel strike risk for small sea turtles associated with oil and gas vessel traffic for each species (Table 44). The resulting estimates are shown below in Table 45. As noted above, there are no stranding records of small loggerhead sea turtles in the action area with evidence of vessel strike, which could suggest they are infrequent. Nevertheless, we do not assume this to mean they do not occur so for the purposes of our analysis here, assume a minimum of 1 small loggerhead vessel strike in our calculations.

Table 45. Estimated annual vessel strikes of small (<30 cm length) sea turtles in the action area.

Species	Total Small Sea turtle strandings (2015-2023) with Evidence of Vessel Strike	Annual Average Vessel Strikes (Observed)	Annual Average Vessel Strikes (Corrected)	Annual Average Small Sea Turtle Vessel Strikes Resulting from Oil and Gas Vessels
Kemp's Ridley	13	1	9	5
Loggerhead	1[38]	0.1	1	0.3
Green	75	8	52	26

In summary, sea turtles in the action area are likely to be struck by oil and gas vessels. Many sea turtles die as a result of being struck by moving vessels, and while some injuries are likely not fatal our analysis focuses on lethal strikes and assumes these represent all strikes of sea turtles associated with the proposed action.

8.4.4 Gulf Sturgeon

There are little data available on vessel strikes of Gulf sturgeon. However, the last five-year species review identified vessel strikes as an emerging threat for Gulf sturgeon. The Florida Fish and Wildlife Commission maintains a database of stranded Gulf sturgeon going back to 1999. In the state of Florida through 2023, managers have recovered 44 stranded Gulf sturgeon (Figure 80). For the majority of these salvaged fish, no cause of death was identified (68.2%) with the next most common cause of death attributed to red tides (25%). There are no vessel strikes in the Florida database, contrasted with 242 Atlantic sturgeon recovered in the Delaware River and Bay where 52% were identified as vessel strikes (NMFS 2022). BOEM (2025) identified five vessel strike mortalities of Gulf sturgeon between 2015 and 2018 from Florida (4) and Alabama (1).

[38] Note: There are no stranding records of small loggerhead sea turtles in the action area with evidence of vessel strike, but given that only a small portion of at sea mortalities of small sea turtles are documented, for the purposes of our exposure analysis here, we assume a minimum of 1 small loggerhead vessel strike.

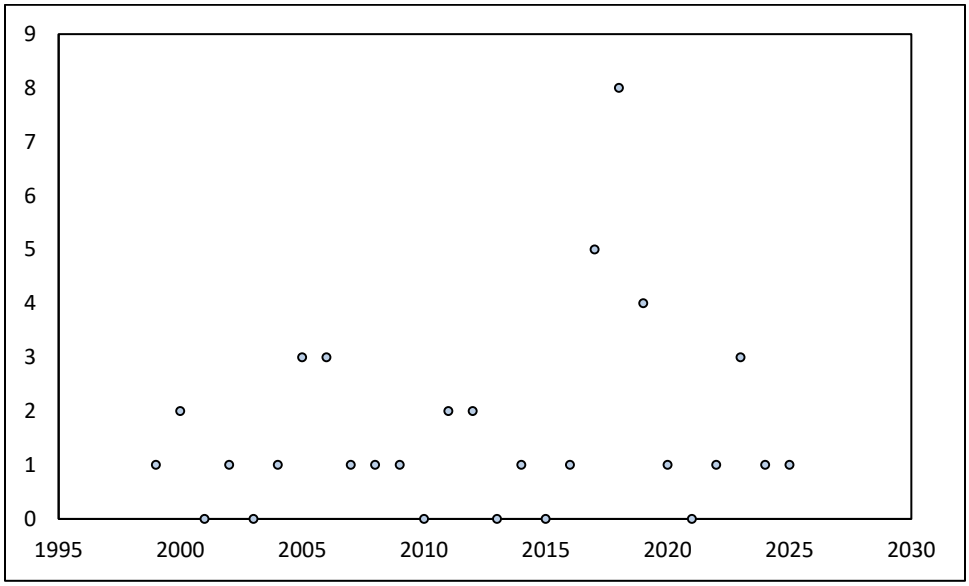


Figure 80. Gulf sturgeon recovered each year on Florida shores since 1999

The carcass data are opportunistically collected, and therefore the reported carcasses are likely only a portion of the sturgeon that are killed each year. Many vessel strikes result in carcasses sinking or floating out to sea, while only a subset of total strikes wash to shore. But once on shore, only a subset of those carcasses are discovered and reported. Therefore, the total number of sturgeon killed by vessels is expected to be higher than the number reported to management agencies, although the actual number is highly uncertain. A carcass reporting rate adjusts for the mortalities that occurred but were not reported to help better understand how many vessel struck are represented by the one that is reported.

Both likelihood of reaching shore and likelihood of being reported have been studied in Atlantic sturgeon and reported in the literature. These estimates differ by nearly an order of magnitude. Balazik et al. (2012) conducted carcass drift experiments in the middle James River to estimate the proportion of undetected Atlantic sturgeon vessel strike mortalities. This study deployed 17 carcasses during a 4 week period and determined that 94% (16/17) of the carcasses stranded along shorelines. However, the Gulf sturgeon carcasses reported above and vessel traffic associated with this program would not be in narrow, mid river locations like was analyzed in Balazik et al. (2012). The probability of a carcass reaching shore in open systems (either bays or the Gulf) would be far less likely; likely under 10%. The water flow in these systems is typically moving water out of the bay and offshore and any winds that could push a carcass towards shore would need to do so for a prolonged period to move it laterally from the shipping channel to shore. Further, many carcasses sink, making them unobservable. While no studies have been conducted of sturgeon carcass drift in bays, estuaries, or the ocean, Demetras et al. (2020) did demonstrate that in San Francisco Estuary vessel strikes may threaten sturgeon conservation even though carcasses rarely reach shore and are therefore rarely observed.

Of the proportion of vessel struck sturgeon that reached shore, there is further uncertainty as to the probability of someone discovering the carcass and then the probability of that person being aware of its ESA status and reporting it to a manager (NMFS, USFWS, or the state). McDonald et al. (1993)conducted a study in the Delaware River where 168 carcasses were placed along shorelines along the Delaware River and Bay. Eight of these carcasses were observed by individuals and reported to managers, resulting in a carcass reporting rate of 4.76%. NMFS maintains a hotline for reporting sturgeon carcasses and has engaged in considerable outreach to inform the public of the need to report these species. Reporting rates are likely increasing each year with outreach efforts but the rate of increase cannot be quantified. Observed vessel strikes of sturgeon in Florida are not surprising given the relatively larger Gulf sturgeon populations and the accessibility of the Florida Coast for people to find a report a sturgeon that comes ashore. Likewise and for the same reasons, it is not surprising that the probability of a sturgeon being struck, but also coming ashore and being discovered decreases geographically moving west in their range.

The number of oil and gas vessels traversing Gulf of America ports at any given time varies. Louisiana and Texas ports seem to have heavier traffic; however, ports out of Mississippi, Alabama and Florida also sustain oil and gas vessel traffic. Based on this, Gulf sturgeon in the Pearl and Pascagoula River systems have a higher chance of being exposed than those in the other five river systems where they are found. However, the Pearl and Pascagoula River Gulf sturgeon populations are the two smallest Gulf sturgeon populations.

Vessel strikes depend on 1) the presence of a vessel, 2) the presence of Gulf sturgeon, 3) physical parameters of the waterbody (depth, width, channel). Other factors such as vessel speed and propeller size likely also play a role as more water is moved through propellers when a vessel is moving rapidly and larger propellers can move more water. The more water moving through propellers increases the suction distance around the vessel from which a sturgeon can be pulled into an interaction.

Given the low probabilities of vessel struck sturgeon floating, then reaching shore, then being discovered, and then being reported, the best scientific data available (Balazik et al. 2012, Fox et al. 2020) suggests there is less than a 1% chance of Gulf sturgeon in the action area being reported after being hit. Because of the small population sizes estimated for Gulf sturgeon, it is not surprising there is only one report of a vessel struck Gulf sturgeon being recovered in the action area (Alabama) over a four-year survey period. If we use the documented rate of reported Gulf sturgeon mortality due to vessel strikes in the action area of one observed death every four years, we calculate approximately 11 observed deaths in 45 years due to vessel strike. If we assume approximately 1% of strikes float, reach shore rather than floating offshore, settle in a location where they can be found, and are then reported, this may suggest as many as 100 sturgeon every four years (25 sturgeon each year) are likely to be struck and killed. However, approximately 9.23% of vessel traffic in the action area is associated with the Oil and Gas

Program. Therefore, on average, no more than 2.3 Gulf sturgeon are likely to be killed by vessels from this action each year; or 104 over the 45 years of the Oil and Gas Program.

Sturgeon, particularly larger sturgeon like Gulf sturgeon that are struck by vessels may experience a variety of responses. Whether the strike results in injuries or mortality depend on a variety of factors, but the most significant factor is propeller size because larger sizes are more likely to sever a sturgeon completely. Smaller vessels tend to have smaller propellers, making large vessels more likely to be lethal for sturgeon. The best scientific and commercial data available reveal observations of sturgeon being killed by vessels (Brown and Murphy 2010), Balazik et al. 2012, Demetras et al. 2020, BOEM 2025). Because a vessels associated with oil and gas extraction are larger vessels and have larger propellers, we would anticipate all sturgeon struck by vessels associated with this action to be killed.

8.4.5 Summary of the Effects of Vessel Strikes

Based on the above analysis, we conclude that sperm whales, Rice's whales, sea turtles, and Gulf sturgeon will be adversely affected by vessel strikes associated with oil and gas program-related vessel traffic. These adverse effects will be due to injury or death from either blunt force trauma or propeller impacts. We also conclude that oceanic whitetip sharks and giant manta rays are not likely be adversely affected by vessel strikes.

It is important to note that the estimated numbers of animals we anticipate will be struck by vessels associated with the Oil and Gas Program do not include traffic from tankers and barges that carry post-refining Gulf of America-sourced oil, because, as noted previously, we are not able to determine what percentage of this tanker traffic can be attributed to the Oil and Gas Program.

We estimated that the following numbers of Rice's whales, sperm whales, Gulf sturgeon and Kemp's ridley, loggerhead (Northwest Atlantic Ocean DPS), green (North Atlantic DPS), and leatherback sea turtles will be adversely affected by vessel strikes associated with the Oil and Gas Program over 45 years (Table 46).

Table 46. Number of takes by mortality and nonlethal injuries over the 45-year duration of this opinion

Species		
	Adult and Neritic Juveniles	**Oceanic Juveniles**
Kemp's ridley	3,465	225
Loggerhead	3,420	14
Green	10,170	1,170
Leatherback	135	0
	Nonlethal Vessel Interaction	**Lethal Strikes**
Sperm Whales	4	12

Rice's whales	3	9
Gulf sturgeon	0	104

8.5 Effects of Sound

There is a considerable body of scientific information on anthropogenic sound and its effects on marine life (Abgrall et al. 2008; Bowles 1994; Croll et al. 2001; Croll et al. 1999; Frankel and Clark 2000; Gisiner 1998; Gordon et al. 2003; Greene and Moore 1995; McCauley and Cato 2001; Normandeau Associates Inc. et al. 2011; Norris 1994; NRC 1994; NRC 1996; NRC 2000; NRC 2003; NRC 2005; OSPAR 2009; Popper and Hastings 2009a; Reeves 1992; Southall et al. 2007; Tyack and Clark 2000; Weilgart 2007; Wright et al. 2007). Despite the interest in this area of research and the numerous studies available, for many species we lack sufficient information on how individuals use sound to communicate or perceive and interact with the environment. Furthermore, the mechanisms by which human-generated sounds affect the behavior and physiology (including non-auditory physiology) of marine mammals, and the circumstances that are likely to produce outcomes that have adverse consequences for individual marine mammals and marine mammal populations are not completely understood. Although sound is believed to be relatively less important for sea turtles than it is for sperm whales or Rice's whales, similar uncertainties remain regarding the effects of anthropogenic sound on these species. When we consider exposure to different types of sound in the exposure categories, we must always consider the frequency content of the sound and duration of the sound source. For example, the reaction of animals exposed to disturbing levels of sound would be expected to differ for brief, infrequent sound versus sound that is repeated over long periods of time. Such is the case with the use of explosives to decommission oil and gas structures that result in short periods of elevated sound levels.

The following sections on the effects of human-made sound from certain activities associated with the Oil and Gas Program on listed species are divided into three subsections, which consider the effects of these categories of activity:

1. Geological and Geophysical;
2. Decommissioning; and
3. Construction Sound.

Specific information relevant to these activities and the methods to determine effects they may cause is summarized in each of the three sound subsections of this opinion. This introductory section is intended to first provide a brief background on acoustics, and then an overview of the effects of sound on sperm whales, Rice's whales and sea turtles. We then discuss acoustic thresholds, and use those thresholds to estimate sperm whale, Rice's whale, and sea turtle exposure and response levels for each of the sound sources associated with the Oil and Gas Program we determined are likely to adversely affect ESA-listed species.

8.5.1 Overview of Sound

Sound travels in waves, the basic components of which are frequency, wavelength, velocity, and amplitude. Frequency is the number of pressure waves that pass by a reference point per unit of time and is measured in hertz (Hz) or cycles per second. Wavelength is the distance between two peaks or corresponding points of a sound wave (length of one cycle). Higher frequency sounds have shorter wavelengths than lower frequency sounds, and typically attenuate (decrease) more rapidly, except in certain cases in shallower water. Amplitude is the height of the sound pressure wave or the "loudness" of a sound and is typically described using the relative unit of the decibel (dB). A sound pressure level (SPL) in dB is described as the ratio between a measured pressure and a reference pressure (for underwater sound, this is one micro Pascal [µPa]), and is a logarithmic unit that accounts for large variations in amplitude; therefore, a relatively small change in dB corresponds to large changes in sound pressure. The source level (SL) represents the SPL referenced at a distance of one meter from the source decibels relative to one µPa, and thus is written as dB re: 1 µPa at 1 m, while the received level is the SPL at the listener's position (i.e., zero m from the listener) and thus is written as dB re: 1 µPa with no distance.

Root mean square (rms) is the quadratic mean sound pressure over the duration of an impulse. Rms is calculated by squaring all of the sound amplitudes, averaging the squares, and then taking the square root of the average (Urick 1983). Rms accounts for both positive and negative values; squaring the pressures makes all values positive so that they may be accounted for in the summation of pressure levels (Hastings and Popper 2005b). This measurement is often used in the context of discussing behavioral effects, in part because behavioral effects, which often result from auditory cues, may be better expressed through averaged units than by peak pressures.

Sound exposure level (SEL; represented as dB re: 1 μPa^2-s) represents the total energy contained within a certain time period and considers both intensity and duration of exposure. For a single pulse (e.g., single airgun shot), it may be written as SEL_{ss}, whereas cumulative sound exposure levels over multiple pulses may be written as SEL_{cum}. Peak sound pressure (also referred to as zero-to-peak sound pressure or 0-pk) is the maximum instantaneous sound pressure measurable in the water at a specified distance from the source, and is represented in the same units as the rms sound pressure. Another common metric is peak-to-peak sound pressure (pk-pk), which is the algebraic difference between the peak positive and peak negative sound pressures. Peak-to-peak pressure is typically approximately six dB higher than peak pressure (Southall et al. 2007).

When underwater objects vibrate or activity occurs, sound-pressure waves are created. These waves alternately compress and decompress the water as the sound wave travels. Underwater sound waves radiate in a manner similar to ripples on the surface of a pond and may be either directed in a beam or beams or may radiate in all directions (omnidirectional sources), as is the case for pulses produced by the airgun arrays considered here. The compressions and decompressions associated with sound waves are detected as changes in pressure by aquatic life and man-made sound receptors such as hydrophones.

The addition of sound to the marine environment is recognized as a risk by the scientific community (Payne and Webb 1971), that could harm marine mammals or significantly interfere with their normal activities (NRC 2005). Assessing whether a sound may disturb or injure a marine mammal involves understanding the characteristics of the acoustic sources, the marine mammals that may be present in the vicinity of the sound, and the effects that sound may have on the physiology and behavior of those marine mammals. Although it is known that sound is important for marine mammal communication, navigation, and foraging (NRC 2003) (NRC 2005), there are many unknowns in assessing impacts such as the potential interaction of different effects and the significance of responses by marine mammals to sound exposures (Nowacek et al. 2007; Southall et al. 2007).

Sounds are often considered to fall into one of two general types: impulsive and non-impulsive, which differ in the potential to cause physical effects to animals (see Southall et al. (2007) for in-depth discussion). Impulsive sound sources produce brief, broadband signals that are atonal transients and occur as isolated events or repeated in some succession. They are characterized by a relatively rapid rise from ambient pressure to a maximal pressure value followed by a rapid decay period that may include a period of diminishing, oscillating maximal and minimal pressures, and generally have an increased capacity to induce physical injury. Non-impulsive sounds can be tonal, narrowband, or broadband, brief or prolonged, and may be either continuous or non-continuous. Some can be transient signals of short duration but without the essential properties of pulses (e.g., rapid rise time). The duration of non-impulsive sounds, as received at a distance, can be greatly extended in a highly reverberant environment. The action involves both impulsive (e.g., seismic airguns) as well as non-impulsive sounds (e.g., vessel sound).

Other sound sources from the Oil and Gas Program include; oil platform construction, MODUs, oil and gas extraction activities, vessel dynamic positioning, and platform destruction and removal (including underwater explosives).

Impact pile driving creates repetitive impulsive sound. An impact pile driver generally operates in the range of 36 to 50 blows per minute. Vibratory pile driving creates a nearly continuous sound made up of a series of short duration rapid impulses at a much lower source level than impact pile driving. The sounds are emitted both in the air and in the water.

Underwater explosions would occur after decommissioning and during equipment removal and secondarily from swimmer defense airguns. The shock wave and blast sound from explosions are of concern to marine animals. Depending on the intensity of the shock wave and size and depth of the animal, an animal can be injured or killed. Further from the blast, an animal may suffer non-lethal physical effects. Outside of these zones of death and physical injuries, marine animals may experience hearing related effects with or without behavioral responses.

The detonation depth of an explosive is particularly important due to a propagation effect known as surface-image interference. For sources located near the sea surface, a distinct interference pattern arises from the coherent sum of the two paths that differ only by a single reflection from

the pressure-release surface. As the source depth and/or the source frequency decreases, these two paths increasingly, destructively interfere with each other, reaching total cancellation at the surface (barring surface-reflection scattering loss).

Potential Effects of Sound to ESA-Listed Species

Having provided a broad background on acoustics, we now provide an overview of the potential effects of sound exposure to ESA-listed species, mainly sperm whales, Rice's whales, and sea turtles.

Depending on the type and location of a sound, potential effects of anthropogenic sound include interference with communication (i.e., masking), disruption or changes in behavior, hearing impairment (i.e., permanent or temporary hearing threshold shifts), or other non-auditory physical and physiological effects such as hematomas and injuries to the lungs, intestines, and other internal organs. In cases of extreme exposure (e.g., high peak pressure levels from underwater explosives), stunning or death could occur from external and internal injuries. Death is also possible due to indirect effects that may result in reduction of fitness (e.g., increased energetic demands, increased susceptibility to predators or other anthropocentric stressors).

Like many marine animals, sea turtles, Rice's whales, and sperm whales likely rely on sound to detect prey, predators, and habitat types, and to navigate and communicate. Sperm whales use echolocation to find prey and navigate, and also use clicks known as codas to communicate with conspecifics. While Rice's whales do not echolocate to find prey, they use sound to communicate and perhaps for other ecological reasons. The use of sound by sea turtles is less clear, but it may be important in certain life stages (Lavender et al. 2014) and/or used to detect cues or threats in the environment.

The passage of sound waves through the ears results in hearing detection, but overly loud or persistent sounds can result in adverse effects on hearing. Effects on hearing ability can impair or limit an animal's ability to detect sound in its environment. Underwater environments in the Gulf of America can be turbid or dark where light does not reach deeper waters. In these types of low-visibility habitat, marine animals rely on other senses, including hearing, to detect the surrounding environment. Persistent sounds in the environment can mask important sounds or limit the distance over which an animal can detect sound or communicate. Increased ambient sound levels can impact marine mammals by changing communication space, altering behavior and causing stress (Hatch et al. 2012; Parks et al. 2013a; Parks et al. 2013b; Pirotta et al. 2013; Rolland et al. 2012).

Stress responses occur when an animal is exposed to a stressor that triggers a behavioral, nervous system, endocrine, or immune response. Stress resulting from sound exposure has been observed in a number of vertebrate species in both laboratory and free-living animals (Holberton et al. 1996; Hood et al. 1998; Jessop et al. 2003; Krausman et al. 2004; Lankford et al. 2005; Reneerkens et al. 2002; Thompson and Hamer 2000). There is some evidence suggesting that persistent ship sound may be a source of chronic stress in baleen whales (Rolland et al. 2012),

inferred from a correlation between the presence of stress hormones and presence of ship sound. Jansen (1998) reported on the relationship between acoustic exposures and physiological responses that are indicative of stress responses in humans (for example, elevated respiration and increased heart rates). Jones and Broadbent (1998) reported on reductions in human performance when faced with acute, repetitive exposures to acoustic disturbance. Trimper et al. (1998) reported on the physiological stress responses of osprey to low-level aircraft sound while Krausman et al. (2004) reported on the auditory and physiological stress responses of endangered Sonoran pronghorn to military overflights. Smith et al. (2004a); (2004b)identified sound-induced physiological stress responses in hearing-specialist fish that accompanied temporary and permanent hearing losses. Welch and Welch (1970) reported physiological and behavioral stress responses that accompanied damage to the inner ears of fish and several mammals.

Stress responses can have adverse effects on immune response, reproduction, and metabolism, and can change normal behaviors. Stress-induced changes in the secretion of pituitary hormones have been implicated in failed reproduction (Moberg 1987; Rivier 1985) and altered metabolism (Elsasser et al. 2000), reduced immunity (Blecha 2000) and increased stress hormones in marine mammals (Romano et al. 2004). Adverse stress responses could also occur when an animal does not have sufficient energy reserves to meet the energetic costs of a stress response. In such cases, energy resources must be diverted to the stress response which imposes a cost to other important biological functions. For example, when mounting a stress response diverts energy away from growth in young animals, those animals may experience stunted growth. When mounting a stress response diverts energy from a fetus, an animal's reproductive success and its fitness will suffer. Studies of other marine animals and terrestrial animals would lead us to expect some marine mammals experience stress responses to loud or chronic exposure to sound.

When considering the effects of sound exposure on the behavior of whales, a spectrum of responses is possible depending on the life history stage, sex, habitat, or time of year. In general, more severe consequences of sound exposure occur at close ranges. Injury and disturbance typically occur in relatively close proximity to the source of sound, while the general detection of the sound extends to farther distances. Detection of the sounds produced does not necessarily equate to an adverse effect. Species have different lifestyles, sound-detection capabilities, and behavioral responses that must be considered in addition to the season, location, habitat, and life stage that may be affected. Examples of adverse consequences that could occur include a shift in an animal's attention away from normal behaviors, such as foraging, as a result of exposure to a sound source. If a sound source captures an animal's attention, the animal may respond by ignoring the stimulus at non-disturbing levels assuming a "watch and wait" posture, or be disturbed and respond accordingly (Cowlishaw et al. 2004). Most of the published literature suggests that moving sources coming towards an animal will increase the amount of time animals will dedicate to being vigilant, and less time resting or foraging (Gill et al. 2001; Stockwell et al. 1991). Types of responses may also include the classical "fight or flight" response, which includes an overt behavioral response, such as avoidance, that may be accompanied by a cardiovascular, gastrointestinal, exocrine, and adrenal responses that produce

changes in heart rate, blood pressure, and gastrointestinal activity that humans commonly associate with stress. These short-term responses are usually advantageous when an animal identifies and assesses a threat and takes immediate actions to defend itself or young, or avoids the threat altogether. Although "flight or fight" can be advantageous to avoid a threat, evasive behaviors could have some negative consequences on animals if they are driven out of important habitats or otherwise result in some harm to animals.

Injury to hearing can result if the sound causes a permanent reduction in hearing abilities, also known as permanent threshold shifts (PTS). Auditory injury (AUD INJ), which includes PTS will permanently impair an animal's ability to detect and use certain frequencies of sound or could completely deafen an animal if auditory structures are severely damaged or altered (e.g., by exposure to explosions). Temporary hearing loss, also known as a temporary threshold shift (TTS), is a short-term hearing impairment resulting from exposure to loud sounds that is recoverable with time (hours to days). Temporary hearing loss is not considered physical injury but will cause auditory impairment to animals over the short period in which the TTS lasts. The consequences of hearing impairment would be greater in sperm whales and Rice's whales as compared to sea turtles. This is because all available data suggest that sea turtles are much less sensitive to anthropogenic sound than cetaceans, which may be in part due to the fact that sea turtles appear to be less reliant on sound than cetaceans (Gomez et al. 2016; Nelms et al. 2016; Nowacek et al. 2007; Popper et al. 2014; U.S. Navy 2017). Sperm whales are constantly echolocating during foraging dives, listening to the vocalizations of calves and other whales within their group, and listening for the sounds of predators and other acoustic signals in the marine environment. Rice's whales are vulnerable mainly because the majority of the sound energy that oil and gas activities, especially G&G, produce is in the lower frequency range, which may interfere with their communication, including potential mating calls.

Acoustic Thresholds

To analyze the effects of sound on sperm whales, Rice's whales, and sea turtles, we rely on information concerning the sound levels at which animals are expected to respond in a manner that may result in adverse effects. In this section, we discuss what is known about sperm whales, Rice's whale, and sea turtle hearing and detail the information used to determine the acoustic thresholds that if met or exceeded, are expected to result in adverse effects. We focus on thresholds for impulsive acoustic sources such as seismic airguns and pile driving, as of all the acoustic sources associated with the action, they are likely to have the greatest overall impact on ESA-listed species. We address explosive and continuous sounds below in the individual sections associated with the activities that generate these types of sound.

For behavioral disturbance of Rice's and sperm whales, NMFS has historically relied on an acoustic threshold of 160 dB re: 1 μPa (rms) for impulsive sounds to determine the received sound level at which marine mammals are expected to be harassed. This value is based on observations of behavioral responses of mysticetes (Malme et al. 1983; Malme et al. 1984; Richardson et al. 1986b; Richardson et al. 1990), but was used for all marine mammal species.

However, recent data suggests that this threshold may not be appropriate in all circumstances. For example, whether or not changes in behavior can harm an animal depend on the context of the sound exposure: the species, life history stage, or what behavior the animals were engaged in at the time of exposure (Ellison et al. 2012). In order to focus on the types of sounds that have the greatest potential to cause disturbance, we considered the use of steps of decibel increases in which increasingly more severe consequences of exposure can be expected. Our analysis considers that behavioral harassment or disturbance is not limited to the 160 dB threshold that has been traditionally used as the benchmark for the onset of behavioral disturbances. Disturbance may be dependent on a number of sound source characteristics including the frequency content, duration or repetitive nature of the sound, the depth of the source, and whether or not the source is moving. In addition, individuals may respond in a variety of ways, some of which have more significant consequences than others.

To determine the levels of sound that could potentially disturb sperm whales, we relied on data from a controlled exposure experiment (CEE) for sperm whales (Jochens et al. 2008). For assessing sound levels that are expected to disturb Rice's whales, we relied on studies of other baleen whale reactions to seismic sounds (Richardson et al. 1986a). There are several controlled studies on the responses of other related baleen whales to seismic airguns. Given that all baleen whales hear at low frequencies, and that they have similar anatomy and behavior, we consider data on the responses of other baleen whales the best available science to inform our understanding of the level at which Rice's whales are likely to be disturbed. For both sperm and Rice's whales, we compare these controlled studies to a recently proposed probabilistic approach to predict disturbance of marine mammals to sound (Wood et al. 2012). The Wood et al. (2012) approach predicts the probability of disturbance of animals at different received levels of sound in a step-wise fashion (i.e., a step-function). The model proposes that with the exception of migrating baleen whales, beaked whales, and harbor porpoises, marine mammals will generally show a behavioral response to weighted levels of sound (with emphasis on sound frequencies for the accumulated exposure of a marine mammal species based on its hearing sensitivity, termed M-weighting) according to the following:

- 10% of animals will respond at 140 dB rms;
- 50% of animals will respond at 160 dB rms; and
- 90% of animals will respond at 180 dB rms.

Although the model proposed by Wood et al. (2012) allows us to estimate the percentage of animals that may respond with increasing sound levels, the model is considered generally applicable to a variety of marine mammal species and is not specific to the species considered in this opinion. As such, we further evaluated these thresholds with data most relevant to sperm whales and Rice's whales.

A CEE study on sperm whales was completed as part of the SWSS that helps put predicted exposures into better context (Jochens et al. 2008). Adult sperm whales were intentionally exposed to seismic survey sound from airguns up to 147 dB (rms) and their behavior and

vocalizations recorded on tags attached to eight whales. The results of the CEE (Jochens et al. 2008; Jochens et al. 2006b; Miller et al. 2009a) provided the following conclusions regarding the response of sperm whales to airgun sound:

- There was no detection of horizontal avoidance of the seismic source found at exposure levels of less than 147 dB (rms).
- None of the whales changed their behavioral state (one resting, seven foraging), but the one whale that rested through the exposure was approached the closest and may have delayed diving during the exposure period.
- In addition to this observed potential delay to foraging during exposure (Miller et al. 2008; Miller et al. 2009), Bayesian analysis suggested a 20% decrease in foraging activity was more likely than no change in foraging activity for the seven foraging whales that were exposed to lower levels of sound, with one whale showing a statistically significant decrease in click rate activity of 60% (Jochens et al. 2008).
- There was a 19% reduction in buzz rate of whales exposed to the sound of airguns less than 150 dB (rms); however, these foraging "buzz" rates were not statistically different than that of natural variation.
- Oscillations in pitch generated by swimming movements during foraging dives were, on average, 6% lower during exposure than during the immediately following post-exposure period, with all seven foraging whales (one of the eight whales did not undertake a foraging dive) exhibiting significantly less pitching.
- The study concluded that some effects to foraging may be occurring, but it was not statistically significant; therefore, no conclusions on the biological significance of the effects on animals could be made.

Based on the limited sample of eight animals, the CEE portion of the SWSS showed that sperm whales may make minor changes to their diving behavior on foraging dives, but do not actively avoid the survey and are successfully foraging during seismic surveys (although one whale showed 60% decreased success possibly due to other reasons). Although statistically insignificant, the study suggested some small effect on foraging efficiency was occurring. Still, it could not be determined if the decrease in efficiency was the result of changes in sperm whale behavior, effects of the prey items (squid), or some other unknown factors. In another study, playback experiments of seismic airgun sound resulted in squid exhibiting changes in swimming speed, diving depth, and startle responses at levels of 151-161 dB (rms) (McCauley et al. 2000a) which could account for some change in foraging efficiency if changes in prey density or distribution occur. Even so, the CEE study could not conclude that the responses observed in sperm whales at exposures up to 147 dB (rms) resulted in any adverse effects. The study did not expose whales to sound levels greater than 147 dB (rms), but sperm whales are very likely exposed to higher levels in the Gulf of America.

While the CEE and overall SWSS was only based on a sample of eight animals, and its results were somewhat inconclusive, it does suggest some disturbance at received sound levels of 150

dB (rms). This is consistent with the Wood et al. (2012) step function, which predicts 10% disturbance at 140 dB (rms) and 50% disturbance at 160 dB (rms). Given that 150 db (rms) is between these two steps, the Wood et al. model would predict some disturbance between 10% and 50% at this level of sound. In our view, then, the CEE portion of the SWSS supports the step function proposed by Wood et al. (2012), as being predictive of the percentage of sperm whales showing some change in behavior.

There have been several CEEs conducted on baleen whale behavioral responses and the results are similar to the sperm whale CEE (Gomez et al. 2016). As mentioned previously, studies of other baleen whales are considered the best available data to inform our analysis of Rice's whale responses because all baleen whales have similar hearing abilities and share many behavioral traits. We are aware of only one study that provides a direct comparison to the Wood et al. 2012 step function. Malme et al. (1984)studied the response of gray whales exposed to varying sound levels from seismic airguns and found that a 10% response rate at approximately 154-155 dB (rms), a 50% response rate at approximately 160 dB (rms), and a 90% response rate at approximately 175 dB (rms). As mentioned previously, the Wood et al. 2012 step function estimates 10% response rate at 140 dB (rms), a 50% response rate at 160 dB (rms), and a 90% response rate at approximately 180 dB (rms). As previously stated, we believe the similar findings support the Wood et al. step function as a reasonable estimate of the probability of response given exposure to certain sound levels and may be somewhat conservative because a 10% response is estimated at lower received levels. However, it is important to note that the Wood et al. step function takes into account species hearing ranges using auditory weighting functions, whereas the Malme study does not. Nonetheless, other studies of baleen whale response to seismic activity further support the Wood et al. step function as being a reasonable approximation of the expected response probabilities. Other studies of gray whales found that they discontinued feeding and/or moved away at received sound levels of 163 dB re: 1 µPa (rms) (Bain and Williams 2006; Gailey et al. 2007; Johnson et al. 2007; Malme and Miles 1985; Malme et al. 1984; Malme et al. 1986; Malme et al. 1988; Meier et al. 2007; Würsig et al. 1999; Yazvenko et al. 2007). Studies of humpback whales off the coast of Alaska found that individuals startled at 150 to 169 dB re: 1 µPa (rms) and showed clear evidence of avoidance at received levels up to 172 dB re: 1 µPa (rms) (Malme et al. 1984; Malme et al. 1985).

Richardson et al. (1986a) found that bowhead whales began showing subtle avoidance behavior during seismic surveys in the 150-160 dB (rms) range. There are several studies that suggest that migrating baleen whales likely respond at lower received levels than compared to baleen whales engaged in other activities. For example, migrating bowhead whales show strong avoidance reactions to received 120 to 130 dB re: 1 µPa (rms) exposures at distances of 20 to 30 km, but only changed dive and respiratory patterns while feeding and showed avoidance at higher received sound levels (152 to 178 dB re: 1 µPa [rms]) (Harris et al. 2007; Ljungblad et al. 1988; Miller et al. 1999; Miller et al. 2005; Richardson et al. 1995b; Richardson et al. 1999b; Richardson et al. 1986b). Migrating humpbacks altered their travel path (at least locally) along Western Australia at received levels as low as 140 dB re: 1 µPa (rms) when females with calves

were present, or six to 12 km from the acoustic source (McCauley et al. 2000a; McCauley et al. 1998). Importantly, Rice's whales are resident to the Gulf of America and do not exhibit migratory behavior. In summary, based on our review of the above studies, we also find that the step function proposed by Wood et al. (2012) reasonably predicts the percentage of Rice's whales showing some change in behavior that constitutes disturbance.

Based on our evaluation of the studies above, the probabilistic (step) function proposed by (Wood et al. 2012) provides a reasonable characterization of the percentage of whales that may be disturbed by sound. There is considerable uncertainty regarding the effects of higher sound exposures and different sound types on Rice's and sperm whales. Some marine mammal species may show tolerance of some sound in certain frequency bands while different frequency contents may elicit stronger responses (Nowacek et al. 2004). However, we are not aware of any differential responses of whales to the sound sources considered in this opinion. A graded probability of response with exposures to different levels of sound (the step function) is useful to calculate the percentage of animals in an area that may be disturbed over a period of time. For sounds that are persistent over long periods (hours, days, or weeks), the step function can model the daily levels of disturbance a population may be exposed to as a sound source and animals move around the area in which the activity occurs. Thus, the step function from Wood et al. (2012) best predicts the onset of disturbance in Rice's and sperm whales. In the G&G Final Programmatic EIS (BOEM 2017b), BOEM completed Rice's and sperm whale exposure modeling from G&G sound sources using the step function proposed by Wood et al. (2012); we agree with this approach and this modeling as an estimate of disturbances from G&G activity (Table 34). In the subsequent analysis of the effects of the action from sound, we apply these methods and further consider the size of the ensonified area, frequency of the sound sources, and other factors that may affect the severity of the consequences of sound exposure to listed species.

For physiological responses to active acoustics, such as a TTS and AUD INJ, we relied on NMFS's technical acoustic guidance for marine mammals (NOAA 2016) and the updated guidance (NMFS 2024). Unlike the Wood et al. 2012 disturbance thresholds (described above in this section), these auditory thresholds differ by species hearing group (Table 47, below). Furthermore, these thresholds are a dual metric for impulsive sounds, with one threshold based on peak sound pressure level (0-pk SPL) that does not incorporate the duration of exposure, and another based on cumulative sound exposure level (SEL_{cum}) that incorporates exposure duration. The two metrics also differ in regard to considering information on species hearing. The cumulative sound exposure criteria incorporate auditory weighting functions, which estimate a species group's hearing sensitivity, and thus susceptibility to TTS and AUD INJ, over the exposed frequency range, whereas peak sound exposure level criteria do not incorporate any frequency-dependent auditory weighting functions. The metric that results in the largest distance from the source (i.e., produces a largest field of exposure) is used in estimating exposure because of the following quoted from NMFS's acoustic guidance:

> The weighted SEL24h metric takes into account both received level and duration of exposure (ANSI 2013), both factors that contribute to NIHL [noise induced hearing loss]… Human noise standards recognize and

> provide separate criteria for impulsive sound sources using the PK SPL metric (Occupational Safety and Health Administration (OSHA) 29 CFR 1910.95; Starck et al. 2003). Thus, weighted SEL24h is not an appropriate metric to capture all the effects of impulsive sounds (i.e., it often violates EEH; NIOSH 1998), which is why instantaneous PK SPL has also been chosen as part of NMFS's dual metric criteria for impulsive sounds.

In using these thresholds to estimate the number of sperm and Rice's whales that may experience auditory injury, we classify any exposure equal to or above the threshold for the onset of AUD INJ as auditory injury. Any exposure below the threshold for the onset of AUD INJ, but equal to or above any of the Wood et al. 2012 thresholds is classified as disturbance. Among disturbance exposures, we do not distinguish between those individuals that are expected to experience TTS and those that would only exhibit a behavioral response, as the exposure modeling results produced by BOEM in the G&G Final Programmatic EIS do not allow for such differentiation (BOEM 2017b).

Sea turtles are low frequency hearing specialists, typically hearing frequencies from 30 Hz to 2.0 kHz, with a range of maximum sensitivity between 100 to 800 Hz (Bartol et al. 1999; Lenhardt 1994; Lenhardt 2002; Moein Bartol and Ketten 2006; Ridgway et al. 1969). Piniak et al. (Piniak 2012)found green sea turtle juveniles capable of hearing underwater sounds at frequencies of 50 Hz to 1,600 kHz (maximum sensitivity at 200 to 400 Hz). Hearing below 80 Hz is less sensitive but still possible (Lenhardt 1994). Based upon auditory brainstem responses green sea turtles have been measured to hear in the 50 Hz to 1.6 kHz range (Dow et al. 2008), with greatest response at 300 Hz (Yudhana et al. 2010); a value verified by Moein Bartol and Ketten (2006). Other studies have found greatest sensitivities are 200 to 400 Hz for the green sea turtle with a range of 100 to 500 Hz (Moein Bartol and Ketten 2006; Ridgway et al. 1969) and around 250 Hz or below for juveniles (Bartol et al. 1999). However, Dow et al. (2008)found best sensitivity between 50 and 400 Hz.

These hearing sensitivities are similar to those reported for two terrestrial species: pond and wood turtles. Pond turtles respond best to sounds between 200 to 700 Hz, with slow declines below 100 Hz and rapid declines above 700 Hz, and almost no sensitivity above 3 kHz (Wever and Vernon 1956). Wood turtles are sensitive up to about 500 Hz, followed by a rapid decline above 1 kHz and almost no responses beyond 3.0 to 4.0 kHz (Patterson 1966).

To estimate sound levels that would be expected to result in a behavioral response that may be considered harassment under the ESA for sea turtles, we relied on the available scientific literature. Currently, the best available data come from studies by O'Hara and Wilcox (1990) and McCauley et al. (2000a), who experimentally examined behavioral responses of sea turtles in response to seismic airguns. O'Hara and Wilcox (1990) found that loggerhead turtles exhibited avoidance behavior at estimated sound levels of 175 to 176 dB re: 1 µPa (rms; or slightly less) in a shallow canal. McCauley et al. (2000a) reported a noticeable increase in swimming behavior for both green and loggerhead turtles at received levels of 166 dB re: 1 µPa (rms). At 175 dB re: 1 µPa (rms), both green and loggerhead turtles displayed increased swimming speed and increasingly erratic behavior, which the authors suggested may indicate the

turtles were in an agitated state (McCauley et al. 2000a). Based on our evaluation of these behavioral responses, we assume that sea turtles would exhibit a behavioral response (e.g., increased swimming speed and increasingly erratic behavior) in a manner that constitutes harassment under the ESA when exposed to received levels of 175 dB re: 1 μPa (rms) and higher. We use this threshold to estimate the number of instances of adverse effects constituting behavioral harassment.

The U.S. Navy has developed updated thresholds for sound-induced hearing loss (i.e., TTS or AUD INJ) for sea turtles (U.S. Department of the Navy 2024). The U.S. Navy's updated thresholds for sea turtles are extrapolated from Salas et al. (2023), Salas et al. (2024a), and Salas et al. (2024b), all of which observed hearing shifts in response to noise in freshwater turtles. While Salas et al. (2023), Salas et al. (2024a), and Salas et al. (2024b) represent the best available information on hearing shift in freshwater turtles, at the time of this consultation, NMFS has not yet adopted the U.S. Navy's sea turtle thresholds for non-Navy actions.

In order to estimate sound levels that would be expected to result in sound-induced hearing loss in sea turtles, we relied on acoustic thresholds for AUD INJ and TTS for impulsive sounds developed by the U.S. Navy for Phase III of their programmatic approach to evaluating the environmental effects of their military readiness activities (Appendix A in NMFS 2024)). At the time our exposure analysis was conducted, we considered these to be the best available data because they rely on all available information on sea turtle hearing and employ the same statistical methodology to derive thresholds as in NMFS's technical guidance for auditory injury of marine mammals (Appendix A in NMFS 2024; NOAA 2016). Below we briefly detail these thresholds and their derivation.

To estimate received levels from airguns and other impulsive sources expected to produce TTS in sea turtles, the U.S. Navy compiled all sea turtle audiograms available in the literature in an effort to create a composite audiogram for sea turtles as a hearing group. Because these data were insufficient to successfully model a composite audiogram via a fitted curve as was done for marine mammals, median audiogram values were used in forming the hearing group's composite audiogram. Based on this composite audiogram, and data on the onset of TTS in fishes, an auditory weighting function was created to estimate the susceptibility of sea turtles to TTS. Data from fishes were used because there are currently no data on TTS for sea turtles and fishes are considered to have hearing more similar to sea turtles than do marine mammals (Popper et al. 2014). Assuming a similar relationship between TTS onset and AUD INJ onset as has been described for humans and the available data on marine mammals, an extrapolation to PTS susceptibility of sea turtles was made based on the methods proposed by (Southall et al. 2007). Based on these data and analyses, dual metric thresholds were established similar to those described above for marine mammals: one threshold based on peak sound pressure level (0-pk SPL) that does not incorporate the auditory weighting function nor the duration of exposure, and another based on cumulative sound exposure level (SEL_{cum}) that incorporates both the auditory weighting function and the exposure duration (Table 47).

The 2024 acoustic guidance update resulted in several differences relevant to this opinion's analyses: a categorical name change from "mid-frequency" cetaceans (i.e., sperm whales) to "high frequency" cetaceans (and "high frequency" changed to "very high frequency"); increased AUD INJ, including PTS, thresholds for peak impulsive source levels; weighting function changes; a TTS of 40 dB should be used as a proxy for onset of AUD INJ.

"Sound levels just-capable of resulting in TTS or INJ are referred to as "onset" levels; e.g., an exposure just-capable of producing TTS is referred to as the onset-TTS exposure. Onset levels are treated as step functions or "all-or-nothing" thresholds: exposures above the TTS or INJ onset level are assumed to always result in TTS or INJ, while exposures below the TTS or INJ onset level are assumed to not cause TTS or INJ" (NMFS 2024).

Table 47. Impulsive acoustic permanent threshold shift and temporary threshold shift onset criteria be the species groups considered in this consultation

Hearing Group	Generalized Hearing Range[39]	Auditory Injury Onset	Temporary Threshold Shift Onset
Low-Frequency Cetaceans (Rice's whales)	7 Hz to 36 kHz	$L_{p,\ 0\text{-}pk,flat:}$ 222 dB $L_{E,p,LF,24h:}$ 183 dB	$L_{p,0\text{-}pk,flat}$: 216 dB $L_{E,p,LF,24h:}$ 168 dB
High-Frequency Cetaceans (sperm whales)	150 Hz to 160 kHz	$L_{pk,flat}$: 230 dB $L_{E,p,HF,24h}$: 193 dB	$L_{p,0\text{-}k,flat}$: 224 dB $L_{E,MF,24h}$: 178 dB
Sea Turtles	30 Hz to 2 kHz	232 dB re: 1 µPa SPL (0-pk) 204 dB re 1 µPa²·s SEL_{cum}	226 dB re: 1 µPa SPL (0-pk) 189 dB re 1 µPa²·s SEL_{cum}

From (U.S. Navy 2017) and (NMFS 2024). Lpk,flat: unweighted (flat) peak sound pressure level (Lpk) with a reference value of 1 µPa; LE,XF,24h: weighted (by species group; LF: Low Frequency, or HF: High Frequency) cumulative sound exposure level (LE) with a reference value of 1 µPa2-s and a recommended accumulation period of 24 hours (24h).

8.5.2 Effects of Sound from Geological and Geophysical Surveys

G&G surveys consist of subsea mapping of the sea bottom and sub-strata of both developed and undeveloped OCS areas to locate oil and gas reserves, monitor wells being drilled, conduct hazard assessment and archeological surveys, and conduct benthic sampling. Other potential stressors such as vessel and aircraft operations, emissions, and marine debris that are associated with G&G and other aspects of the action are covered in separate subsections of this opinion. This section focuses on the sound sources used in acoustic surveys (airguns and boomers) and the use of equipment to conduct the G&G surveys (OBM surveys) that may adversely affect ESA-listed species (Table 32). The use of CSEM and sediment sampling (geotechnical surveys Section 3.1.4.1) were considered in Section 8.2.

[39] Represents the generalized hearing range for the entire group as a composite (i.e., all species within the group), where individual species' hearing ranges may not be as broad. Generalized hearing range chosen based on ~65 dB threshold from composite audiogram, previous analysis in NMFS 2018, and/or data from Southall et al. 2007; Southall et al. 2019. Additionally, animals are able to detect very loud sounds above and below that "generalized" hearing range.

As discussed above, in order to determine the likelihood of adverse effects occurring from G&G surveys, we use acoustic thresholds to define response categories to determine when adverse effects in listed species are likely to occur. If a sound source is below the threshold, there is minimal chance of any adverse effects occurring. For sound sources that exceed the thresholds, the sounds must be considered further for their potential to expose listed species to levels of sound that can result in adverse responses of an animal. The loudness of G&G sound sources can be measured in different ways. As noted earlier, sound levels are described based on the "average" or rms level over the duration of the pulse that are commonly used to measure the way an animal hears a sound and may behaviorally respond to it. The peak level (zero-peak) measures the rise in the pressure wave and is commonly used as the measure of concussive potential to injure the ears of animals. For comparison, the field measurement of peak pressure values for airgun pulses are typically about 10-15 dB higher than rms pressures. SEL can also be used to characterize the effects that the duration of exposure may have on the ears of animals. The use of both the peak pressure and SEL metrics are what is referred to as the "dual criteria." When applying dual criteria, the metric with the greater potential to affect animals is used. Some acousticians believe that SEL_{cum} is a better measure of the received levels of total energy marine animals might experience when exposed to multiple pulses from sources such as seismic airguns and sonar (Southall et al. 2007). However, the frequency of the sound source, how often the sound is "on," and the movement of both animals and the sound source can greatly affect whether or not SEL is a better measure of acoustic effects on the hearing of animals.

The first step of the analysis is to determine the G&G sound sources that have a potential to expose listed species to sound levels that may result in adverse responses. We made two comparisons: 1) a comparison of the source level of each type of sound to the received levels of each response category, and 2) a comparison of the frequency content of each sound type compared to the hearing abilities of listed species. We reviewed G&G permits and compiled the common types of sound sources that are used in the Gulf of America (Table 49). We compared the source level for each type of sound to the received level that defines the Wood et al. (2012) step function for behavioral disturbance and the TTS/PTS response categories. If the source level is below the received level that causes identified responses, the sound type is excluded from further analysis. We also compared the hearing ranges of Rice's whales, sperm whales and sea turtles with the frequency range of the types of acoustic sources. If a G&G sound source falls outside the hearing range of a species, it is considered inaudible. However, the consideration of TTS/AUD INJ based on peak pressure levels associated with impulsive sounds is not frequency-dependent (NOAA 2016). As such, even if an acoustic source falls outside of the hearing range of a particular species, we evaluated the possibility of TTS/AUD INJ occurring based on the acoustic source levels. Based on our evaluation, only airguns and boomers have the potential to adversely affect Rice's whale, sperm whale and sea turtles and their effects are discussed in the following subsections.

Table 48. Descriptions of geological and geophysical acoustic sources used in the Gulf of America

Type of Sound Source	Example	Source Level (dB re 1 µPa at 1m)	Pulse Durations (ms)	Operating Frequencies (kHz)
Airgun array	Various volumes and configurations	Up to 260 dB (zero to peak) and 250 dB (rms)	> 100 ms	0.01-20 (main energy < 2)
Boomer	Sercel GI-90 in^3 airgun	186 (p-p)	61-80 ms	0.10-2.5
Boomer	Applied Acoustics CSP201	208 dB (rms)	180 ms	0.5–1.5
Side-scan sonar*	EdgeTech 4200	218 (210-226) dB (rms)	0.6-26 ms	6, 105, 200, 210, 240, 410, 540, 1,600
Side-scan sonar*	Raytheon ProSAS PS-60	218 dB (rms)	Unavail.	60
Multi-beam Echosounder*	Simrad EM2000	207 dB (rms) and 218 dB (peak)[a]	0.2 ms	200
Multi-beam Echosounder*	Kongsberg EM 2040	208 dB (rms)	0.2 ms	200-400
Multi-beam Echosounder*	R2 Sonic 2024	221 dB (rms)	Unavail.	200-400
Single Beam Echosounder*	Teledyne Odom Hydrotrac	152 dB (rms)	.01 ms at 24 kHz, .1 ms at 200 kHz	24-340
Sub-bottom profiler*	EdgeTech DW-216	160 dB (rms)	20 ms	2-16
Sub-bottom profiler*	EdgeTech DW106	216 dB (rms)	40 ms	2-6
Sub-bottom profiler*	Geopulse	186 (p-p)	20	3.5

*HRG surveys
NOTE: In most cases zero-to- peak pressure levels are not reported in G&G permits for non-airgun sound sources. For sources where the zero-to-peak pressure is not reported, the zero-to-peak pressure levels are estimated by adding 10 dB to the reported rms level.
[a] Peak pressure value from specification sheet found at:
http://www.km.kongsberg.com/ks/web/nokbg0240.nsf/AllWeb/C75143F8AA145B48C12575E500276CA4

8.5.2.1 G&G Sound from Airguns and Boomers

Whales

In this section, we estimate adverse effects to sperm and Rice's whales that may result from exposure to sound associated with airguns and boomers. For injury, we rely on NMFS's recently issued acoustic thresholds for assessing injury to marine mammals (NOAA 2024) and for harassment we rely on the probabilistic acoustic thresholds detailed above in the *Acoustic Thresholds* Subsection 8.5.1, as originally proposed by Wood et al. (2012). Figure 81 provides a diagram to help illustrate how the different thresholds compare. Below, we summarize our sound

exposure analysis, which we have adopted based on BOEM's final 2017 PEIS. Importantly, NMFS Permits and Conservation Division also relies on BOEM's 2017 PEIS in estimating exposure of marine mammals for their MMPA rule. The acoustic modeling report can be found online as Appendix D of BOEM's PEIS for G&G in the Gulf of America [https://www.boem.gov/Gulf-of-Mexico-Geological-and-Geophysical-Activities-Programmatic-EIS/] and also at https://www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-oil-and-gas. Our analysis is applicable to our programmatic evaluation of BOEM's action, as well as our evaluation of NMFS Permits and Conservation Division's MMPA rulemaking for the Oil and Gas Program.

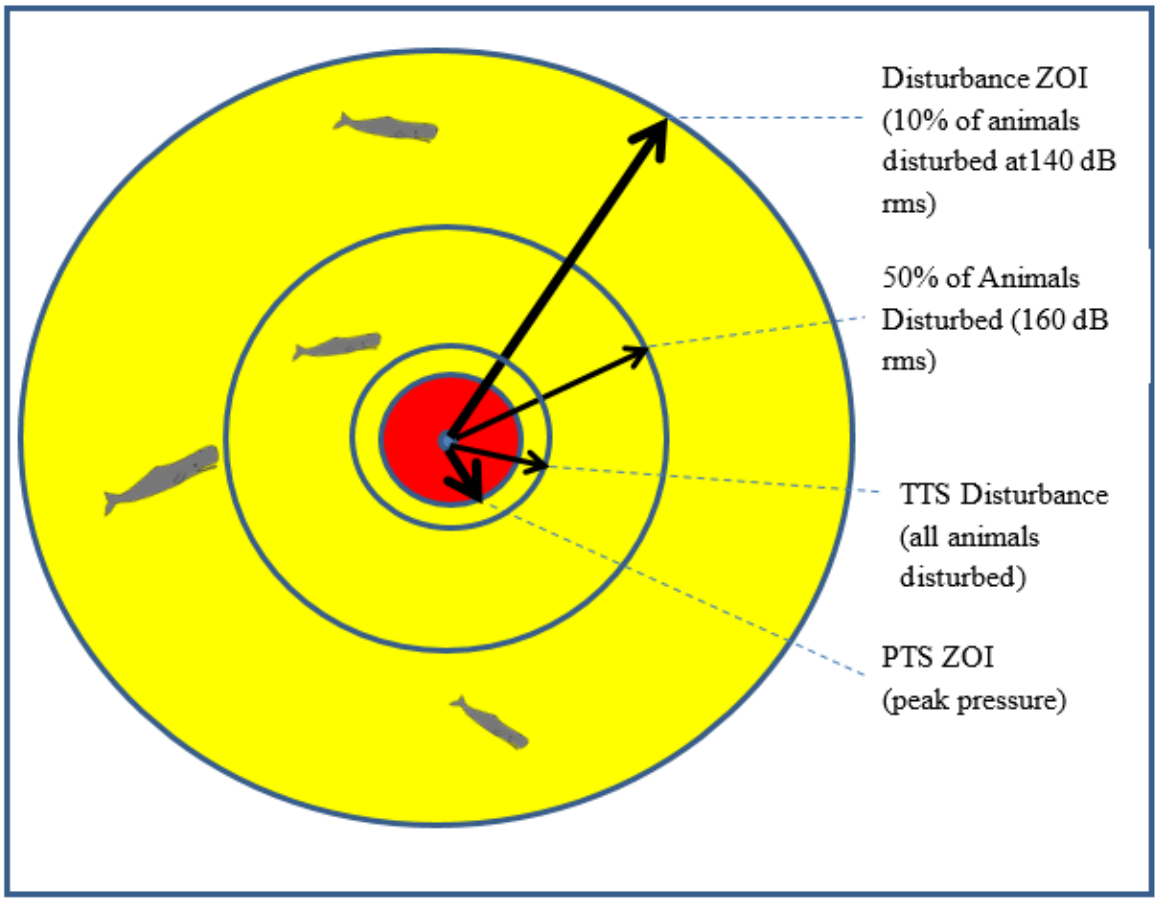


Figure 81. Example diagram showing theoretical distances to the acoustic thresholds. Note that distances for AUD INJ (including PTS) and TTS displayed are based solely on peak pressure, not SEL as the later involves the duration of exposure and cannot be easily depicted graphically

To provide some spatial resolution to the projections of survey effort and to provide reasonably similar areas within which BOEM's acoustic modeling might be conducted, the geographic region where G&G activities are conducted was divided into seven zones (Figure 82), largely on the basis of water depth, seabed slope, and defined BOEM planning area boundaries. Three primary bathymetric areas were defined as shelf (0-200 m water depth), slope (200-2,000 m), and deep (> 2,000 m). Using survey effort per zone and cetacean density data from Roberts et al.

(2016a), (Zeddies et al. 2015 in BOEM 2017c) modeled marine mammal exposures from representative G&G sources. The results from each zone were summed to provide GOA-wide estimates of sound exposure for each marine mammal species for each survey type for each notional year. To get annual aggregate exposure estimates, 24-hr average exposure estimates from each survey type were multiplied by the number of expected survey days from BOEM's effort projections. Because these projections are not season-specific, surveys were assumed to be equally likely to occur at any time of the year and at any location within a given zone. These modeled sound exposures are summed and represent the aggregate number of adverse effects to individuals expected to result from future surveys given the specified levels of effort for each survey type in each year, which may vary according to the statistical distribution associated with these mean annual sound exposures. The model was updated when most of EPA was withdrawn; therefore, the exposures were reduced.

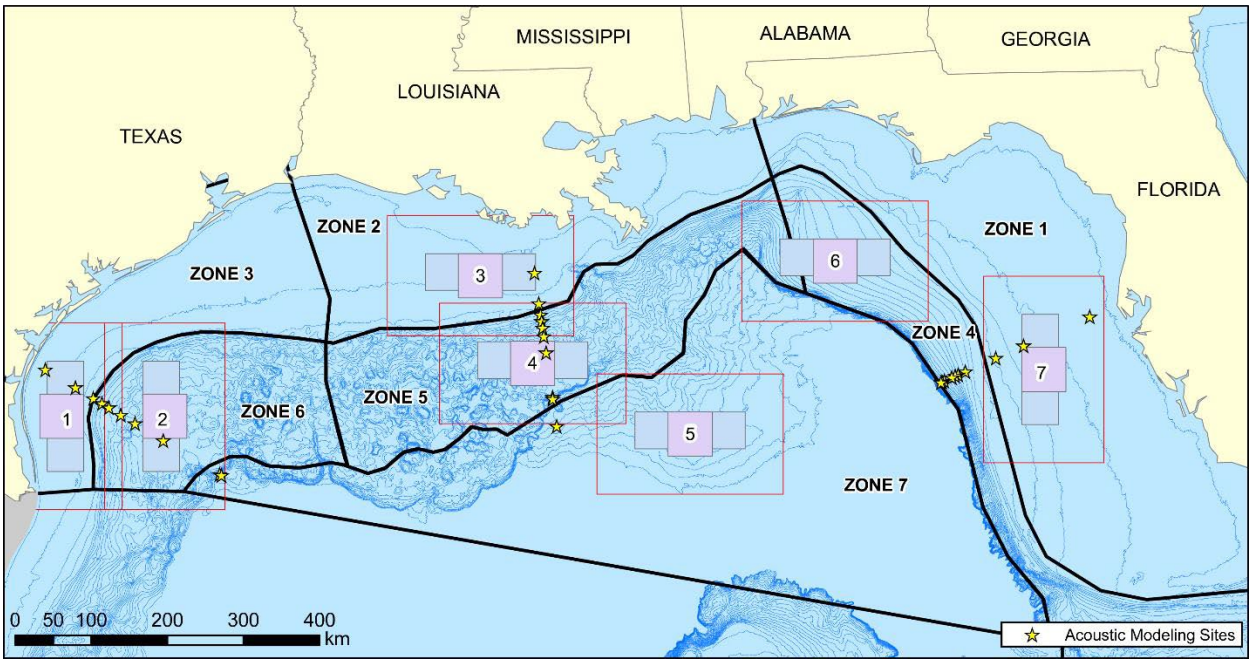


Figure 82. BOEM modeling zones. Zones 1-3 represent shelf area, Zones 4-6 represent slope area and Zone 7 is deepwater. Zeddies et al. (2015) Appendix D (BOEM 2017e)

Sound Exposure

We used BOEM's corrected modeling to determine the number of instances in which sperm whales and Rice's whales will be exposed and adversely affected by sounds produced by seismic surveys in the Gulf of America. The modeling provided by BOEM considered the level of activity resulting from the next 5 years of activity, with a reduction of area for each modeled zone to account for the omission of the withdrawn portion of the EPA. We applied the 5-year average to our calculations to predict the number of exposures of whales exposed to sound levels likely to cause adverse effects over the 45 years of the Oil and Gas Program. BOEM did not remodel exposures from geophysical surveys, but they provided corrected sound exposure estimates, which we extrapolate over the 45-year period analyzed in this opinion. With the

removal of the withdrawn area in the EPA, Table 49 represents the percentage reduction in survey area for each modeled zone. Activity planned in the withdrawn area will require a separate ESA section 7 consultation.

We account for adverse effects from sound from geophysical surveys using airguns and boomers in specific zones in the active leasing areas using BOEM's sound exposure scenarios, as provided, and use activity level per zone as a surrogate to measure the extent of take. Monitoring of this surrogate will allow us to determine whether take levels are exceeded, requiring reinitiation of consultation.

Table 49. Percentage reduction in survey area for each modeled zone

Modeled Zone	Percentage Reduction in Area
1	100.0
2	2.7
3	0.0
4	98.2
5	4.0
6	0.0
7	33.0

BOEM's estimate of the number of whales that might be exposed to levels of sound likely to cause adverse effects was determined by modeling the acoustic footprint from sound sources and the number of exposures in each response category. The modeling used representative sound sources for each survey type based on the equipment used in Gulf of America operations. Actual array output varies by seismic survey type and can be considerably higher or lower depending on the number of arrays and airguns used. Specific modeling of each of the following survey types was completed:

- 2D surveys;
- 3D NAZ surveys;
- 3D WAZ surveys;
- coil surveys;
- a single airgun (90 in^3); and
- boomers.

It is important to note these calculations did not include or account for ancillary activities, such as some VSP surveys. Thirty sites were modeled among the planning areas to calculate acoustic propagation of the sound sources and determine received levels by whales moving around the sources. Therefore, the number of exposures provides a reasonable characterization of the

number of animals that may be exposed to different sound levels from each source throughout the action area.

Sperm Whale

Received levels that meet or exceed 230 dB (peak), the PTS threshold for sperm whales, in most cases are not expected to occur. The model estimated sound levels within 18.2 m from the sound source, which is within the near field of the acoustic array, and thus too small a distance to reflect a realistic distance to a particular sound level (Zeddies et al. 2015). This is because, within the near field, the source levels used in the acoustic modelling are overestimated and not applicable. In fact, until one reaches a distance of approximately three or four times the maximum distance to the near field, the average intensity of sound at any given distance from an array is still less than that based on calculations that assume a directional point source (Lurton 2002). Given this, using the distance to the maximum extent of the near field as the cut-off for where sound levels are considered lower than the estimated source level based on the directional point source assumption is a conservative approach because, even beyond this distance, the acoustic modelling still overestimates the source level that animals would receive. For example, the seismic airgun array used by the National Science Foundation on their R/V *Marcus G. Langseth* has an approximate maximum near field distance of 140 m at 1 kHz (NSF and USGS 2011). Field measurements of this array indicate that the source behaves like multiple discrete sources, rather than a directional point source, beginning at approximately 400 m (deep site) to 1 km (shallow site) from the center of the array (Tolstoy et al. 2009), distances that are actually greater than four times the 140 m maximum near field distance. Within these distances, the recorded received levels were always lower than would be predicted based on calculations that assume a directional point source, and increasingly so as one moves towards the array (Tolstoy et al. 2009).

Within the near-field, in order to explicitly evaluate the likelihood of exceeding any particular acoustic threshold, one would need to consider the exact position of the animal, its relationship to individual airguns, and how the individual acoustic sources propagate and their acoustic fields interact. While in some cases received levels at or in excess of a particular threshold may be possible, we find this highly unlikely for several reasons. While the data are mixed as to whether or not sperm whales show avoidance of seismic activity more broadly (Barkaszi et al. 2012; Bowles 1994; Gordon et al. 2003; Jochens et al. 2008; Madsen et al. 2006; Madsen et al. 2002a; Mate et al. 1994; Miller and Dawson 2009; Miller 2005; Potter et al. 2007; Southall et al. 2007; Southall et al. 2017), in most cases we do not expect sperm whales to come within 18.2 m of active arrays because they would likely hear and see the array prior to this and avoid approaching it at such close range, particularly if such close exposure were to cause any pain. Nonetheless, PSO data from 2003-2008 indicate that at least three sperm whales approached an active airgun array to within 10 m, but, if such a situation were to occur, we would expect the airguns to be shutdown based on the shutdown requirements, which minimize the chances of PTS occurring. Furthermore, given that within the near field source levels would be below those used in the

acoustic modelling, even if sperm whales are within 18.2 m of the array, the exceedance of a particular threshold would only be possible under highly unlikely circumstances (e.g., a sperm whale would need to be in exactly the right position, under a particular configuration of airguns, that fire at a particular time). For these reasons, we find that adverse effects to sperm whales consisting of PTS/injury are extremely unlikely to occur, and thus discountable.

Table 50displays the results of BOEM's modeling of the annual number of instances in which a sperm whale may be harassed, based on a 24-hour modeling period, in Gulf of America federal waters. These instances of harassment involve either disruptions in behavior (i.e., disturbance) or TTS, or both. In humans, sound-induced hearing loss has been shown to occur in a narrow range of frequencies of the sound, such as those from gunfire, power tools, explosions, and amplification of music (Sadhra et al. 2002; Win et al. 2015; Zhao et al. 2010). We expect that any temporary hearing loss in sperm whales would occur in the frequencies representing the main energy of seismic survey sound between 10-2,000 Hz. It is important to note the numbers in Table 50 do not necessarily represent individual animals given the 24-hour reset used in the modelling. In fact, we expect that some animals will be harassed more than once. The nature of the intermittent exposure to disturbance due to moving whales and seismic surveys could result in consecutive disturbances over days or weeks. BOEM's modeling suggests the average daily exposures from all surveys may be less than 30 minutes/day (Zeddies et al. 2015 in BOEM 2017c), and the types of surveys using multiple vessels with active sound sources are likely to result in longer periods of disturbance than single vessel surveys.

Table 50. BOEM's corrected annual number of sperm whale exposures by disturbance from seismic survey airgun and boomer sound

YEAR	Exposure of Sperm Whales*Sum of Instances of Harassment
1	40,112
2	33,121
3	33,859
4	22,564
5	29,036
Annual average	31,738

*The number of exposures is not equal to the annual number of individuals exposed. The number of individuals exposed by harassment each day is summed over a one-year period such that animals may be exposed multiple times from one survey or over the course of a year from different surveys.

Not all survey types have the same potential to adversely affect sperm whales. The likelihood of disturbance responses from individual surveys depends on the survey type and array configuration, the duration of the survey, and the number of vessels used. These factors are reflected in the modeling results for each survey type (Table 51) and show that 3D NAZ surveys

have the greatest potential to adversely affect sperm whales, followed by 3D WAZ, 2D surveys, and coil surveys.

Table 51. Number of daily harassment exposures to sperm whales from different geological and geophysical survey types, summed over 10 years of proposed activities in the Gulf of America

Type of Survey	Exposure of Sperm Whales to Harassment over 5 Years	Exposures over 10 years
2D (1 vessel, 8,000 in^3 array)	3,777	7,554
3D NAZ (2 vessels, 8,000 in^3 array)	102,277	204,554
3D WAZ (4 vessels, 8,000 in^3 array)	41,138	82,276
Coil Survey (4 vessels, 8,000 in^3 array)	11,497	22,994
VSP (2D as proxy)	391	782
90-cubic-inch airgun	2	4
Boomer	1	2

BOEM's modeling shows that sperm whales will be exposed to levels of sound that cause harassment up to 31,938 times on average annually (Table 51**,** above). This number reflects the number of instances (based on a 24-hour reset) in which a harassment event will occur, but is not equal to the number of individual sperm whales that will be harassed each year. There are an estimated 2,128 sperm whales in the northern Gulf of America based on the density data used to estimate exposure (Roberts et al. 2016b). The total annual estimated 31,738 occurrences of harassment is the sum of the number of instances of harassment, which greatly exceeds the population number. We expect that individual sperm whales will be harassed multiple days annually.

Seismic survey activity in deep water is proposed mostly in the CPA, and to a lesser extent in the WPA and EPA. Proportionately, most of the predicted harassments will occur in deepwater areas of the CPA (200-2,000 m depths) and very deep waters greater than 2,000 m on the OCS. The majority of survey activity in very deep water will occur in the CPA.

Depending on the location of surveys and whales over the course of an entire year, individual whales can be harassed different numbers of days per year. For example, Figure 83 demonstrates that sperm whales are not uniformly distributed over the Gulf of America, and nor are oil and gas activities.

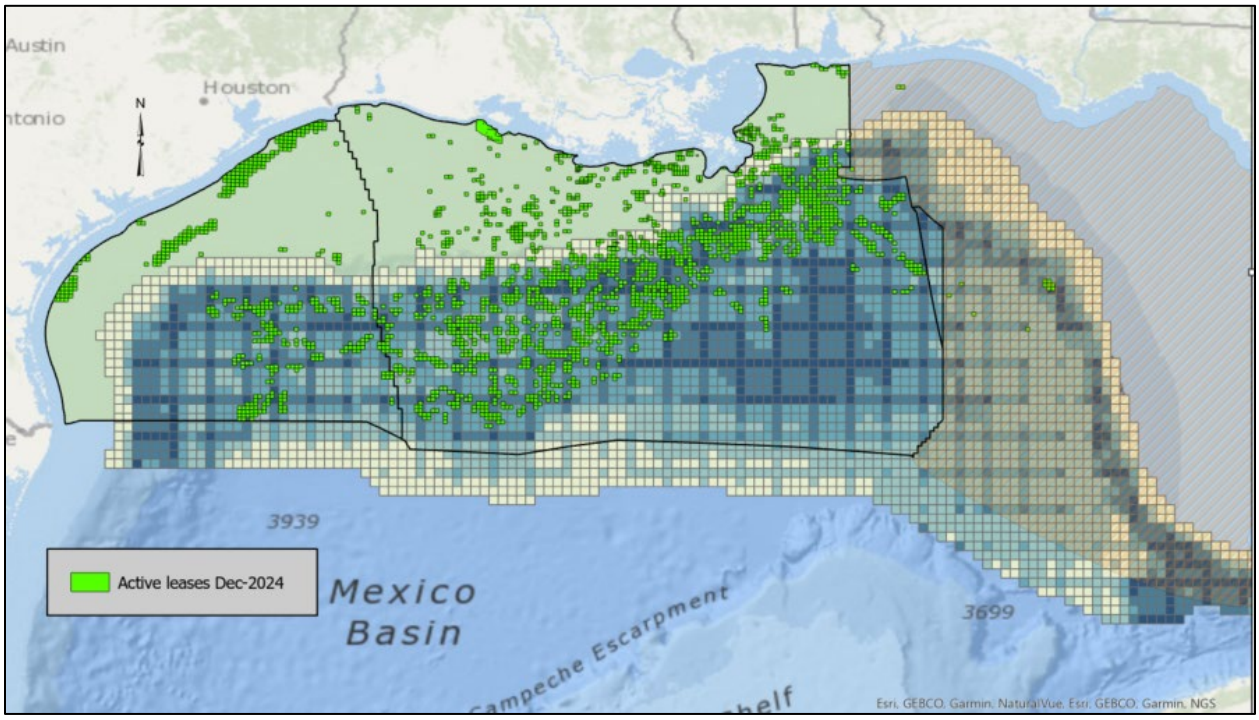


Figure 83. Predicted sperm whale mean year-round density (blue-tinted grid cells) based on habitat features in the Gulf of America overlaid with active oil and gas lease blocks. Hatched area on right displays the withdrawn area (GOMAPPS)

Rice's Whale

BOEM determined, in their BA supplemental information that there is a reasonable potential for seismic surveys to expose Rice's whales to sound levels that may cause adverse effects (BOEM and BSEE 2024). This species is infrequently seen and responses would likely not be observable. The degree of displacement, if any, length of time involved, and types of behaviors interrupted would influence the significance of this disturbance. At higher received levels, auditory injury could occur resulting in some impairment of the whale's hearing sense and permanent loss of hearing abilities.

There are little available density data for global Bryde's whales and less so for Rice's whale, especially on the effects of anthropogenic sound on this species. As such, we rely on information from other Bryde's whale populations, as well as from other baleen whale species, in conducting our effects analysis. Based on best available density estimates (Section 8.1.2.1, Figure 84), we believe that individual Rice's whales could travel outside the bounds of the RWA and may be affected by G&G surveys.

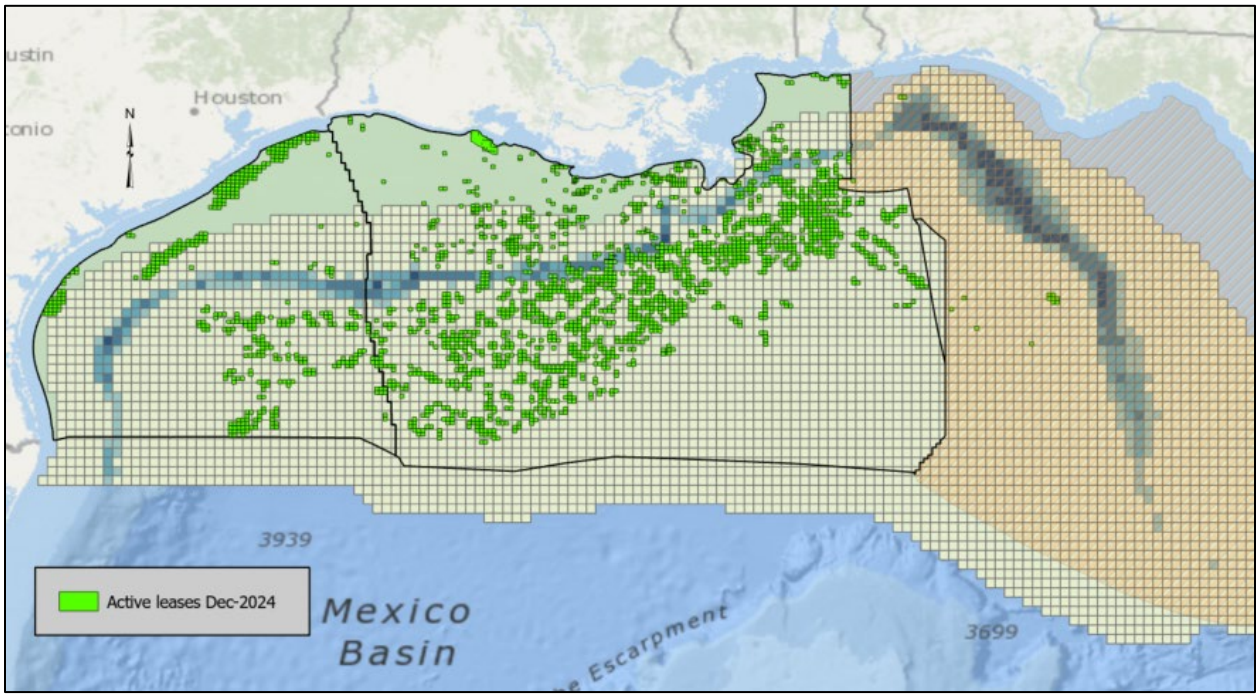


Figure 84. Predicted Rice's whale density (blue-tinted grid cells) based on habitat features, Sightings and acoustic detection data in the Gulf of America (GoMMAPPS)

As stated in the 2016 Status Review, one of the top factors threatening the Rice's whale is modification or curtailment of habitat range (Rosel 2016). Rice's whale distribution in the Gulf of America is thought generally to be concentrated in the northeastern Gulf near De Soto Canyon, in waters between approximately 100 and 400 m depth along the continental shelf break. Rice's whales have been consistently located in the area along the shelf break in the northeastern GOA, with some whales sighted elsewhere due to a large amount of dedicated cetacean survey effort that covered both continental shelf and oceanic waters. Whales have been sighted in this area in all seasons, and all indications are that the whales inhabit this area year-round as a resident population. A tagged whale remained within this area for 38 days, the entire time the tag was active. Based on updated sightings and detection data, it is apparent that Rice's whales occur outside this area. However, it is the known density of whales in a relatively constricted area, forming what is believed to be a resident population that demonstrates the need to protect that area as important habitat for the Rice's whale. Spatial protection is key as the most effective method of avoiding acute effects to individual whales, but also as the only effective method of minimizing chronic effects and the potential for population-level impacts resulting from habitat degradation and/or curtailment of range. The Status Review details these threats as being moderately or very likely to contribute to the decline of the Rice's whale if not addressed.

We are continuing to learn about the Gulf of America's soundscape, specifically near where Rice's whales are found. Wiggins et al. (2016) deployed a High-frequency Acoustic Recorder Package (HARP) at five locations in the Gulf of America from 2010 to 2013. One of the HARPs was in De Soto Canyon at 260 m water depth and the deepwater sites were similar to each other

with their highest sound pressure levels below 100 Hz. As described in earlier sections of this opinion, De Soto Canyon is where the Rice's whales are consistently found. Of the five HARP sites, De Soto Canyon had the lowest sound spectrum level recorded; however, the Gulf of America overall had a high average SPL for sounds below 60 Hz (90-95 dB re 1 µPa squared) at deepwater sites (Wiggins et al. 2016). Location of seismic surveys during the data collection was not clear, hence we do not know if there were G&G activities (i.e., seismic surveys) occurring near the HARP in the EPA during the data collection.

From 2020-2023, Frasier et al. (2024b) collected acoustic monitoring data using HARPs and MARPs placed in locations throughout the Gulf of America (Figure 57). This study included data from a collection of 10 years of recordings from long-term sites (action-area-relevant deeper water sites: MC, DC, LC, DT and shallower water sites: GA and SL) in addition to the annually-deployed sites over the three-year period.

Frasier et al. (2024b) preliminarily reported detecting Rice's whale calls on 7 of the 17 sites . It should be mentioned that absence of calls does not necessarily mean absence of individuals, rather it represents no individual's calls are being detected. The study measured ambient sound pressure spectrum levels at each of the sites. Sites where Rice's whale were detected were of the "quieter" ambient site locations, which supports other findings that DeSoto Canyon, where Rice's whale are observed most often, is a quieter area in the Gulf (Wiggins et al. 2016).

Table 52. Summary of Rice's whale call detections and recording effort over the 2020-2022 period (Table modified from Frasier 2024 Table 7). Yellow highlights signify the locations within the action area.

Site	Effort (Days)	Effort (Hours)	Eastern Calls	Western Calls	Presence (% Days)	Presence (% Hours)
AC	690	16,576			0.0	0.0
GC	632	15,019			0.0	0.0
MC	450	10,757			0.0	0.0
DC	656	15,722	223,988	10	99.2	87 4
DT	695	16,660			0.0	0.0
LC	689	16,452	5		0.6	0.0
CE	683	16.404			0.0	0.0
MR	680	16,329		579	14.9	1.9
GA	691	16,561		602	11.0	1.2
SL	632	15,09		1	0.2	0.0
Y1B	371	8,885			0.0	0.0
Y1C	364	8,725			0.0	0.0
Y1D	364	8,726	10,760		54.4	23.0

Site	Effort (Days)	Effort (Hours)	Eastern Calls	Western Calls	Presence (% Days)	Presence (% Hours)
Y2A	321	7,672			0.0	0.0
Y2B	319	7,645			0.0	0.0
Y2C	319	7,638		162	19.4	1.7
Y2D	319	7,647			0.0	0.0

In addition, the study visualized detections of large airgun array use over time (Figure 85):

> At most of the 21 locations over the August 2020 to July 2023 recording period, the ambient soundscape below 100 Hz is dominated by seismic survey signals (airguns) nearly year round ... Individual surveys up to months long in duration are visible in the long spectrograms at all of the sites. Further, throughout the three years, the same surveys appear simultaneously across most acoustic recorders (as seen by similar start and end times of airgun noise in the 10 Hz to 100 Hz frequency band across sites), illustrating the long-range propagation of these intense low-frequency signals. Over this period, sound levels are elevated the most in the airgun frequency band at site GC where substantial survey activity was focused on active lease blocks…Deep sites tended to have the most consistent occurrence of seismic survey signals due to long-range propagation across the open Gulf. Transmission of airgun signals up slope from deep into shallow water environments is weak; therefore, levels in the seismic band are generally lower at sites DC, GA, SL…. (Frasier et al. 2024b).

In a similar study that used HARPs, Soldevilla et al. (2024) found that the sites designated as Corpus Christi (CC) and West Flower Banks (WF), located in the western portion of the action area, detected Rice's whale calls 25% and 33% of the time year-round, respectively (Figure 86).

Sound emitted from seismic surveys is of greater concern for baleen whales. These whales vocalize at similar low frequencies to air gun pulses, so may be more vulnerable to adverse effects from acoustic sources that produce sound at those frequencies. There is potential for behavioral harassment and acoustic injury depending on the distance from the source and the duration of exposure.

BOEM conducted seismic airgun survey sound exposure modeling for all marine mammals in the Gulf of America as part of their PEIS, as was previously described. We evaluated this modeling, and determined it suitable for estimating the number of instances in which Rice's whales will be exposed to sounds produced by seismic surveys in the Gulf of America. The modeling provided by BOEM considered the Gulf-wide level of activity resulting from ten years of actions. We have applied the ten-year average to our calculations to predict the number of exposures over the 45 years of the Oil and Gas Program.

BOEM's modeling predicts an annual average of 12 instances of Rice's whale exposure to received levels of 183 dB (SEL) that would cause PTS (SEL produced a larger PTS estimates for Rice's whales compared to peak pressure, given their hearing range), and an annual average of 452 instances of Rice's whale exposure at a level would result in harassment. As for sperm whales, numbers of exposures to sound are not equal to the annual number of whales exposed to sound at levels that cause adverse effects because individuals may be exposed multiple times

(Table 53). As noted above, human sound-induced hearing loss has been shown to occur in a narrow range of frequencies of the sound source (i.e., music, gunfire, etc.). We expect the loss of hearing sensitivity in Rice's whales due to sound-induced hearing loss would selectively occur in the frequencies of the main energy of seismic survey sound at 10-2,000 Hz.

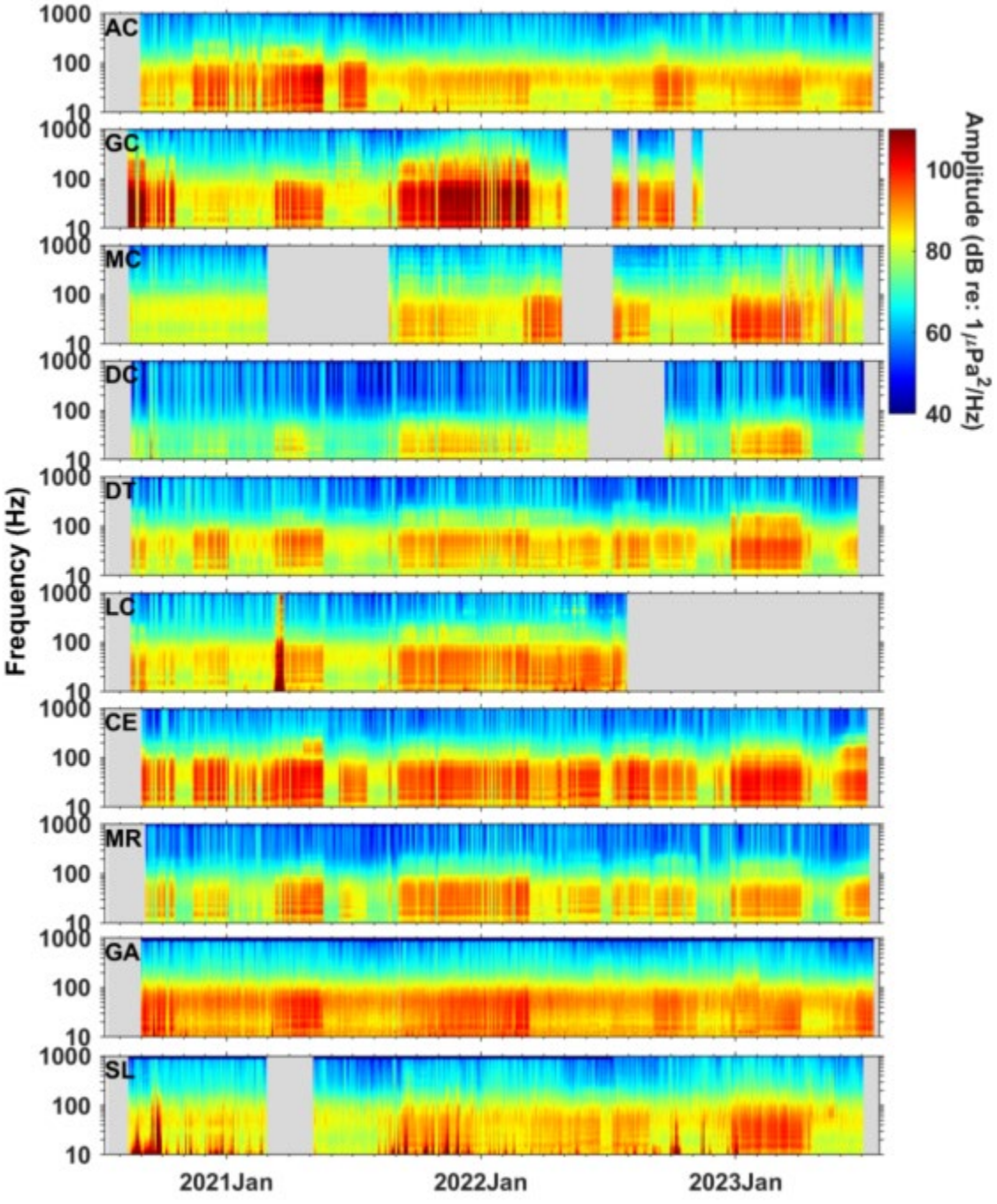


Figure 85. Long spectrograms using daily averaged spectra for 2020-2023 data recordings at long-term sites. Gray blocks represent periods with data recording (Frasier et al. 2024). Darker red bars at 100 Hz and below mainly represent seismic survey recordings.

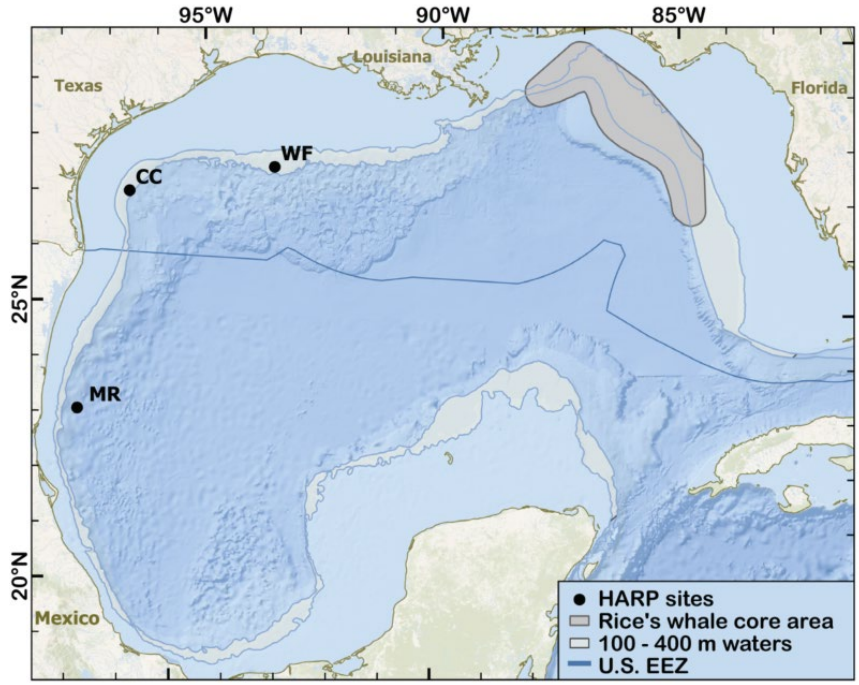


Figure 86. Locations of three HARP, represented by black dots, CC and WF) deployed near the western Gulf of America shelf break from September 2019 to August 2020 (Soldevillaet al. 2024)

Table 53. Number of Rice's whale exposures to permanent threshold shift and harassment or temporary threshold shift from seismic survey airgun and boomer sound over five years

YEAR	PTS*	Harassment*
1	14	537
2	13	505
3	11	429
4	9	341
5	12	448
Annual Average	12	452

**The number of exposures is not equal to the annual number of individuals exposed. The number of individuals harassed each day is summed over a one-year period such that animals may be exposed multiple times from the same survey or over the course of a year from different surveys. All decimal numbers were rounded up to next whole number.*

Not all survey types will have the same potential to adversely affect Rice's whales. The likelihood of PTS exposures and harassment from individual surveys largely depends on the survey type and array configuration, the duration and location of the survey, and the number of

vessels used. These factors are reflected in the modeling results for each survey type (Table 54) and show that 3D NAZ surveys have the greatest potential to adversely affect Rice's whales, followed by 3D WAZ, coil, and 2D surveys.

Table 54. Number of daily permanent threshold shift and harassment or temporary threshold shift exposures from geological and geophysical survey types expected to affect Rice's whales, summed over five years

Type of Survey	Exposure of Rice's whales to PTS Sound Levels over 5 Years of Proposed Activities	Exposure of Rice's whales to Harassing Sound Levels over 5 Years of Proposed Activities
2D (1 vessel)	1	83
3D NAZ (2 vessels)	40	1,342
3D WAZ (4 vessels)	3	685
Coil Survey (4 vessels)	16	151
VSP (2D as proxy)	1	7
Five-year Total	61	2,268 [a]

[a] *This number is slightly less than total in Table 53 above due to rounding in an individual year.*

Because Rice's whales are cryptic, we do not expect that PSOs will be able to easily detect them during visual observation, although observations have been made, including observations during active G&G surveys. Available information on baleen whale reactions to seismic survey sound suggests that they will avoid the sound source (Ellison et al. 2016; Gordon et al. 2003; Southall et al. 2007; Stone and Tasker 2006). To estimate the effect avoidance of seismic activity has on the likelihood animals are exposed to sound levels that may result in injury such as PTS, Ellison et al. (2016)modeled the exposure of bowhead whales to sound levels that may result in injury with and without avoidance. The model was parameterized based on empirical data on bowhead whale behavior. The results suggest that if animals show avoidance behavior there is approximately an 80% reduction in exposure to sound levels that may cause injury. We assume, based on the species' similarities, that Rice's whales would also avoid being exposed to PTS levels of G&G-associated sounds, and therefore we rely on the Ellison et al. (2016) 80% aversion value (i.e., 80% of PTS exposures will be avoided) to estimate that up to 108 (of the total 540) individuals could be exposed to sound levels that cause hearing loss over the 45 years of the action.

BOEM's modeling shows that Rice's whales would be exposed to levels of sound that cause harassment an average of 452 times annually. This number reflects the number of instances of harassment that would be expected without mitigation. The number is not equal to the number of individual Rice's whales that will be harassed each year. Rice's whale is 51 animals, with a confidence interval of 20 to 130 whales (Garrison et al. 2020b) and a minimum population estimate of 34 (NMFS 2021). An unmitigated annual 452 instances of harassment greatly exceeds the population number; we expect that individuals would be harassed multiple times per year. Because geophysical surveys are omitted from the area under the GOMESA moratorium,

that PTS in individuals that remain within the moratorium area and the annual number of instances of harassment will be less. However, because animals may travel outside the bounds of the moratorium area, we believe it is still possible that individual Rice's whales will be harassed more than once a year because of exposure to G&G survey activities.

Seismic survey activity occurring in deep water is proposed to occur mostly in the CPA, and, to a lesser extent, in the EPA with a total number of 697 days total combined for the program per year that each type of survey is projected in the EPA. Given the action removed the area under Presidential withdrawal, it is unclear what level of activity is expected in the EPA portion still under active leasing.

Depending on the location of surveys and whales over the course of an entire year, individual whales may be harassed different numbers of days per year. Estimating such detailed exposures is not possible given the geographic scale (per zone) at which BOEM provided projections for survey days. Nonetheless, based on the number of projected exposures per year and the number of Rice's whales estimated in the Gulf of America, animals venturing outside or near the edge of the moratorium area could be exposed multiple times in a year. Based on BOEM's modeling of seismic surveys using multiple source vessels, the number of harassment days per year is not expected to increase, but the duration of exposure each day can be prolonged when multiple source vessels are used or in the case of certain types of surveys, such as coil surveys. The harassment resulting from multiple-vessel surveys can result in longer duration exposures per day that may have a more severe adverse effect on Rice's whales.

Response

Displacement, and frequency of being displaced, from important feeding or breeding areas over a prolonged period would likely be more significant, especially as frequency increases. Marine mammal responses to anthropogenic sound vary by species, state of maturity, prior exposure, current activity, reproductive state, time of day, and other factors (Ellison et al. 2012); this is reflected in a variety of aquatic, aerial, and terrestrial animal responses to anthropogenic sound that may ultimately have fitness consequences (Francis and Barber 2013). Animals generally respond to anthropogenic perturbations as they will predators, increasing vigilance, and altering habitat selection (Reep et al. 2011). Habitat abandonment due to anthropogenic sound exposure has been found in terrestrial species (Francis and Barber 2013). Because of the similarities in hearing anatomy of terrestrial and marine mammals, we expect it is possible for sperm and Rice's whales to behave in a similar manner as terrestrial mammals when they detect a sound stimulus.

Several studies have aided in assessing the various levels at which whales may modify or stop their calls in response to sounds for airguns. Whales continue calling while seismic surveys are operating locally (Greene Jr et al. 1999; Jochens et al. 2006a; Madsen et al. 2002b; McDonald et al. 1993; McDonald et al. 1995; Nieukirk et al. 2004; Richardson et al. 1986b; Smultea et al. 2004; Tyack et al. 2003). However, humpback whale males increasingly stopped vocal displays

on Angolan breeding grounds as received seismic airgun levels increased (Cerchio et al. 2014). Some blue, fin, and sperm whales stopped calling for short and long periods apparently in response to airguns (Bowles et al. 1994; Clark and Gagnon 2006; McDonald et al. 1995). Fin whales (presumably adult males) engaged in singing in the Mediterranean Sea moved out of the area of a seismic survey while airguns were operational as well as for at least a week thereafter (Castellote et al. 2012). Dunn and Hernandez (2009) tracked blue whales during a seismic survey and did not observe changes in call rates and found no evidence of anomalous behavior that they could directly ascribe to the use of airguns at sound levels of approximately less than 145 dB re: 1 µPa (rms). Blue whales may also attempt to compensate for elevated ambient sound by calling more frequently during seismic surveys (Di Iorio and Clark 2009). Bowhead whale calling rate was found to decrease during migration in the Beaufort Sea when seismic surveys were being conducted (Nations et al. 2009). Calling rates decreased when exposed to seismic airguns at received levels of 116 to 129 dB re: 1 µPa (possibly but not knowingly due to whale movement away from the airguns), but did not change at received levels of 99 to 108 dB re: 1 µPa (Blackwell et al. 2013).

Sperm Whale

To evaluate the impact from exposure to sound from G&G surveys at harassment levels for sperm whales, we reviewed studies on the responses sperm whales exhibit to seismic activity, as well as other anthropogenic sounds. Sperm whales may briefly respond to underwater sound by slightly changing their behavior or relocating a short distance, in which case the effects are adverse only if the behavioral changes or movement from the area is measureable.

Several studies have aided in assessing the various levels at which sperm whales may modify or stop their calls in response to sounds for airguns. Sperm whales, at least under some conditions, may be particularly sensitive to airgun sounds, as they have been documented to cease calling in association with airguns being fired hundreds of kilometers away (Bowles et al. 1994). Other studies have found no response by sperm whales to received airgun sound levels up to 146 dB re: 1 µPa (peak-to-peak) (Madsen et al. 2002b; McCall Howard 1999). Given the available data, we assume that some sperm whales exposed to seismic airgun sounds may cease calling or otherwise alter their vocal behavior. Sperm whales that are resting near the surface often produce communication clicks between each other called codas. Coda communication within groups is not likely to be affected by seismic survey sound at far distances, but a passing survey close to whales could disrupt communication while the vessel passes. It is believed that sperm whales passively listen to other whales' echolocation signals during foraging dives. Females can listen to the sonar clicks of one another and use that information to determine the direction and distance of others in their group. This may be important for sperm whales to maximize their foraging efficiency and work cooperatively while foraging to maximize the group's feeding success. However, we expect that any responses involving changes in vocal behavior would be temporary and animals would resume or modify calling at a later time or location away from the seismic source.

Male sperm whales also produce loud, slow, low frequency clicks when accompanying a breeding group of females (http://dosits.org/animals/use-of-sound/marine-mammal-communication/vocalizations-associated-with-reproduction/). These clicks differ from clicks in coda patterns in that they are much louder and not given in any repeatable pattern. It is unknown if males locate female groups by passive listening of female clicks during dives, listening to codas, or some other means. If males are passively listening to sonar clicks of foraging females, there could be some masking of those clicks by seismic survey sound. Masking occurs when a sound is a similar frequency and similar to or louder than the sound an animal is trying to hear (Clark et al. 2009c; Erbe et al. 2016). Masking of sonar clicks could decrease the distance over which males can detect females, resulting in increased energy expenditure by males to find females. However, due to the widespread distribution of sperm whales in the northern Gulf of America, the mating success of whales is not likely to be adversely affected in the long-term by any masking that may occur.

Sperm whale behavioral response to airguns has thus far included mild changes in behavior (temporarily disrupted foraging, avoidance, cessation of vocal behavior) or no reaction. Several studies have found sperm whales in the Atlantic Ocean to show little or no response (Davis et al. 2000; Madsen et al. 2006; Miller et al. 2009b; Moulton et al. 2006a; Moulton and Miller 2005; Stone 2003; Stone and Tasker 2006; Weir 2008). Detailed study of sperm whales in the Gulf of America suggests some alteration in foraging from less than 130 to 162 dB re: 1 µPa peak-to-peak, although other behavioral reactions were not noted by several authors (Gordon et al. 2006; Gordon et al. 2003; Jochens et al. 2006a; Madsen et al. 2006; Winsor and Mate 2006). This has been contradicted by other studies, which found avoidance reactions by sperm whales in the Gulf of America in response to seismic ensonification (Jochens and Biggs 2003; Jochens and Biggs 2004; Mate et al. 1994). Johnson and Miller (2002) noted possible avoidance at received sound levels of 137 dB re: 1 µPa. Other anthropogenic sounds, such as pingers and sonars, disrupt behavior and vocal patterns (Goold 1999; Watkins et al. 1985; Watkins and Schevill 1975). Miller et al. (2009a)found sperm whales did not demonstrate horizontal avoidance to airgun exposure in the Gulf of America, although foraging behavior may have been affected based on changes in echolocation rate and slight changes in dive behavior. Displacement from the area was not observed. Winsor and Mate (2013) did not find a non-random distribution of satellite-tagged sperm whales at and beyond five km from airgun arrays, suggesting individuals were not displaced or did not move away from the airgun array at and beyond these distances in the Gulf of America (Winsor and Mate 2013). However, no tagged whales within five km were available to assess potential displacement within 5 km (Winsor and Mate 2013). The lack of response by this species may in part be due, in part, to its higher range of hearing sensitivity and the low-frequency (generally less than 188 Hz) pulses produced by seismic airguns (Richardson et al. 1995b). Sperm whales are exposed to considerable energy above 500 Hz during the course of seismic surveys (Goold and Fish 1998), so, even though this species generally hears at higher frequencies, this does not mean that it cannot hear airgun sounds. Breitzke et al. (2008)found that source levels were approximately 30 dB re: 1 µPa lower at 1 kHz and 60 dB re: 1 µPa lower at

80 kHz compared to dominant frequencies during a seismic source calibration. Reactions of sperm whales to impulse sound likely vary depending on the activity at time of exposure. For example, in the presence of abundant food or during breeding encounters, toothed whales sometimes are extremely tolerant of sound pulses (NMFS 2006c).

To consider different scenarios where different proportions of the population of sperm whales are harassed by different amounts of G&G sound each year, Farmer et al. (2018b) developed a bioenergetics model to examine the impacts of lost foraging opportunities that may result from exposure to G&G sounds based on a 10-year period of activity. The model was parameterized for juvenile, mature, pregnant, lactating and post-breeding females, juveniles, and mature males and assumed a previously undisturbed population. Changes in body condition and associated energy reserve levels were tracked on a daily basis for disturbed and undisturbed foraging scenarios. During undisturbed foraging days, whales grew and were able to replenish depleted reserves, whereas during days of disturbed foraging, whales were programmed to attempt to cover the caloric deficit from carbohydrate reserves. Remaining deficits were covered by lipid and protein reserves in the blubber, muscle and viscera, until terminal starvation occurred. Although recovery is minimally possible through refeeding, it is not likely that sperm whales could recover once terminal starvation has occurred (Farmer et al. 2018b).

Farmer et al. (2018b) suggests that sperm whales could reach terminal starvation between three weeks and two months depending on the level of disturbance and life stage. Figure 87 displays an undisturbed whale trajectory (left) compared with a disturbed whale trajectory (right). An undisturbed sperm whale makes substantial gains in reserves through time; the rate of these gains in reserves varies with life stage and reproductive status. Infrequent, minor disruptions in foraging are not fatal, but may result in reduced body reserves relative to an undisturbed individual (Figure 87).

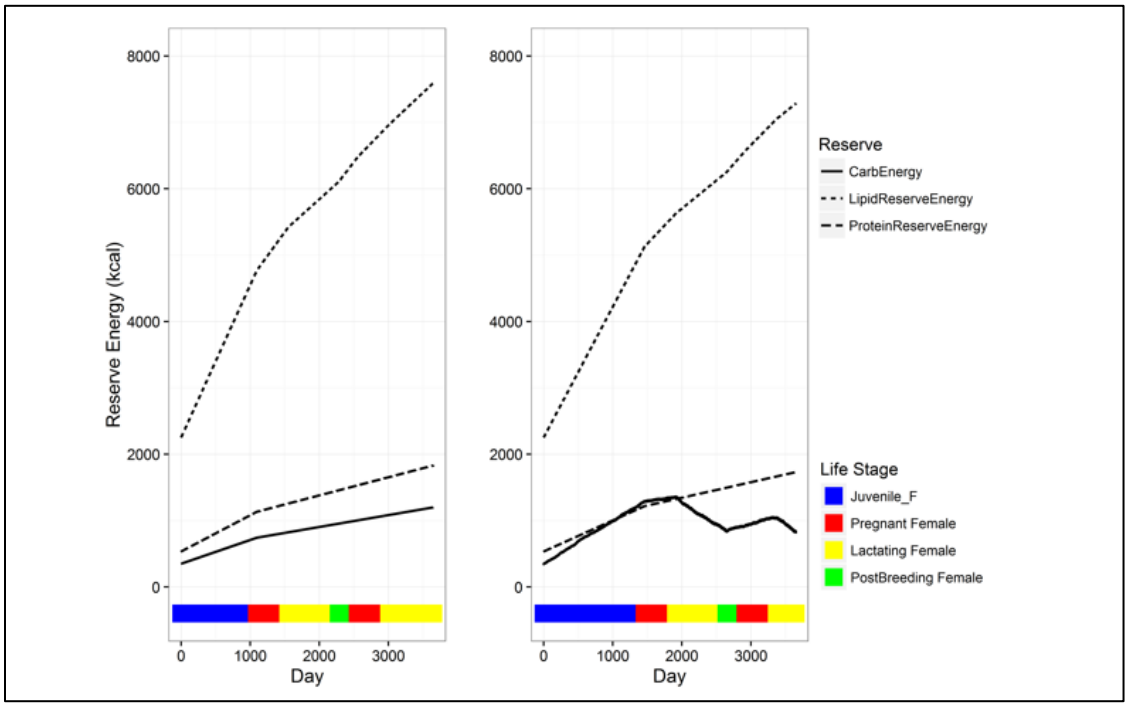


Figure 87. Modeled energy reserve levels of undisturbed (left) versus disturbed (right) sperm whales (Farmer et al. 2018b)

The 500 simulated sperm whales illustrate the ability to endure partial foraging disruptions for much longer time periods than full foraging disruptions (i.e., starvation), largely because partial foraging results in smaller daily caloric deficits (Figure 88). Lactating females and juveniles were the most susceptible life stages.

In a companion paper, Farmer et al. (2018a) utilized the results of the bioenergetics study to model the population consequences of disturbance from G&G for sperm whales in the Gulf of America. In this study, Farmer et al. (2018a) found that foraging impairment from reactions to anthropogenic sounds could have consequences including individual fitness reduction, leading to miscarriage or stillborn, calf abandonment, or terminal starvation depending on the frequency and duration of exposures, the intensity of the behavioral response, and individual ability to compensate for prior foraging disruption through increased consumption and assimilation of prey. It is unclear whether whales can optimize the replacement of reserves (Farmer et al. 2018) or increase the amount of time spent foraging relative to other activities when prey availability or foraging efficiency is reduced (Boyd 1999; Crocker et al. 2006; McDonald et al. 2017a). For approximately three-quarters of the day, sperm whales are in the foraging dive cycle (Watwood et al. 2006). High levels of compensatory foraging might be unrealistic due to limits on food intake associated with constraints on prey acquisition and processing (Rosen et al. 2007).

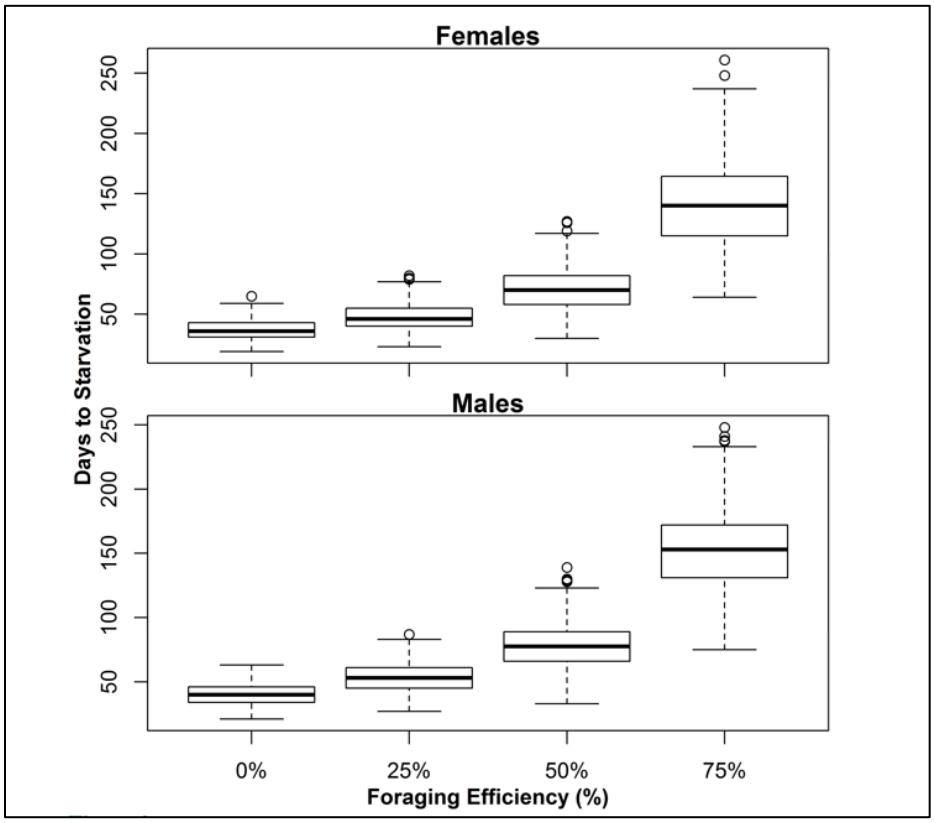


Figure 88. Foraging Efficiency and Starvation (Farmer et al. 2018b)

When using exposure and disturbance based on the step function from Wood et al. (2012), the population consequences of seismic sound exposure to sperm whales in the Gulf of America were not significant when compared with the baseline (Figure 89). However, the majority of model scenarios indicated significant reductions in sperm whale body condition as a consequence of disturbance by G&G activities. For example, when analyzing using other dose-response functions (i.e., 160 dB or Nowacek et al. 2007), the population consequences of behavioral disturbance are predicted to be significant. Reduced body reserves have been implicated in lower reproductive potential (Le Boeuf et al. 2000; Lockyer 1981; Miller et al. 2011; Williams et al. 2014) and reduced calf size and fitness (Christiansen et al. 2014).

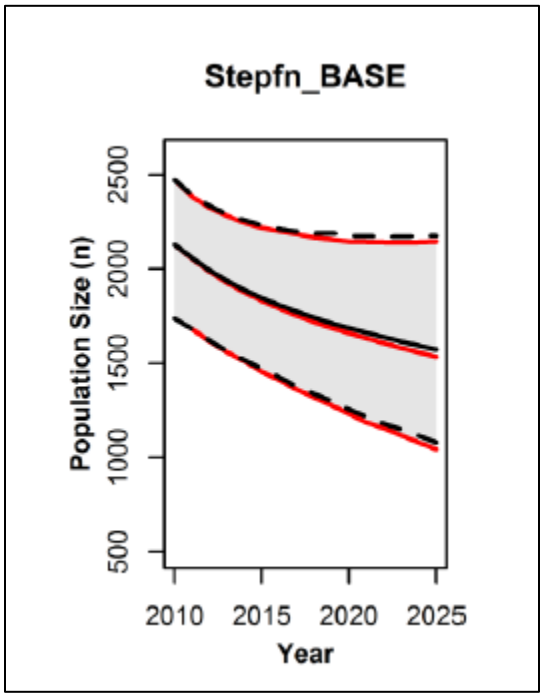


Figure 89. Demographic model representing baseline population trajectories (black lines) with 95% confidence limits (dashed lines), and behaviorally disturbed populations (red lines) (modified from Farmer et al. (2018a))

As part of BOEM's PEIS, an Expert Working Group (EWG) was established to assess potential effects of anthropogenic disturbance on marine mammals, including sperm and Rice's whales. This EWG was made up of private and academic scientists, with support from BOEM, NMFS and the oil and gas industry, to attempt to give more biological relevance to the way anthropogenic disturbance is currently measured. During their work, they had several realizations quoted here from their preliminary report (Southall et al. 2017):

- "Recognition that industrial activities occur within complex acoustic environments that include other human and natural sound sources;
- Geographic scales over which assessments should occur are broader than previously considered;
- The probability of negative effects is strongly species-dependent and context dependent (especially for behavioral effects); and
- The relative magnitude of potential impacts must be evaluated within a biological-significance framework that incorporates key species-specific parameters such as population status, distribution patterns, adaptability, and variability and uncertainty in these and other parameters."

This group used these realizations and available information on anthropogenic disturbance and created an analytical framework and associated risk assessment to better estimate the impacts of behavioral disturbance on marine mammal populations. This framework was then applied to

examine the potential acute effects of anthropogenic sound sources on marine mammals in the Gulf of America, focusing on seismic airgun surveys. The framework had six iterative stages: 1. Describe and quantify survey activity; 2. Derive or obtain protected species distribution; 3. Calculate sound exposure for protected species; 4. Quantify potential exposures regarding sound impact criteria; 5. Evaluate biological significance and perform risk assessment; and 6. Assess overall conclusions. Results included quantitative exposure predictions for injury and disturbance and qualitative predictions as to the biological significance of these exposures. The EWG framework provided a qualitative approach with similar results to the Farmer et al. (2018a) results described above in this section.

It is possible that sperm whales that have previous experience with seismic survey sound may be habituated to them. Habituation is often characterized by animals that appear to no longer respond or have a decreased sensitivity to a disturbance after repeated exposure to the disturbance (Lusseau et al. 2008; Rodriguez-Prieto et al. 2009; Watkins 1986). Animals are more likely to respond more dramatically to a novel sound and will more quickly recover from any disturbance from the exposure over time from repeated experience with the sound. But habituation becomes more rapid and pronounced after a series of habituation-recovery events.

Another form of non-response is tolerance, which is similar to habituation, but may have a different outcome. If a sperm whale is tolerant, or remaining in the area and, perhaps, foraging less efficiently, the effects could be adverse.

We believe that sperm whales are highly motivated to remain in areas that seismic surveys are occurring, so that they can continue engaging in deep foraging dives. The SWSS study showed that although sperm whales were not showing lateral avoidance of surveys, some low-level disturbances to foraging (increased resting periods at the surface and lower “creak” rates) may have been beginning to occur at exposure to airgun sound < 150 dB (rms). We are not discounting the possibility that sperm whales will avoid seismic surveys at closer ranges where exposure will be considerably higher; however, habituated whales or whales that have experienced hearing damage from previous exposures to surveys may not show responses.

BOEM proposes the continued requirement for PSO monitoring of sperm whales and the shut-down of airguns when animals are sighted within 500 m of a vessel. The continued requirements will help limit the number of exposures by shutting down airguns when animals are sighted at the surface. Nonetheless, visual surveys are only effective at detecting animals at the surface and within relatively close proximity to a vessel during daylight hours. Sperm whales will continue to be exposed while they are unsighted when undergoing foraging dives, resting just beneath the surface, at night or times of poor visibility, or within an area of disturbance that extends beyond the 500-m shut-down distance.

There is currently no way for vessels in the Gulf of America to communicate sightings of whales to each other to reduce the possibility of multiple exposures on a day-to-day basis. Advances in PSO and PAM software and satellite communications could allow PSOs to communicate whale

positions to other seismic surveys operating in the area (e.g., coil and azimuth types of surveys). With the current mitigation proposed, the disturbance of animals outside this zone or underwater inside the zone and long-duration disturbances of sperm whales from multiple vessel surveys is likely to occur and adversely affect sperm whales.

Rice's Whale

To understand how exposure to sound will impact Rice's whales, we rely on data indicating that cetaceans may briefly respond to underwater sound by slightly changing their behavior or relocating a short distance, in which case the effects are adverse only if the behavioral changes or movement from the area is measurable.

Given the available data from studies of different cetaceans, described previously, we assume that some Rice's whales exposed to seismic airgun sounds at harassment levels may cease calling or otherwise alter their vocal behavior. However, we expect that such responses would be temporary and animals will resume or modify calling at a later time or location away from the seismic source.

While there are few studies on Rice's whales specifically, there are numerous studies on the behavioral responses baleen whales exhibit to airguns. Activity of individuals seems to influence response (Robertson et al. 2013), as feeding individuals respond less than mother and calf pairs and migrating individuals (Harris et al. 2007; Malme and Miles 1985; Malme et al. 1984; Miller et al. 1999; Miller et al. 2005; Richardson et al. 1995b; Richardson et al. 1999b). In bowhead whales, surface duration decreased markedly during exposure to airgun sounds, especially while individuals were engaged in traveling or non-calf social interactions (Robertson et al. 2013). In addition, migrating bowhead whales show strong avoidance reactions to received 120 to 130 dB re: 1 µPa (rms) exposures at distances of 20 to 30 km, but only changed dive and respiratory patterns while feeding and showed avoidance at higher received sound levels (152 to 178 dB re: 1 µPa [rms]) (Harris et al. 2007; Ljungblad et al. 1988; Miller et al. 1999; Miller et al. 2005; Richardson et al. 1995b; Richardson et al. 1999b; Richardson et al. 1986b). Nations et al. (2009) also found that bowhead whales were displaced during migration in the Beaufort Sea during active seismic surveys. In fact, as mentioned previously, the available data indicate that most, if not all, baleen whale species exhibit avoidance of active seismic airguns (Barkaszi et al. 2012; Castellote et al. 2012; Gordon et al. 2003; National Academy of Sciences 2016; Potter et al. 2007; Southall et al. 2007; Stone and Tasker 2006). Despite the above observations and exposure to repeated seismic surveys, bowhead whales continue to return to summer feeding areas and when displaced, appear to re-occupy within a day (Richardson et al. 1986b). We do not know whether the individuals exposed in these ensonified areas are the same returning or whether though they tolerate repeat exposures, they may still experience a stress response.

Gray whales respond similarly to seismic surveys as described for bowhead whales. Gray whales discontinued feeding and/or moved away at received sound levels of 163 dB re: 1 µPa (rms) (Bain and Williams 2006; Gailey et al. 2007; Johnson et al. 2007; Malme and Miles 1985;

Malme et al. 1984; Malme et al. 1986; Malme et al. 1988; Meier et al. 2007; Würsig et al. 1999; Yazvenko et al. 2007). Migrating gray whales began to show changes in swimming patterns at approximately 160 dB re: 1 µPa (rms) and slight behavioral changes at 140 to 160 re: 1 µPa (rms) (Malme and Miles 1985; Malme et al. 1984). As with bowhead whales, habitat continues to be used despite frequent seismic survey activity, but long-term effects have not been identified, if they are present at all (Malme et al. 1984). Furthermore, when strict mitigation measures are taken to avoid conducting surveys during certain times of the year when most gray whales are expected to be present and to closely monitor operations, gray whales may not exhibit any noticeable behavioral responses to seismic activity (Gailey et al. 2016).

Humpback whales exhibit a pattern of lower threshold responses when not occupied with feeding. Migrating humpbacks altered their travel path (at least locally) along Western Australia at received levels as low as 140 dB re: 1 µPa (rms) when females with calves were present, or six to 12 km from the acoustic source (McCauley et al. 2000a; McCauley et al. 1998). A startle response occurred as low as 112 dB re: 1 µPa (rms). Closest approaches were generally limited to three to four km, although some individuals (mainly males) approached to within 100 m on occasion where sound levels were 179 dB re: 1 µPa (rms). Changes in course and speed generally occurred at estimated received levels of 157 to 164 dB re: 1 µPa (rms). Similarly, on the East coast of Australia, migrating humpback whales appear to avoid seismic airguns at distances of three km at levels of 140 dB re: 1 μPa^2-s. A recent study examining the response of migrating humpback whales to a full 3130 in^3 seismic array found that whales exhibited no abnormal behaviors in response to the active seismic array, and while there were detectible changes in respiration and diving, these were similar to those observed when baseline groups (i.e., not exposed to active seismic sources) were joined by another whale (Dunlop et al. 2017). While some whales were also found to reduce their speed and change course along their migratory route, overall these results suggest that the behavioral responses exhibited by humpback whales are unlikely to have significant biological consequences for fitness (Dunlop et al. 2017). Feeding humpback whales appear to be somewhat more tolerant. Humpback whales off the coast of Alaska startled at 150 to 169 dB re: 1 µPa (rms) and no clear evidence of avoidance was apparent at received levels up to 172 dB re: 1 µPa (rms) (Malme et al. 1984; Malme et al. 1985). Potter et al. (2007) found that humpback whales on feeding grounds in the Atlantic Ocean did exhibit localized avoidance to airguns. Among humpback whales on Angolan breeding grounds, no clear difference was observed in encounter rate or point of closest approach during seismic versus non-seismic periods (Weir 2008).

Observational data are sparse for specific baleen whale life histories (breeding and feeding grounds) in response to airguns, including for Rice's whales. As noted above, the available data support a general avoidance response. Some fin and sei whale sighting data indicate similar sighting rates during seismic versus non-seismic periods, but sightings tended to be further away and individuals remained underwater longer (Stone 2003; Stone and Tasker 2006). Other studies have found at least small differences in sighting rates (lower during seismic activities), as well as whales being more distant during seismic operations (Moulton et al. 2006a; Moulton et al.

2006b; Moulton and Miller 2005). When spotted at the average sighting distance, individuals will have likely been exposed to approximately 169 dB re: 1 µPa (rms) (Moulton and Miller 2005).

In addition to having acute effects due to the immediate exposure of loud sounds from seismic activity, regular, ongoing seismic activity has the potential to significantly add to ambient ocean sound levels (Hildebrand 2009). Unlike sperm whales, Rice's whales are expected to hear best and communicate at the same low frequencies that seismic airguns produce the most sound. As such, the effects of chronic seismic sound are more likely to have adverse effects on Rice's whales when compared to sperm whales.

There is substantial frequency overlap between airgun array sounds and the vocalizations of baleen whales such as Rice's whales. As such, the proposed seismic surveys could mask these calls at some of the lower frequencies for this species. Based on G&G predictions provided by BOEM, seismic activity is expected to occur fairly constantly within the action area. Modeling of chronic exposure to sound associated with BOEM's G&G activities program performed as part of BOEM's 2017 PEIS indicates that at least one location within the area where Rice's whales are most often found is expected to remain relatively quiet (Matthews et al. 2015). This may be because of absorption of sound by soft, non-reflective sediments in this area and/or because the level of seismic activity within this area is expected to be relatively low. Nonetheless, we do not assume that this particular site necessarily best represents the levels of chronic sound from seismic activity across the entire range of Rice's whales in the Gulf of America. In fact, in other locations, Matthews et al. (2015) estimated substantial decreases in both listening space and communication space for Rice's whales. Based on these results, we expect that all Rice's whales would be chronically exposed to seismic sound due to the accumulation of sound across seismic surveys except in the Presidential withdrawl area.

Chronic exposure of Rice's whales to high levels of anthropogenic sound, such as that produced by seismic activity, may result in chronic stress and masking of important biological sounds (Clark et al. 2009b; Hatch et al. 2012; Rolland et al. 2012). Masking could interfere with Rice's whale's ability to gather acoustic information about its environment such as the location of predators, prey, conspecifics, including potential mates, and other environmental cues (Richardson 1995).

The EWG's framework was introduced in the preceding section on sperm whales. For Rice's whales, the EWG results were consistent with our effects analysis. The EWG found that Rice's whales are highly vulnerable to injury and disturbance from G&G activities and also at risk of experiencing greater severity of disturbance and injury as compared to many other marine mammals in the Gulf of America. As such, Rice's whales were considered a high risk species in considering the effects of sound from G&G activities (2017 EWG report).

In summary, based on the available data for other baleen whale species, Rice's whales are expected to exhibit a wide range of behavioral responses as a consequence of being exposed to

levels of seismic airgun sound fields likely to cause adverse effects. Rice's whales are expected to mostly exhibit avoidance behavior, and may also alter their vocalizations. These responses are expected to be temporary with behavior returning to a baseline state shortly after the seismic source becomes inactive or leaves the area. Rice's whales are expected to be adversely affected by chronic exposure to increased ambient sound because of seismic activity. Such chronic exposure is expected to negatively affect the fitness of individual Rice's whales. Because of the Presidential withdrawal in the EPA, where most of the RWA is located and where Rice's whale are primarily found, chronic exposure to seismic sound will be reduced such that individual Rice's whales that remain inside the area will not be adversely affected. However, individuals that move out of this area, will be exposed to chronic sound level increases. The extent of effects from this exposure to individuals will depend on the length of time they spend outside the closed area.

Sea Turtles

Boomer and airgun G&G sound sources have the potential to affect sea turtle hearing and behavior. In this section, we analyze the potential adverse effects to sea turtles that may result from exposure to sound associated with airguns and boomers. For PTS and TTS, we rely on the acoustic thresholds derived by the U.S. Navy (2017) and, for harassment, we rely on information in the literature that suggests harassment occurs at exposure levels of 175 dB re: 1 μPa (rms) and above (McCauley et al. 2000a). Because we do not have density estimates for hawksbill sea turtle, we do not include numbers for this species, although we anticipate exposure of hawksbill sea turtles to sound from airguns and boomers.

Sound Exposure

BOEM did not complete an exposure or response analysis for sea turtles to airguns and boomers under the action, so we conducted our own independent analyses. For sound exposure, we relied on the predictions of G&G activity provided by BOEM in the same seven geographic zones used by JASCO for BOEM's marine mammal exposure modeling. Using these activity level estimates and information on the density of sea turtles, we multiplied averaged zonal species density by the expected annual ensonified area to determine the number of animals that may be exposed to the different G&G sound sources. We also accounted for the corrected G&G activity levels, omitting the area of the EPA under withdrawal.

We estimated the number of sea turtles exposed to airgun and boomer sounds by first determining the estimated radial distance from the representative airgun array used in BOEM's 2017 PEIS modeling efforts to the various acoustic thresholds identified in Table 55. The 8,000 in^3 airgun array was estimated to have a source level of 248 dB (peak) and 238 dB (rms) for an array and a 10-second shot interval.

Table 55. Distance to acoustic thresholds from the 8,000 cubic inches representative airgun array

Response	Radial Distance (m)* to threshold
Permanent threshold shift (PTS) [232 dB re: 1 µPa SPL (0-pk)]	6.3
Temporary threshold shift (TTS) [189 dB re 1 $\mu Pa^2 \cdot s$ SEL_{cum}]	196.2
Harassment [175 dB re: 1 µPa (rms)]	1,412.5

**Radial distances were calculated using a 20 LOGR spreading loss equation.*

We then used these distances to calculate ZOIs (km^2), conservatively relying on the acoustic threshold that resulted in the largest distance for PTS and TTS. ZOIs were calculated as the area that would be ensonified by an airgun array out to the radial distance on either side of a vessel track as the vessel moves through the water. As for marine mammals, we used BOEM's survey activity level projections, estimated in days, to calculate exposure. We assumed an average vessel speed of 4.5 knots to calculate the estimated distance covered in a single day (assuming 24-hour operations), and multiplied this by two times the radial distance to the acoustic thresholds to estimate the total ZOI per geographic zone. We then multiplied the zone specific daily ZOIs by the zonal average densities of each species of sea turtle to obtain the number of sea turtles exposed per zone per 24-hour day. Consistent with how annual marine mammal exposures were estimated by JASCO, we then multiplied the expected 24-hour exposures of sea turtles by the predicted number of survey days to obtain the total annual exposure within the action area. Finally, annual average exposures were calculated as an estimate of annual exposure of adult sea turtles to airgun sounds for the entire duration of the action (Table 56). Importantly, these estimates represent instances of exposure at or above the specified threshold, not necessarily the number of individuals exposed. This is because on average, the estimated per year ensonified area in some cases is greater than the full extent of the action area, indicating that some areas will be ensonified more than once, perhaps even on the same day. Thus, our exposure estimates represent instances of sound exposure and we assume that some individuals will likely be exposed more than once within any given year.

As for sperm whales, the PTS distance for sea turtles was within the near-field of the acoustic source. In fact, at 6.3 meters, a sea turtle would need to be directly under the array, in order to experience sound levels that would cause PTS. However, as noted for sperm whales, within the near-field, sound levels estimated assuming a point source are over-estimated. Thus, for the same reasons we do not expect PTS in sperm whales, we do not expect any individual sea turtle to be exposed to sound fields that would result in PTS. That is, we do not expect sea turtles to approach active arrays because they would likely hear and see the array and avoid it. Furthermore, given that within the near-field and given the dimensions of the array, source levels

would be below the estimated 248 dB (peak) and 238 dB (rms), we believe exceedance of the PTS threshold for sea turtles is extremely unlikely to occur, and therefore discountable.

Table 56. Annual number of adult sea turtles exposed to seismic airgun survey sounds above threshold

Response	Kemp's ridley	Loggerhead	Green	Leatherback
TTS	25,944	40,640	915	902
Harassment	186,779	292,579	6,585	6,496

*Hardshell turtles are incorporated by percentage abundance as Kemp's ridley, loggerhead, green, or hawksbill sea turtles.

The above analysis only estimates the exposure of adult sea turtles to sounds associated with airguns and boomers because the density data we relied on represents sea turtles of approximately 30 cm and greater (Section 8.1.2.2). As such, we conducted an additional analysis to estimate the exposure of juvenile sea turtles to sounds associated with airguns and boomers.

Oceanic juvenile sea turtles typically do not dive very deep and thus, may not frequently enter the area of the loudest sound field produced from a downward pointing airgun array. Oceanic juvenile Kemp's ridley sea turtles (233 mm [about 9.2 in] straight carapace length) with attached data recorders spend the bulk of their time at or within 1 m of the surface (Witherington et al. 2012). Oceanic juveniles spent more than 93% of their time at the surface during the day, and, when dives occasionally occurred, depths ranged from 1.7-3.7 m. At night, dive depths were between 6.3-12.8 m. According to BOEM, airguns are typically towed 8-12 m below the surface and the sound of airguns is directed downward. Although horizontal propagation is known to occur over many kilometers from the source, sound modeling for airgun arrays are not accurate above and lateral to arrays at distances less than 75-100 m from an array (Caldwell and Dragoset 2000) because the sound transmission is much lower and variable in the near-field at the surface. Because the tow depths of airgun arrays and dive depths of oceanic juveniles are very similar, at least at night, based on the Kemp's ridley data discussed above, it is possible that an oceanic juvenile will be located at a depth in which they would experience exposure to an airgun array sound as estimated by the acoustic modeling. However, because juveniles spend most of their time near the surface, in most cases, exposure is expected to be less than that predicted by the acoustic modeling because applying such modeling for near surface waters overestimates sound exposure levels.

The above overview indicates that juvenile sea turtles may be at depths great enough to be considered below an airgun array, but, in many cases, they will likely be closer to the surface where sound levels would be lower. In our sound exposure analysis for juvenile sea turtles, we assume that any sea turtle within the footprint of the ensonified area (i.e., within the area ensonified regardless of depth) may be exposed to sound levels that would result in adverse effects. This is the same approach as for adults because we did not alter our exposure estimates

ro account for the possibility that some adult sea turtles would be near the surface and thus be exposed to lower sound levels than predicted for deeper depths.

To estimate the total number of juvenile sea turtles exposed to sounds from airguns at TTS and harassment acoustic thresholds, we followed the same general methodology used for adults. We first calculated the daily ensonified area at the TTS and behavioral harassment acoustic thresholds for sea turtles, and then multiplied this by the total annual average number of survey days predicted by BOEM of 1,802. The total number of survey days was used because we did not have zone-specific density estimates for juvenile sea turtles. The resulting number, representing the total yearly ensonified area per acoustic threshold, was then multiplied by the juvenile sea turtle density estimates to obtain final exposure estimates in Table 57. PTS exposure was not calculated because it was determined that PTS was discountable.

Importantly, these estimates represent instances of exposure at or above the specified thresholds for a response and not necessarily the number of individuals exposed. This is because, on average, the estimated per year ensonified area in some cases is greater than the full extent of the action area, indicating that some areas will be ensonified more than once, perhaps even on the same day. Thus, our exposure estimates represent instances of exposure and we assume that some individuals will likely be exposed more than once within any given year.

Table 57. Annual number of oceanic juvenile sea turtles taken by exposure to seismic survey sound

Response	Kemp's ridley	Loggerhead	Green	Leatherback
TTS	2,375	17,791	32,675	0
Harassment	17,096	128,086	235,239	0

Response

Given the above estimated exposure, ESA-listed sea turtles may exhibit a variety of different responses to sound fields associated with airguns, including hearing threshold shifts, behavioral responses, and non-auditory physical and physiological responses (Nelms et al. 2016).

Although all sea turtle species studied exhibit the ability to detect low frequency sound, the potential effects of exposure to loud sounds on sea turtle biology remain largely unknown (Nelms et al. 2016; Samuel et al. 2005). Only one study addressed sea turtle TTS, conducted by Moein et al. (1994), in which a loggerhead turtle experienced TTS upon multiple airgun exposures in a shallow water enclosure, but recovered full hearing sensitivity within one day. We assume that sea turtles will not move towards a sound source that causes them stress or discomfort. Some experimental data suggest sea turtles may avoid seismic sound sources (McCauley et al. 2000a; Moein et al. 1994), but monitoring reports from seismic surveys in other regions suggest that some sea turtles do not avoid airguns and were likely exposed to higher levels of pulses from seismic airgun arrays (Smultea and Holst 2003). However, even if sea turtles are in close proximity to a G&G survey sound source, based on our exposure analysis, we

would only expect TTS or behavioral harassment of sea turtles, including responding by moving away from sounds produced by the airgun array. For those individuals that experience TTS, the available data suggest hearing will return to normal within days of the exposure (Moein et al. 1994). Sea turtles that incur hearing impairment due to exposure to seismic surveys may experience an impaired acoustic awareness that increases the risk of adverse effects from human activities on the OCS, as well as increase their susceptibility to natural threats such as predators. Hearing impairment could result in sea turtles no longer responding to the sounds of nearby airguns and not hearing the engine or propeller sound of approaching vessels. A lack of response to these auditory cues could result in an increased risk of vessel strikes. Sea turtles with auditory impairment could still rely on their vision to respond to and avoid potential threats, but avoidance to visual cues (Hazel et al. 2007) would occur at much closer ranges to the threat than the warning an auditory signal could possibly provide.

It is likely that sea turtles will exhibit behavioral responses. Behavioral responses to human activity have been investigated for several species of sea turtles: green and loggerhead (McCauley et al. 2000a; O'Hara and Wilcox 1990); and leatherback, loggerhead, olive ridley, and 160 unidentified turtles (hardshell species) (Weir 2007). The work by O'Hara and Wilcox (1990) and McCauley et al. (2000a) on loggerhead turtles formed the basis of our 175 dB re: 1 µPa (rms) threshold for determining when sea turtles would be harassed by sound exposure because at and above this level loggerheads exhibited avoidance behavior, increased swimming speed, and erratic behavior. Loggerhead turtles have also been observed to move towards the surface upon exposure to airgun sound (Lenhardt 1994; Lenhardt et al. 1983). Loggerhead turtles resting at the ocean surface were observed to startle and dive as an active seismic source approached them, with the responses decreasing with increasing distance (Deruiter and Larbi Doukara 2012). However, some of these animals may have reacted to the ship's presence rather than the seismic source specifically (Deruiter and Larbi Doukara 2012). Monitoring reports from seismic surveys show that some sea turtles move away from approaching airgun arrays, although sea turtles may approach within 10 m of active airgun arrays with minor behavioral responses (Holst et al. 2006; LGL Ltd 2005a; LGL Ltd 2005b; LGL Ltd 2008; NMFS 2006a; NMFS 2006b).

Observational evidence suggests that sea turtles are not as sensitive to sound as marine mammals, and behavioral changes are only expected when sound levels rise above received sound levels of 175 dB re: 1 µPa (rms). If exposed to sound at such levels, based on the available data, we anticipate some change in sea turtle swimming patterns. Some sea turtles may approach the active airgun array, but we expect them to eventually turn away to avoid the active airgun array. As such, we expect temporary displacement of exposed individuals from some portions of the action area as seismic vessels transit through while conducting surveys. The effect of disturbance of sea turtles caused by exposure to seismic survey sound is expected to vary with life history stage. Oceanic juvenile turtles will most frequently be exposed to disturbing levels of sound when *Sargassum* habitat is present within the disturbance distance ZOI (4,467 m) from an airgun array. Exposure within this distance could displace oceanic juveniles from *Sargassum*

habitat needed for food and shelter, resulting in decreased foraging success, increased energy expenditure to find food and new shelter, and an increased risk of predation due to displacement. Adult sea turtles disturbed by sounds from seismic surveys will likely relocate to an adjacent area, at least temporarily, requiring increased energy expenditure and raising stress levels.

Direct evidence of seismic sound causing stress is lacking in sea turtles. Animals often respond to anthropogenic stressors in a manner that resembles a predator response (Beale and Monaghan 2004; Frid 2003; Frid and Dill 2002; Gill et al. 2001; Harrington and Veitch 1992; Lima 1998; Romero 2004). As predators generally induce a stress response in their prey (Dwyer 2004; Lopez and Martin 2001; Mateo 2007), we assume that sea turtles may experience a stress response if exposed to loud sounds from airgun arrays. We expect breeding adult females may experience a lower stress response. Female loggerhead, hawksbill, and green turtles appear to have a physiological mechanism to reduce or eliminate hormonal response to stress (predator attack, high temperature, and capture) in order to maintain reproductive capacity at least during their breeding season; a mechanism apparently not shared by males (Jessop 2001; Jessop et al. 2000; Jessop et al. 2004).

Prey Species

G&G surveys using airguns and boomers could affect sperm whales, Rice's whales and sea turtles by reducing the abundance or availability of prey or changing the structure or composition of the prey community. Sperm whales, Rice's whales and all species of sea turtles are likely to forage in the action area. Because fish and invertebrate species such as squid and jellyfish are pelagic prey for sperm whales and some sea turtles, such effects might have adverse consequences for individuals if foraging success declines because of adverse effects of sound on prey.

A range of invertebrates (jellyfish, crustaceans, arrow worms, octopus, and squid) are reported to be sensitive to low-frequency (10–150 Hz) sound disturbances induced by sound waves or other sources (Western Australian Department of Industry Resources 2002). This sensitivity overlaps the dominant frequency range of seismic pulses. Available studies report responses to airgun shots as being limited to transient alarm responses such as tail-flicks (lobsters), and siphon closing (ascidians) (Western Australian Department of Industry Resources 2002). Mortality of giant squid in the Bay of Biscay may have been because of seismic airgun activity in the area (Guerra et al. 2004). McCauley et al. (2000a) examined the effect of marine seismic surveys on captive squid and cuttlefish and reported a strong startle response or directed movement away from airguns during sudden, nearby start-ups at received levels of 174 dB (rms). Alarm responses in squid were detected during gradual ramp-up of airguns once levels exceeded 156-161 dB (rms). Squid in these trials appeared to make use of the sound shadow measured near the water surface. These responses for captive squid suggest that behavioral changes and avoidance of operating airguns are likely. The authors concluded squid significantly alter their behavior at an estimated distance of 2-5 km from an approaching large seismic sound source.

Studies of the behavioral responses of fish and foraging success in the area of seismic sound sources report similar behavioral responses (Dalen and Knutsen 1986b; Engås and Løkkeborg 2002; Hirst and Rodhouse 2000; Kenchington 1999; LaBella et al. 1996; Santulli et al. 1999; Thomson et al. 2001; Turnpenny and Nedwell 1994; Wardle et al. 2001). Whiting (hake) showed a sudden downward movement, changing their distribution from being dispersed between 25 m (80 ft) and 55 m (180 ft) depth, to forming a compact layer below 55 m (180 ft) in response to airgun sound (Chapman and Hawkins 1969). Toward the end of an hour-long exposure to the airgun pulses, the fish had habituated to the sound and moved up in the water column, despite the continued presence of sound pulses. However, when the airgun resumed firing after a dormant period, the fish exhibited another downward response. In other airgun experiments, catch-per-unit-effort (CPUE) of demersal fish was reported to decline when airgun pulses were emitted (Dalen and Knutsen 1986b; Dalen and Raknes 1985; Skalski et al. 1992). Fish behavior returned to normal minutes after the sounds ceased. In the Barents Sea, abundance of cod and haddock measured acoustically was reduced by 44% within 9.2 km (5 nmi) of an area where airguns operated (Engås et al. 1996). Actual catches declined by 50% throughout the trial area and 70% within the shooting area. This reduction in catch decreased with increasing distance up to 30-33 km (16-18 nmi), where catches were unchanged. Eggs of several commercial fish species exposed to a single seismic airgun (300 in^3) have also been shown to experience a reduction in survival (Kostyuchenko 1973).

In a fairly exhaustive review, Carroll et al. (2017) summarized the available information on the impact seismic surveys have on fishes and invertebrates. Seismic surveys could cause physical and physiological responses, including direct mortality, in fishes and invertebrates. In fishes, such responses appear to be highly variable, and depend on the nature of the exposure to sound from seismic activity, as well as the species. Current data indicate possible physical and physiological responses include hearing threshold shifts, barotraumatic ruptures, stress responses, organ damage, and/or mortality. For invertebrates, research is more limited, but the available data suggest that exposure to seismic activity could result in anatomical damage and mortality in some cases. In crustaceans and bivalves, there is variable information regarding responses with some studies suggesting seismic surveys do not result in meaningful physiological and/or physical effects, while others indicate such effects may be possible under certain circumstances. All available data on echinoderms suggest they exhibit no physical or physiological responses to exposure to seismic activity. Based on the available data, as reviewed by Carroll et al. (2017), we assume some fishes and invertebrates may experience physical and physiological effects, including mortality, but, in most cases, such effects are only expected at relatively close distances to the seismic source. However, recent evidence indicates that seismic airguns may lead to significant mortality of zooplankton out to approximately 1.2 km (McCauley et al. 2017) from the sound source.

McCauley et al. (2017) found that the use of a single airgun led to a decrease in zooplankton abundance by over 50% and a two- to three-fold increase in dead adults in larval zooplankton when compared to control scenarios. Adverse effects to zooplankton were found up to 1.2 km,

the maximum distance to which the sonar equipment used in the study was able to detect changes in abundance. McCauley et al. (2017) note that, for seismic activities to have a significant impact on zooplankton at an ecological scale, the spatial or temporal scale must be large in comparison to the ecosystem in question. This is in part because, for such activities to have a measurable effect, they need to outweigh the naturally high turnover rate of zooplankton (McCauley et al. 2017). In particular, 3-D seismic surveys, which involve the use of multiple overlapping track lines to extensively and intensively survey a particular area, are of concern (McCauley et al. 2017).

In a study of airgun effects on copepods by Fields et al. (2019), copepods (*Calanus finmarchicus*) within 5 to 20 meters of the airgun had higher cumulative mortality within a week of exposure, but did not exceed 30% at any distance after one week. The authors suggested that there may have been an adverse effect from the plankton bags used, and concluded lower adverse effects from airguns than those presented in Fields et al. (2019); McCauley et al. (2017).

The prey of Rice's whales, sperm whales, and sea turtles may exhibit behavioral responses if exposed to active seismic airgun arrays. Based on the available data, as reviewed by Carroll et al. (2017), considerable variation exists in how fishes behaviorally respond to seismic activity, with some studies indicating no response and others noting startle or alarm responses and/or avoidance behavior. However, no effects to foraging or reproduction have been documented. Similarly, data on the behavioral response of invertebrates suggests that some species may exhibit a startle response, but most studies do not suggest strong behavioral responses. Any behavioral responses by prey species may also be associated with a stress response.

Based on the best available data, we anticipate seismic surveys would result in a reduction in availability of prey for ESA-listed species near the airgun array immediately following the use of active seismic sources. This may be due to changes in prey distributions (i.e., due to avoidance) or abundance (i.e., due to mortality), or both. However, we do not expect this to have a measurable immediate impact on sperm whales, Rice's whales, and sea turtles. In many cases, sperm whales, Rice's whales, and sea turtles will avoid closely approaching a seismic array when active and, as such, will not be in areas where prey are affected by sound exposure. Even though we do not anticipate significant immediate adverse effects, long-term, aggregate effects to populations of prey are possible considering the combined effect of all seismic surveys associated with the Oil and Gas Program in space and time.

In their review of the impacts of seismic activity on fishes and invertebrates, Carroll et al. (2017) also examined whether or not seismic activity was associated with population level changes in abundance by examining studies that quantified fisheries catch before and after seismic activity. A few studies found negative effects of seismic activity on catch rates, but most found no effects, and a few found that seismic activity led to an increase in catch rates. In a recent study, Richardson et al. (2017) scaled up the results of McCauley et al. (2017) to examine the effects of a hypothetical seismic survey on zooplankton off the coast of Australia. Their results indicated

seismic surveys had a significant impact on the abundance of zooplankton within and near the survey area, but such effects were short-lived and minimized by ocean circulation.

Based on these studies, there is mixed evidence regarding whether seismic activity can have population level effects to prey, leading to adverse effects to species at higher trophic levels. We do not anticipate seismic activity associated with the action will result in adverse effects to sperm whales, Rice's whales, and sea turtles via indirect effects to prey species for the reasons discussed herein. Firstly, extensive seismic activity has occurred in the Gulf of America for decades and current data do not suggest sperm whales, Rice's whales, and sea turtles are prey-limited. Since 2000, we are aware of five cases of stranded sperm whales in the Gulf of America that showed signs of emaciation, at least one of which appeared to die of age-related complications (NMFS stranding data). For Rice's whales, little information exists on their foraging behavior but impacts to prey are not considered one of the major threats to the species. For sea turtles, while there remain gaps in foraging ecology information, few data indicate prey availability is a threat to the species. Oceanic stage juveniles associated with and foraging within *Sargassum* communities could experience localized, short-term effects from prey reductions. Secondly, while the action area is likely to experience significant seismic activity, male sperm whales (Jochens et al. 2008) and sea turtles (Girard et al. 2009) in particular are not confined to the action area and, therefore, access prey outside of the areas exposed to seismic activity. Furthermore, sperm whales typically feed at great depths, far from the highest sound levels from seismic activity. Therefore, impacts to sperm whale prey are less likely, although this does not discount indirect effects to their prey through effects to lower trophic levels that may be in the area of seismic survey activities and associated sound. While the Rice's whale's range is more constricted, making them less likely to leave the action area, the RWA restriction is likely to provide substantial protection for Rice's whale prey. Thus, while we expect some effects to the abundance and availability of prey for sperm whales, Rice's whales, and sea turtles from sound associated with G&G surveys, these are expected to be too small to be measurable and, thus, insignificant for individual sperm whales, Rice's whales, and sea turtles. Therefore, the effects from impacts to prey associated with G&G survey sound levels are not likely to adversely affect these species.

8.5.3 Effects of Sound from Decommissioning

The use of explosives to decommission oil and gas structures result in short periods of elevated sound levels. When analyzing the effects of sound from the use of explosives during decommissioning, we consider the frequency content of the sound and the duration of the sound source.

BSEE regulations require lessees remove all sea floor obstructions from their leases within one year of lease termination. These regulations require lessees to sever bottom-founded structures and their related components at least 5 m (16 ft) below the mudline (BML) to ensure no portions of the structure that could interfere with future lease activities or other oceanic activities in the area (e.g., shrimp trawling), should the components be exposed due to scour or other sediment

disturbances. The structures for removal are generally grouped into three main categories: 1) the structure (piles, jackets, caissons, templates, mooring devices, etc.), 2) the well (wellheads, casings, casing stubs, etc.), and 3) pipelines. The main sound-related aspect of decommissioning that could result in impacts to sea turtles, Rice's whales and sperm whales is the use of explosives to sever or cut structures to be removed. Non-explosive methods are also used, but have very low impacts on the surrounding environment. BOEM has not provided any information on sound levels produced from non-explosive methods to remove structures. Based on our review of other oil and gas sounds, the sound produced from these non-explosive methods is likely to elicit some short-term behavioral responses that will be to small to be measurably detected and, thus, insignificant. We have no evidence suggesting the sound levels produced are harmful to listed species.

Explosive severance is the primary severance method of concern during decommissioning because it could lead to the disturbance, injury, or death of listed species exposed to the shock waves from underwater explosions. BOEM and BSEE estimate 5-25 structures to be decommissioned annually will be removed using explosives. In the years 2004-2013, six structures were removed with explosives in depths greater than 200 m. BOEM expects no structures would be explosively removed in waters greater than 200 m. All removals with explosives are expected to occur in the CPA or WPA.

No explosive removals are expected in water depths greater than 200 m, hence, sperm whales are not likely to be affected by explosive removal of structures. Given the mitigation measures in place, the presence of any sperm whale within the TTS, injury or mortality zone from sound during an explosive severance operation is extremely unlikely and the potential for TTS, injury, or mortality is discountable.

Due to the majority of sightings occurring within the EPA, the likelihood of Rice's whales being adversely affected by decommissioning activities is extremely low and, thus, discountable. The action does not include new leases and structures requiring decommissioning in this area where the whales are most common.

We do not expect decommissioning to have adverse effects on Rice's whales or sperm whales based on BOEM's projections that the 10-year period of new leases evaluated in this opinion will not include new leases in the EPA. If new leases are offered in the EPA such that decommissioning of structures would occur over the timeframe of this opinion, or should a structure in water depths greater than 200 m be proposed, reinitiation of consultation would be required.

8.5.3.1 Overview of Decommissioning and Effects of Underwater Explosions on Sea Turtles

In this section, we describe the probable risks of the structure removal activities on sea turtles. We describe the particular aspects of decommissioning that may affect listed sea turtle species and the routes of effects from those activities. In particular, we examine the major stages of decommissioning with emphasis on the use of explosives to sever structures from the ocean

bottom. Our analysis will examine the possible effects to listed species from using underwater explosives based on the exposure thresholds and areas that may be affected, PSO data from past decommissioning activities, and other available scientific and commercial data.

We look at three stages of decommissioning in this section:

1. Pre-severance operations (reparation and cleaning of the structure to be removed);
2. Severance and removal of the structure (with explosives and other cutting methods); and
3. Site clearance activities (Table 58).

Table 58. Summary of actions and potential effects resulting from decommissioning

Decommissioning Stage	Activities	Route of Effects
Pre-Severance Activities	Pipeline flushing, tank and deck cleaning, top-side cutting, equipment removal, pile jetting, survey work (sonar, diver, and/or ROV), deployment of work vessels, equipment, and personnel	Exposure to changes in water quality, air quality, vessel and construction sound, marine debris
Severance and Removal of Offshore Structures	Non-explosive cutting, explosive severance, PSO monitoring, vessel transport of structure to shore for salvage, or granting a variance for an alternative use for a state reef programs	Behavioral response to detonation sound, injury or death from pressure waves, vessel and construction sound, and vessel strikes
Site Clearance	Bottom trawling, diver surveys, sonar surveys	Capture, forced submergence, and retrieval in trawl nets

Pre-Severance and Severance Activities

Vessels are mobilized to the removal site to transport equipment and crew to and from the work site. Stressors from vessel operations associated with decommissioning include vessel discharges to marine waters. We consider the potential effects of air emissions and discharges to OCS waters, vessel strikes, and marine debris for all OCS oil and gas activities, in separate subsections of this opinion and focus on acoustic stressors in this portion of the analysis.

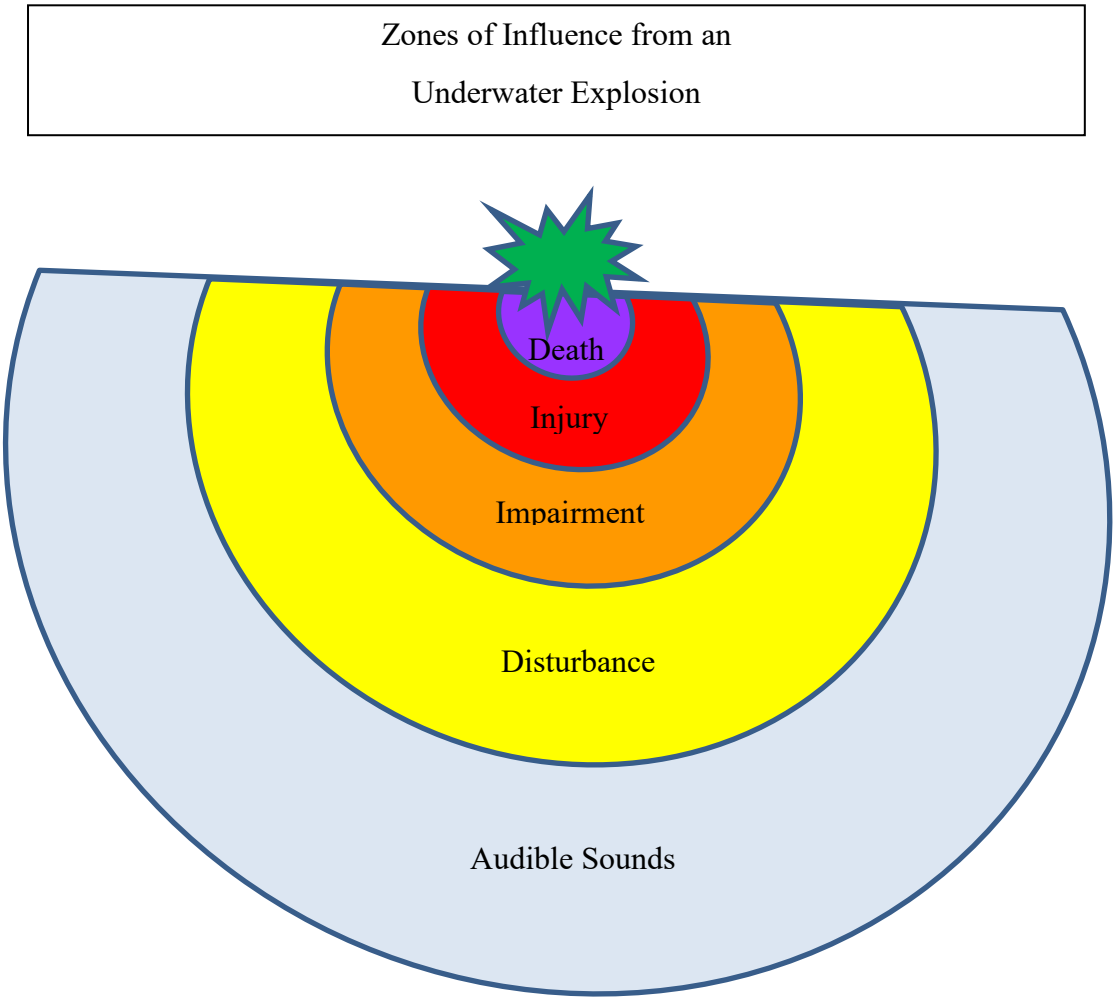
Pre-severance activities include vessel anchoring, jetting of sediments for below mudline (BML) severing, and removal of surface structures before the structure is cut. Jetting uses high-pressure water sprayed from inside or outside of a pile to excavate sediment and sand layers. Jetting could result in sound up to 170.5 dB re 1 µPa (peak) (Molvaer and Gjestland 1981)or about 160 dB (rms). This level of sound is not expected to result in any behavioral disturbance to sea turtles. Jetting sound would be short-term and minor while preparing a structure for cutting from the seabed. Although jetting will temporarily increase the ambient sound levels in the area, the potential for jetting sound to affect ESA-listed sea turtle species given the sound level in comparison to sea turtle hearing thresholds means disturbance is extremely unlikely to occur and, thus, discountable.

Underwater Explosions

The largest concern with structure removals is the use of explosives for severance. Most of the structures to be severed with explosives have cylindrical metal components protruding from the bottom sediment, such as support legs, piles, or well conductors that are the focus for severance. A variety of explosives are used to disconnect structures from their foundation under the sea floor, such as pentaerythritol tetranitrate, cyclonitrite (RDX), trinitrotoluene (TNT), Composition B, and C-4. Explosives are placed inside or outside of these structures such that the energy from a blast will sever the target by mechanically distorting (ripping), jet cutting, or fracturing the material. As noted in the previous section, since BSEE requires that bottom-founded components are cut at least 5 m (16 ft) BML, most severance charges are placed at 6 m (20 ft) BML or greater to increase the tamping effect and allow for a second detonation below the minimum cut depth, if the first detonation is not successful. Additionally, explosives can also be used above the mud line to cut structures above the foundation to assist in large jacket disassembly and removal operations.

Underwater detonations, like other loud sound-producing sources, have more severe impacts at closer distances to the detonation because the pressure wave is more pronounced near the source (Figure 90). An underwater explosion is composed of an initial shock wave, followed by a succession of oscillating bubble pulses. A shock wave is a compression wave that expands radially out from the detonation point of an explosion. At a given distance from a detonation, the propagation of the shock wave may be affected by several components including the direct shock wave, the surface-reflected wave, the bottom-reflected wave, and the bottom-transmitted wave. The direct shock wave results in the peak shock pressure (compression) and the reflected wave at the air-water surface produces negative pressure (expansion).

For an explosion underwater, a blast wave travels through the animal's body and may cause internal injury to gas-filled organs (e.g., ears, lungs, intestines, and other organs) due to impedance differences at the gas-liquid interface. In the case of detonations, the pressure wave is very pronounced from the sudden release of high energy, and the resulting shock wave can have injurious or mortal impacts to animals closest to the site. The amount of explosives used is the primary factor affecting the size of the impacted area, but extent of impacts is also affected by the depth of the charge, type of explosive, and whether bulk or shape charges are used. Impacts of explosive severance on sea turtles include death, injuries to internal organs, auditory damage, physical discomfort, and behavior disruptions.



A generalized diagram showing one-half of the zones of influence associated with an underwater explosion

Nature of Explosive Use in Severance Activities

Depending on the size of the structure or complex of structures, multiple charges are often used for each detonation event Table 59). Charges are separated by a delay of about one second to prevent pressures from combining into a larger pressure wave; however, a detonation can last for as many seconds as there are charges. The number of detonation events per structure ranges from one to five per day, depending on the complexity of the structure (Table 60).

Table 59. Number of charges per detonation event used to remove offshore structures in 2013

	Number of Explosive Charges/Detonation Event									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10-16**
Number of Occurrences	77	9	14	18	13	6	4	5	1	5

Source: BOEM BA supplemental information.

Table 60. Number of detonation events used to remove offshore structures in 2013

	Number of Detonations Events/Structure				
	1	**2**	**3**	**4**	**5**
Number of Occurrences	50	34	3	5	1

Source: BOEM BA supplemental information

Heavier charge weights result in explosions with larger impact zones. Since 2008, there has been a trend to use increasingly larger charge weights after industry was permitted to use charge sizes above 50 lb. The most commonly used charge weight in 2008 was in the 5-100 lb range. In 2013, the use of 150-200-lb charges were the most common (NMFS Platform Removal Observer Program, Figure 91). Therefore, a 200-lb charge, which is the largest recorded as used during decommissioning (although weights up to 500 lb are permitted) is used in this analysis to estimate the largest ZOI for all explosive removals.

BSEE developed an "Under Water Calculator" (UWC) to estimate the distance of ZOIs from different charge sizes. The UWC can calculate a pressure distance for any charge placed 15 ft below the mudline inside a pile, leg, conduit, or other structure. The UWC is intended as a tool to predict zones of influence from different charge weights placed inside of a pile for various structure types and is considered the best available tool for its purpose. The UWC informs the development of appropriate mitigation measures to minimize impacts to sea turtles and marine mammals, and is used to identify the appropriate mitigation strategy for individual projects that propose different charge weights and different placement of explosives to sever structures on the OCS. The UWC underwent a peer review through the Center for Independent Experts (CIE) completed in early 2017. The CIE review concluded the tool was useful for informing mitigation and had an adequate level of accuracy. The CIE panel made recommendations for improvements that BSEE has indicated it will be using to make adjustments to the tool. The UWC was used to calculate representative distances to impact zones relative to charge sizes for sea turtles (Table 61).

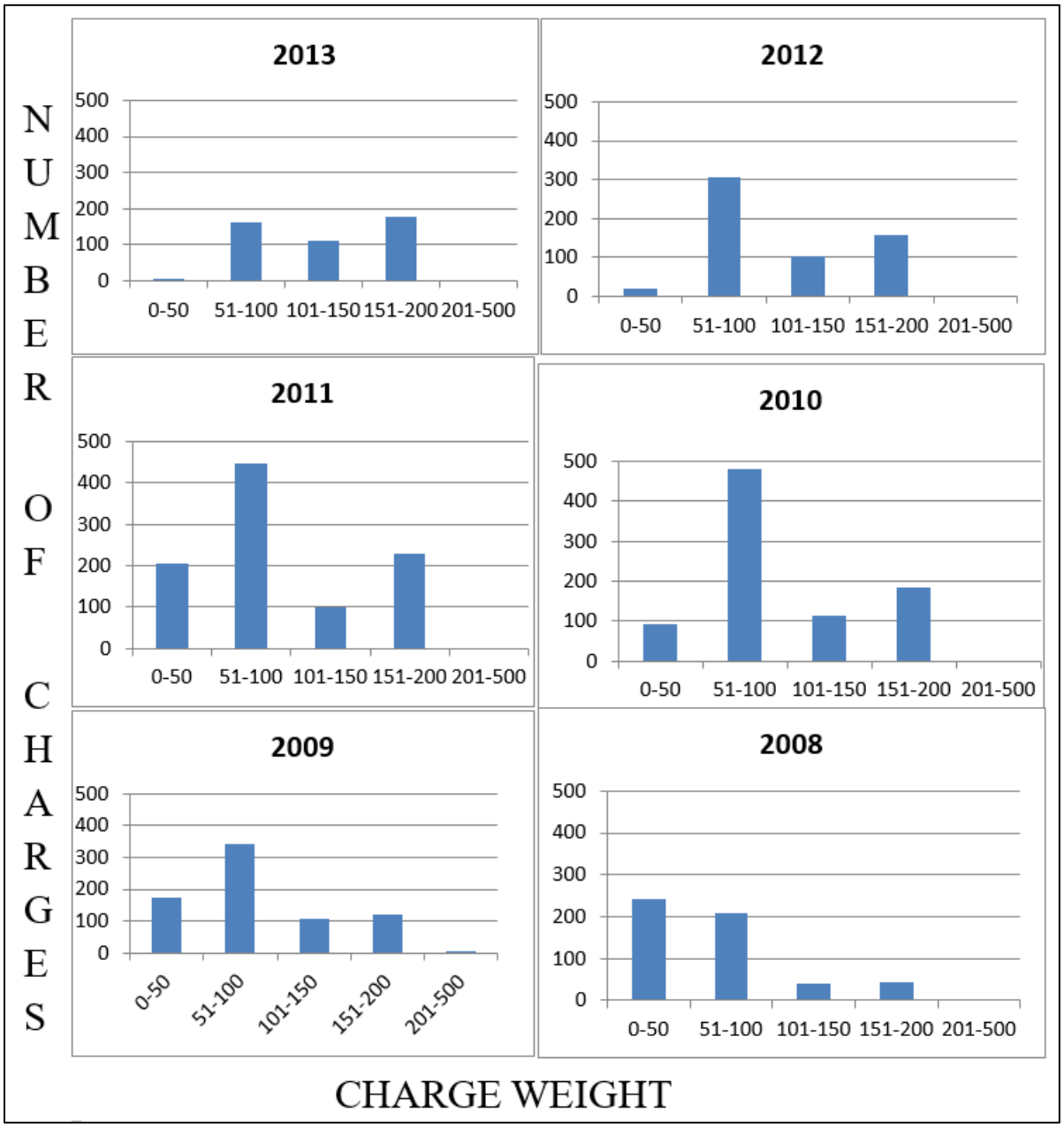


Figure 90. The size and number of charge weights used from 2008-2013 (BOEM BA supplemental information)

Table 61. Representative impact distances for sea turtles from two charge sizes within and outside structures

Zone of Influence	UWC Radius (m) and Area (km^2) from Detonation			
	80-lb Charge in Open Water		200-lb Charge in Open Water	
	Radius	Area	Radius	Area
Mortality	155.2	0.076	210.7	0.140
Injury	358.8	0.404	478.9	0.721

Impairment	573.3	1.033	778.1	1.902
Disturbance	1,014	3.230	1376.8	5.955

	80-lb Charge in a Main Pile		200-lb Charge in Main Pile	
	Radius	**Area**	**Radius**	**Area**
Mortality	34.9	0.004	47.3	0.007
Injury	58	0.011	78.8	0.020
Impairment	78.5	0.019	106.5	0.036
Disturbance	111.8	0.039	151.8	0.072

Source: BSEE UWC supplemental information

8.5.3.2 Sea Turtles

There are several accounts of sea turtles spending considerable time around some offshore oil and gas structures, presumably for shelter and feeding on animals living on or near the structure. Although turtles do not spend their entire lives around structures, they could spend days, or, in some cases months, before moving to other areas. Offshore oil and gas structures provide topographic relief and have been shown to attract sea turtles (Gitschlag and Herczeg 1994; Lohoefener et al. 1990; NMFS 1989; Rosman et al. 1987). Offshore structures support algae, barnacles, and other colonizing organisms that serve as food for sea turtles.

The underwater use of explosives can kill, injure, impair, and cause animals to have behavioral responses to detonations. Lethal injuries result from massive trauma or combined trauma to internal organs as a result of close proximity to the point of detonation. Impacts to sea turtles from explosive removal operations may range from noninjurious effects (e.g. acoustic annoyance; mild tactile detection or physical discomfort) to varying levels of injury (i.e. non-lethal and lethal injuries)(Viada et al. 2008). Very little information exists regarding the impacts of underwater explosions on sea turtles (Viada 2008). Effects of explosions on turtles often must be inferred from documented effects to other vertebrates with lungs or other gas-containing organs, such as mammals and most fishes. Types of lethal injuries reported for marine mammals include massive lung hemorrhage, gastrointestinal tract injuries (contusions, ulcerations, and ruptures), and concussive brain damage, cranial and skeletal (shell) fractures, hemorrhage, or massive inner ear trauma (Ketten 1995). Examples of nonlethal injuries include eardrum rupture, bruising, and immobilization of severely stunned animals. Stunned animals beneath the water may drown or become vulnerable to other impacts while they are immobilized. Minor organ injuries and contusions can occur as a result of underwater explosions; however, sea turtles are expected to recover over time through normal healing processes. Still, delayed complications arising from nonlethal injuries could ultimately result in the death of the animal because of increased risks from secondary infection, predation, or disease. Rupture of the ear drum is not a life-threatening injury, but it does correlate to permanent hearing loss (Ketten 1995) and could adversely affect an animal's hearing.

The injury and death of sea turtles exposed to underwater explosions have been reported in several cases (Duronslet et al. 1991; Gitschlag and Herczeg 1994; Klima et al. 1988). NMFS studied the effects of offshore oil and gas structure removals using 23 kg (50 lb) of nitromethane (Klima et al. 1988). Loggerhead and Kemp's ridley sea turtles were located at distances of 213.4 m (700 ft), 365.8 m (1,200 ft), 548.6 m (1,800 ft), and 914.4 m (3,000 ft) from the platform removed with explosives. The charges were placed inside platform pilings at a depth of 5 m below the mudline. Four sea turtles within 365.8 m of the detonation were unconscious following detonation, as well as an individual at 914.4 m (3,000 ft). Sea turtles were expected to have drowned if they were not recovered from the water following the detonation. Recovered turtles exposed to the blast exhibited everted cloacas, and abnormal pink coloration of soft tissues around the eyes and external nares and the base of the throat and flippers for a period of two to three weeks. Other Kemp's ridleys that were further from the detonation were apparently unharmed. In another case, an unintended exposure of sea turtles to a blast occurred. This resulted in two immature green turtles (100-150 ft away) being killed when 20 lb of plastic explosives (C-4) were detonated in open water by a U.S. Navy Ordnance Disposal Team. Necropsies revealed extensive internal damage, particularly to the lungs (Schroeder and Foley 1995). Three sea turtles were unintentionally exposed to underwater shock tests by the Naval Coastal Systems Center in 1981 off the coast of Panama City, Florida. Three detonations of 1,200 lb of TNT at mid-depth (in about 120 ft of water) injured one turtle at a distance of 500-700 ft and another at 1,200 ft from the blast. A third turtle 2,000 ft from the blast was apparently not injured (O'Keefe 1984).

Non-lethal effects of underwater explosions on marine turtles include impairment or displacement of oceanic juveniles from developmental *Sargassum* habitat. Observable behaviors of effects on adults include erratic swimming at the surface, stunned animals floating motionless or with little movement, and other indications of abnormal behavioral. These behaviors may result from the detection of strong vibrations and pressure waves throughout the body that cause physical discomfort and temporary hearing loss. Physical discomfort or tactile detection can occur in the soft tissue areas around the nose, eyes, mouth, nares, and vent, or vibration through the shell and bones of a turtle. Marine turtle auditory perception occurs through a combination of bone and water conduction (Lenhardt et al. 1983), and it is reasonable to assume that exposure to shock impulses produced by underwater explosions are sufficient to elicit a strong disturbance response.

Sound Exposure and Response

Different sizes of impact zones result from the wide range of charge sizes authorized under the Oil and Gas Program. Response threshold levels are used to estimate the ranges within which certain effects can occur, determine the risk of those effects to listed sea turtle species, and develop mitigation and monitoring to reduce effects. Any exposure to levels resulting in impairment, injury, or mortality would adversely affect a sea turtle. Oceanic juvenile sea turtles could also be adversely affected throughout the disturbance zone because they could be

displaced from important developmental habitat provided by the *Sargassum* community. The threshold levels for each type of effect considered in this exposure analysis are defined below (Table 62).

Table 62. Sea turtle exposure thresholds for five levels of severity from single detonation events

Mortality	Injury	Impairment	Disturbance	Onset of Behavioral Response
> 237 dB (peak)a or 102 psi	> 229 dB (peak)b or 40 psi	> 224 dB (peak)c or 23 psi	> 218 dB (peak)d or 12 psi	> 180 dB (peak)e or 0.14 psi
Mortal injury, cracked carapace, lung, intestinal, and organ damage	Potentially lethal physical injuries, prolonged immobilization by stunning, auditory trauma	Temporary hearing loss, stunning (disorientation, erratic flipper movements, or brief immobilization)	Oceanic juvenile habitat displacement from the area, increased swimming speed, increased heart rate	Brief response to a single explosive "bang," startle responses which include diving or swimming

[a] Richmond et al. 1973
[b] Popper et al. 2014
[c] Impairment levels are approximated from the stunned sea turtles observed by NMFS PSOs following detonations.
[d] Disturbance levels are approximated as a sub-TTS, high level behavioral response.
[e] DeRuiter and Doukara 2012

We consider the potential for adult sea turtle impairment, injury and mortality from underwater explosions. We took a representative removal scenario of a 200-lb charge detonated in a main pile and calculated the area over which it could cause adverse effects to sea turtles. To calculate the distance from a structure for each zone of influence, we used BSEE's UWC. We then analyzed PSO data from NMFS's Platform Removal Observer Program (PROP) to estimate the number of animals expected to occur within these ZOIs during future removals under the Oil and Gas Program. We believe using PSO data is the best approach for estimating exposures to explosive severance because PSO data from PROP are robust. Many animals can be seen from a low-flying helicopter prior to detonation and sea turtle exposures have been minimized since the start of the PROP in 1987. We acknowledge that there is the potential for unobserved turtles to be exposed to sound from explosive severance. However, we believe the data provided by PROP are the best available information compared to information on adult sea turtle densities in the action area because PSO data better represent the actual density of turtles around platforms. Platforms and other structures tend to create habitats that may in fact attract sea turtles; therefore, the density of sea turtles around platforms may be higher than elsewhere in the action area.

The following is a description of our analysis from the 2020 opinion. We did not conduct a new analysis of sea turtle exposure to explosive sound from decommissioning activities for this opinion because the UWC and associated modeling we are currently awaiting a new version of the UWC, which has not been updated since the 2020 opinion. As such, the analysis below was not run with updated PROP data or the new estimated maximum annual number of structures to

be decommissioned of 25 (see Section 3.1.4.12). Instead, the previous estimate of 81 annual decommissioned structures via explosives was used.

We evaluated PSO sea turtle sightings data to determine the average number of individuals sighted for each species per structure (Table 63).

Table 63. Total number of adult sea turtles observed at structure removal sites during 2004-2013

Species	YEAR										
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Avg. Number/ Structure
Kemp's ridley	7	15	5	18	17	50	53	56	76	60	0.3168
Loggerhead	90	67	168	44	53	108	83	93	124	71	0.7995
Green	2	4	0	1	4	4	3	0	16	7	0.0364
Leatherback	1	0	2	2	2	3	3	7	9	8	0.0328
Hawksbill	0	0	0	0	0	1	1	2	0	0	0.0035
Unknown	36	14	16	20	20	32	24	24	68	31	0.2529
											Total
Total Turtles	136	100	191	85	96	198	167	182	293	177	1625
Number of Structures	90	93	69	86	96	126	144	188	130	105	1127

[a] *Each sea turtle sighting was counted as a separate individual unless there was evidence indicating the same animal was observed on multiple occasions. Evidence might include distinguishing characteristics such as carapace size, barnacle pattern, etc., as well as dive frequency and location. When PSOs lacked a clear view of a turtle and it was impossible to determine if this was a repetitive sighting, the turtle was generally recorded as a new individual. Bias in the data include that these numbers over represent the actual number of individual sea turtles that occurred due to repeated sightings, and underreporting of individuals that went undetected by PSOs. Source data: NMFS' Platform Removal Observer Program.*

Sightings of sea turtles from PSO data show loggerheads are more commonly sighted around oil and gas platforms, even though NMFS density estimates show that Kemp's ridleys are reportedly more abundant. Whether this is due to differences in habitat use (water depth of removals), a greater affiliation of loggerheads with oil and gas structures, or other reasons is currently unknown. From the total number of sea turtle sightings over 10 years, we corrected the number of sightings for unidentified sea turtles by applying the relative proportion of positive identifications for each sea turtle species to unidentified turtle sightings and correcting the positive identified turtle numbers (Table 64).

Table 64. Adjusted number of adult sea turtle sightings around oil and gas structures to account for unidentified sea turtles

Species	Adults/Structure	Percent of Sightings	Correction for Unknowns	Adjusted Adults/Structure
Kemp's ridley	0.3168	26.64	0.0673	0.3841
Loggerhead	0.7995	67.24	0.1700	0.9695
Green	0.0364	3.06	0.0077	0.0441
Leatherback	0.0328	2.76	0.0070	0.0398
Hawksbill	0.0035	0.30	0.0007	0.0043

We used these sightings numbers (Table 64) to predict the number of adult sea turtles that may be exposed to future underwater explosions because of the 81 explosive removals predicted to occur annually. This was accomplished by converting the distances for each ZOI we calculated with the UWC to an area (km^2). We then compared the areas for each ZOI. For the representative scenario of a 200-lb charge detonated in a main pile (Table 61), the comparison for each ZOI shows the mortality zone is 5.19% of the total area, the injury zone is 14.81% of the total area, and the impairment zone is 26.67% of the total area monitored. The remaining 53.34% of the area encompasses the disturbance zone. Using these percentages, we used the average number of sea turtle sightings around platforms and calculated the number of sea turtles that could be present in each ZOI (Table 65).

Table 65. Predicted annual number of adult sea turtles present in the ZOI for 81 annual structure removals based on ten years of protected species observer sightings

Effect	Total Predicted Sea Turtle Sightings from PSO Data				
	Kemp's ridley	Loggerhead	Green	Leatherback	Hawksbill
Mortality	2	4	0	0	0
Injury	5	12	1	0	0
Impairment	8	21	1	1	0

Note: Predicted sightings are calculated by multiplying the number of adjusted sightings per structure times 81 structures removed with explosives annually

Although the data show that sightings are frequent, impacts are expected to be minimized due to the use of PSOs monitoring the area for sea turtles and detonations being delayed when sea turtles are sighted. Thirteen sea turtles have been observed that were injured or killed during explosive removals of platforms since 1987 when NMFS's PROP began observations of sea turtles during decommissioning activities through 2016 (Table 66).

Table 66. Sea turtles that have been observed to be injured or killed during explosive removals of platforms between 1990 and 2016

Date	Observed Injury	Species	Number of Charges	Charge Weight (lb)	Water Depth (ft)	Distance from structure/Time after Blast
10/4/90	Cracked carapace	Loggerhead	1	35	60	10 yd, 1-17 minutes after blast
11/20/97	Cracked carapace	Loggerhead	1	50	72	30 yd, 11 minutes after blast
7/16/98	Dead	Loggerhead	2	50	89	13 yd, 4 minutes after blast
8/20/01	Stunned/not recovered	Loggerhead	7	50	39	50 yd, 5 minutes after blast
8/8/10	Cracked carapace, died	Loggerhead	4 and 3	80 and 180	77	10 yd, 19 min after blast
8/20/10	Dead	Loggerhead	8 and 1	200 and 80	241	50 yd, 4 min after blast
8/15/11	Lethargic/not recovered/unknown injury	Kemp's ridley	1	60	52	500 yd, 2 min after blast
8/27/11	Belly up, flailing flippers/not recovered/injury unknown	unidentified	13	Six 160 and seven 80	136	Unknown, reported by barge captain
3/29/12	Stunned/not recovered/unknown injury	Green	4	160	98	66 yd, 30 min after blast
10/23/12	Stunned/not recovered/unknown injury	Kemp's ridley	3	80	165	466 yd, less than 1 min after blast
7/18/13	Dead	Kemp's ridley	3	80	18	10 yd, 21 min after blast
03/03/15	Injured/bleeding/ cracked carapace	Loggerhead	4	200	130	25 yd, 50 minutes after blast [a]
11/09/15	Stunned	Kemp's ridley	4	80	130	648 yd, 10 minutes after blast

[a]*Post-detonation survey had already ended*

To estimate the severity of effects from underwater detonations to adult sea turtles, we first evaluated injuries and mortalities, then we evaluated impairments. We estimated the number of affected animals over five-year periods using the PSO data and BOEM's projected activity levels

to predict the number of expected injuries and deaths, because annual estimates would result in fractions of turtle takes.

As displayed in Table 66 from 2011-2016, two loggerheads, three Kemp's ridleys, one green, and one unidentified turtle were documented as having been injured or killed as a result of explosive removal of structures during decommissioning. All unidentified sea turtles sighted around structures have been hardshell species that were likely loggerhead, green, or Kemp's ridley sea turtles. There has never been a hawksbill or leatherback documented as killed because of explosive removal of structures during decommissioning, likely because these species are not common near structures. We calculated that injuries and deaths should correspond to one turtle for every 17 structures (24/405=0.05926 per structure) removed under the action. Over each year, we expect 81 structures will be removed with explosives, resulting in 24 sea turtle injuries and deaths for all species. Because injury can result in delayed mortality, we combined injury and mortality into a single category (Table 67). Using the relative proportions of each species around structures calculated based on data from 2011-2016 PROP reports and the number of turtles reported taken by injury or mortality, we estimate the number of each species of adult sea turtles that will be injured or killed during any given year in Table 68. To account for potential injurious or lethal effects to leatherbacks and hawksbills in the future, we assumed there is the potential for one individual of each species to be impacted. To estimate the number of unobserved turtles, we used the PROP data to calculate an average of the percentages of turtles observed within the pre-detonation zone, but not observed during post-detonation surveys, or had unknown fate, which was approximately 91%.

Table 67. Numbers of predicted occurrences of adult sea turtles in the zone of influence for injury and mortality, and the number of takes expected from underwater explosives if the proposed mitigation and monitoring requirements are followed

Injury and Mortality	Annual Number of Adult Sea Turtles				
	Kemp's ridley	Loggerhead	Green	Leatherback	Hawksbill
Number of predicted occurrences in ZOI	7	16	1	1	1
Number avoided[40] (observed turtles)	6.93	15.84	0.99	0.99	0.99
Total Takes Expected (including unobserved turtles[41])	6.44	14.72	0.92	0.92	0.92
45 year totals	290	663	42	42	42

Next, we evaluated potential impairment of adult sea turtles exposed to sound from detonations. Impaired adult sea turtles may remain mobile and rapidly swim away from the area following

[40] Seven injury/mortality takes from 2011-2016 out of 1,042 PSO-reported turtle observations around platforms (PROP reports 2011-2016).
[41] Unobserved numbers were estimated by multiplying 91% (unknown fate) by the number expected in the ZOI.

exposure to the sound, but a few may be stunned at higher exposures that temporarily immobilize the animal. Based on PSO reports few stunned turtles are expected and most of the temporarily impaired animals are not expected to be observed post-detonation because most turtles are expected to swim away from the area. Although we expect many of the potential impairments can be avoided by implementing the requirements to monitor for turtles pre-detonation, we predict there will be turtles impaired that are unobserved.

Based on sightings and observed impacts to sea turtles, the aerial and surface monitoring for sea turtles conducted by PSOs appear to be very effective at detecting animals and minimizing the number of injuries and deaths during explosive use as part of structure removal. Despite the effectiveness of monitoring to avoid impacts, some sea turtles are still injured or killed by underwater explosions and some sea turtles exposed to sublethal sound levels go unobserved because affected animals are likely to swim away before being sighted. Some injuries and deaths are probably underestimated because dead sea turtles are likely to sink to the ocean bottom (Klima et al. 1988), or they may not be sighted due to their small size. Therefore, it is assumed that some turtle injuries and deaths occur but are not observed.

Table 68. Numbers of predicted occurrences of adult sea turtles in the zone of influence for impairment and the number of takes expected from underwater explosives following the proposed effects minimization measures

Impairment	Numbers of Adult Sea Turtles				
	Kemp's ridley	Loggerhead	Green	Leatherback	Hawksbill
Number of predicted occurrences in ZOI	8	21	1	1	0
Number avoided (observed turtles)	7.92	20.79	0.99	0.99	0
Total Takes Expected (unobserved turtles)	7.36	19.32	0.92	0.92	0
45 year totals	332	870	42	42	0

Sound levels less than 180 dB (peak) are not expected to displace adult sea turtles from the area or disrupt normal behaviors. Exposure to louder sound > 180 dB (peak) may result in more pronounced behavioral responses that can include turtles leaving the area. Structure removals with explosives also result in some loss of available habitat for adult sea turtles using the area affected by an explosion. Adult sea turtles are likely to relocate to an adjacent area or expand their foraging range. Sea turtles use large oceanic areas relative to the area affected by explosive stressors. The displacement from an area where an explosive removal is occurring is likely to be too small to be meaningfully measured and, thus, insignificant. Therefore, the effects of exposure to underwater sound from the use of explosives at levels that cause temporary displacement or

minor behavioral response are not likely to adversely affect ESA-listed sea turtles in the action area.

Like adults, oceanic juveniles are susceptible to injury and mortality from explosives. However, oceanic juvenile behaviors and habitat requirements may result in different responses to sound. Oceanic juvenile turtles may be found when *Sargassum* habitat is present around a structure to be decommissioned. There have been anecdotal reports of detonations carried out in areas with high *Sargassum* coverage. Such events could place oceanic juvenile turtles at particular risk of injury or mortality, in addition to displacement from *Sargassum* habitat that they need for food and shelter. Currently, PSOs can call for the delay of a detonation if *Sargassum* or other conditions such as fog or high sea states present conditions under which adult animals cannot be effectively monitored. There are currently no protective measures to delay detonations or take additional survey measures to avoid impacts to oceanic juvenile turtles when *Sargassum* habitat is present and no adult turtles are sighted. Oceanic juvenile sea turtles can be easily missed by PSOs because they are small and well-camouflaged in *Sargassum* patches. In one rare case, PSOs observed post-hatchling turtles taking cover beside a derrick barge. The turtles eventually moved away from the barge and were not sighted again. Oceanic juvenile presence around explosive removals is possible wherever *Sargassum* is present in quantities that can provide food and shelter for oceanic juvenile sea turtles. *Sargassum* coverage is widely variable from year-to-year and its presence in impact zones cannot be predicted with any certainty. However, we can use densities of oceanic juvenile sea turtles to calculate the expected number of exposed animals. Whereas adult sea turtle densities may be higher near structures, and, thus, using average sea turtle densities within the action area may be inappropriate, juvenile sea turtles are typically associated with *Sargassum* rather than semi-permanent structures like platforms. Using density estimates for the action area was deemed appropriate for estimating juvenile sea turtle exposure to explosive sounds associated with decommissioning.

To estimate the number of oceanic juveniles that may occur in the ZOIs from explosions, we calculated the impact areas using BSEE's UWC for a 200-lb charge in a main pile (Table 69). Oceanic juveniles are expected to occur in greater numbers when *Sargassum* is present, such that the greatest risk to this age class would be present when removals are occurring within or near larger areas of *Sargassum*. Charges occurring in very deep pelagic waters probably have a minimal effect on oceanic juveniles at the surface, but data are not available for deepwater scenarios, and the UWC cannot predict the effect of charge depth on ZOIs at the surface. Despite the variable risks under different scenarios, we apply the average oceanic juvenile density to all anticipated removal operations to obtain estimates of overall numbers of exposures expected from explosive removals of offshore structures.

Table 69. Zones of influence for a 200-lb charge detonated in a main pile for oceanic juvenile sea turtles

Oceanic Juvenile Sea Turtle Response Category	200-lb Charge in Main Pile	
	Radius (m)	Area (km^2)
Mortality	47.3	0.007
Injury	78.8	0.02
Impairment	106.5	0.036
Disturbance	151.8	0.072

We estimate a high sound exposure that begins to approach TTS levels will cause alarm reactions that could result in oceanic juveniles leaving the area and abandoning *Sargassum* habitat. A sub-TTS level of 218 dB re 1 µPa peak pressure, 6 dB below TTS (TTS is 224 dB re 1µ Pa peak pressure), could cause oceanic juvenile sea turtles to abandon *Sargassum* and be displaced to open waters or to habitat that does not support prey availability or provide protection. Oceanic juvenile sea turtles are at a higher risk of predation and need the food sources found within the *Sargassum* community to support their growth. Therefore, detonations occurring when *Sargassum* is present in the impact zone will adversely affect oceanic juvenile sea turtles.

Despite the overall higher density of adult Kemp's ridley sea turtles than loggerheads in the Gulf of America, PSO data show that loggerheads are most frequently sighted and may be more attracted to platforms than other species. We do not expect this trend to occur with oceanic juvenile loggerheads and would expect juvenile Kemp's ridleys to be more abundant. Using PSO sighting rates would over-represent oceanic juvenile loggerheads, and underrepresent oceanic juvenile Kemp's ridley sea turtles. Although oceanic juveniles may sometimes be found in other oceanic areas lacking *Sargassum* (e.g., hatchlings migrating offshore or larger oceanic juveniles traveling between habitats), Witherington et al. (2012) found that oceanic juveniles were most often found within or very near *Sargassum* mats. Based on their association with *Sargassum,* Witherington et al. (2012) calculated densities of oceanic juvenile sea turtles per square kilometer of *Sargassum* habitat, which we used to approximate oceanic juvenile densities for each species in the action area and applied these estimates to the maximum available *Sargassum* habitat in the northern Gulf of America (Table 70).

As we discussed earlier, industry typically uses charge sizes of 80-200 lb to remove offshore structures. A 200-lb charge is currently the largest size that has been used and we use this weight to estimate the impacted area for all explosive removals under the Oil and Gas Program, particularly given the trend towards the use of larger charge weights during structure removal. To estimate sound exposure, we calculated the oceanic juvenile density for each sea turtle species within each impact zone for an individual event. We then multiplied that number times the number of structures to be removed annually to obtain an estimate of the number of oceanic

juveniles of each sea turtle species that may be adversely affected in a given year (juvenile densities x area within each zone x 81 structures removed annually, Table 70).

Table 70. Estimated annual number of oceanic juvenile sea turtle exposures resulting from the use of underwater explosives

	Oceanic Juvenile Animals Exposed Annually				
	Kemp's Ridley	**Loggerhead**	**Green**	**Leatherback**	**Hawksbill**
Mortality/Injury	2.640365	2.191593	3.100291	0	0.09251
Impairment	3.520487	2.922124	4.133722	0	0.123347
Disturbance	7.040974	5.844247	8.267443	0	0.246694
45 year totals					
Mortality/Injury	118.816425	98.621685	139.513095	0	4.16295
Impairment	158.421915	131.49558	186.01749	0	5.550615
Disturbance	316.84383	262.991115	372.034935	0	11.10123

Like adults, oceanic juveniles may show startle reactions resulting from lower levels of sound exposure. Brief dives or swimming responses are not expected to displace juveniles from *Sargassum*. These types of minor responses that are too small to be meaningfully measured would have insignificant effects on individuals. However, exposure of oceanic juveniles to very high sound levels from explosives could result in their abandonment of the area. Displacement from habitat could lead to temporary loss of shelter, decreased foraging success, or predation. A displaced oceanic juvenile may return after a short period or look for other *Sargassum* habitat. In these cases, a measurable level of behavioral disturbance of oceanic juvenile sea turtles is expected.

As mentioned above, the take calculations presented for adult and juvenile sea turtle exposure to explosives from decommissioning activities are based on the previous UWC. We acknowledge that these take numbers are likely overestimates. The Bureaus estimate a maximum of 25 structures decommissioned annually using explosives, rather than the 81 used in the above analysis. Furthermore, BOEM's BA states that no documented impacts to ESA-listed species, including green and loggerhead sea turtles, were recorded during the 14 activities that required monitoring from 2021 to 2022. The Bureaus have also programmatically implemented an Explosive-Severance Scenario Mitigation Protocol (see Attachment 8) for the purpose of minimizing take during these activities. For these reasons, we expect less sea turtle exposure than is estimated above. We intend to revisit this analysis once a new UWC is developed.

8.5.4 Effects of Sound from Construction and Operations

This section of our sound analysis addresses sound from pile driving associated with the installation of structures (i.e., platforms, caissons, wellheads, etc.). Other sources of sound from

construction and operations associated with the action were considered in Section 8.2 and found to be not likely to adversely affect ESA-listed species in the action area. In this section, we characterize the common sources of pile driving sound and analyze their potential to adversely affect Rice's whales, sperm whales, and sea turtles. Note that potential effects to Rice's whale will be determined through step down review of individual pile driving projects planned within the 100-400 m isobaths.

We do not expect pile driving to adversely affect Rice's whales because no pile driving activities are proposed in the EPA where most Rice's whale sightings occur. While there have been recent Rice's whale sightings outside of this area, between the 100 to 400 m isobaths spanning the Gulf of America (see Section 6.2.3), the density of animals outside the EPA is low. BOEM estimates a small number of annual pile driving activities may occur throughout the Gulf of America. Given the unlikelihood of overlap between the small number of pile driving activities that may occur outside the EPA and the low number of Rice's whales in areas outside the EPA, we believe sound exposures to Rice's whales resulting from pile driving under the Oil and Gas Program are extremely unlikely to occur, and, hence, discountable. Therefore, pile driving sounds from the Oil and Gas Program activities are not likely to adversely affect Rice's whales.

Our analysis of the effects of pile driving sound on sperm whales and sea turtles begins with a comparison of the sound produced by offshore activities with response thresholds to determine if there is the potential for adverse effects to these species from sound exposure. If adverse effects are possible, we further consider these sound sources for their likelihood to result in exposure of listed species to sound levels above their hearing thresholds.

To determine the potential for adverse effects to sperm whales, we use the PTS and TTS thresholds in Table 66, and found in the updated 2024 NOAA Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammals (NMFS 2024). The threshold for the onset of behavioral disturbance is sound sources that are within the hearing range of sperm whales. We believe that it is extremely unlikely sperm whales will approach a construction site near enough to be exposed to the damaging high peak pressures and rapid rise time near a pile driving source, similar to our discussion of the likelihood sperm whales will not be present in the immediate area of an air gun array for seismic surveys (Section 8.5.2.1). Because sperm whales are unlikely to be exposed to the pressure with rapid rise time, we are using the criteria for SEL that covers a larger area over which we treat exposure to multiple pulses as non-impulsive (as discussed in NOAA's acoustic guidance for impulsive and non-impulsive acoustic thresholds). For sea turtles, we use the PTS/TTS criteria for pile driving (i.e., impulsive sound source) adopted from the Navy Phase III modeling and behavioral criteria explained in Table 47.

8.5.4.1 Overview of the Effects of Pile Driving

Pile driving is a concern for construction and operational sound effects to sperm whales and sea turtles in the action area. We compared the threshold levels for sea turtles and sperm whales to the sounds produced from pile driving activities to determine if there is the potential for adverse

effects (Table 71). The potential for any source of sound to adversely affect a listed species depends on its source level and frequency range.

Table 71. Pile driving sound sources associated with construction of oil and gas structures

Source of Sound	Source Level (dB)	Frequency (Hz)
Pile Driving	172-215 (peak), 160-205 (rms)	10-20,000 (strongest at 100-1250)

Note: Data from Review on Existing Data of Underwater Sounds from Pile Driving Activities (Jiménez-Arranz et al. 2020)

For our analysis of pile driving sound effects on sea turtles and sperm whales, the effects are divided into three response categories: 1) hearing injury, 2) hearing impairment, and 3) disturbance. We compared the sound levels to the exposure levels at which the potential for adverse effects may occur for sea turtles and sperm whales and analyze the measurable effects of pile driving sound on sea turtles and sperm whales.

Pile driving is needed to install mooring buoys, install piles to serve as the support for oil and gas structures, or to install pile anchors to attach floating structures. Fixed structures are installed in up to about 300 m water depth and are secured to the sea floor with steel piles. With newer technologies, pile driving capabilities are reaching water depths up to 2,000 m (Scaggs 2010) for installation of semi-submersible structures in depths greater than 300 m that are secured to anchor piles in the sea floor. Pile driving during construction activities is of special concern because it generates sound with a very high source level. During pile installation, sound is produced when the energy from construction equipment is transferred to the pile and released as pressure waves into the surrounding water and sediments. The expected type of injury to sea turtles and sperm whales is caused by pressure wave damage to hair cells, ear canals, or ear drums as these structures compress and expand with passage of the wave. Severe injuries are reported to occur to the internal organs in fish (Halvorsen et al. 2012a; Halvorsen et al. 2012b), but these types of injuries have not been reported in larger animals such as sea turtles and sperm whales.

Oil and gas pile driving sounds are typically produced from the installation of open-ended, steel piles that are commonly used in foundations for offshore platforms. These piles are usually driven into the sea floor with impact hammers which use steam, diesel fuel, pneumatic, or hydraulic power as the source of energy. Drilling may also be used to ensure a pile is driven to the needed depth if an impact hammer cannot penetrate hard substrate layers. The amount of sound produced by pile driving depends on a variety of factors, including the type and size of the impact hammer, size of the pile, the properties of the sea floor, and the depth of the water. Thus, the actual sound levels produced vary from location to location. To gain greater insight into the installation methods, duration of installation, and sound levels produced from all construction activities, we supplemented information from BOEM's BA with information available in the published literature to characterize pile sizes and sound levels produced.

Our review of the literature indicates that platforms and caissons used to install offshore structures typically use steel piles between 36 and 96 in in diameter, well conductors that require

between 26- and 36-in diameter steel piles, and subsea piles (anchoring piles) that are typically 48-in in diameter. The size and number of piles appear to be project-specific and dependent on the complexity of the structure and water depth. We used the best available information on pile driving sound to determine sound levels for a range of pile sizes used in the construction of oil and gas structures (Table 72). Data from bridge and port construction reported in (CalTrans 2020).

Table 72. Sound source levels for different steel pile sizes used for offshore construction

Pile Diameter (in)	Source Level of Sound (dB)		
	Peak	RMS	SEL
24	209	181	176
30	210	190	unreported (185 est.)
36	210	193	183
40	208	195	180
48	213	192	179
60	210	195	185
66	197	185	173
72	204	unreported (189 est.)	175
96	220	195	183

BOEM does not collect data on the types and numbers of piles used for offshore structures in the Gulf of America. The pile diameters that have been used between 2020 and 2025 in the Gulf of America range from 24 to 60 in, but we do not know what pile diameters are typically used or the numbers of piles installed each year for different sizes of piles. Based on the limited data available from BOEM and (CalTrans 2020), our analysis assumes the following source levels of sound for all pile-driving:

- Peak pressure (0-peak) source level of 210 dB;
- RMS source level of 195 dB; and
- SEL (single shot) source level of 185 dB.

Rms sound levels are often used to characterize the behavioral response of an animal to a sound, although behavioral responses to peak pressure and SEL have also been reported in the literature. The auditory effects (temporary and permanent hearing loss) from a particular sound can be caused by exposure to either of two thresholds, the peak pressure level or the SEL, often referred to as "dual exposure criteria" in the literature. For comparison of the dual criteria differences, the peak pressure is considered the "instantaneous" potential for injury from single exposures to sound, and SEL is considered the potential for injury from exposure to sound over time. The predominant metric (peak pressure or SEL) that has the greater potential to cause injury is then

chosen as the exposure level to be used in the analysis. For brief exposures, the peak pressure usually dominates as the sound level with the greatest potential to affect animals. For longer periods of exposure, the SEL may be the exposure level of concern.

In open-water environments, several assumptions must be made about the movement of animals around a sound source to determine the time period over which an animal may be exposed. The construction of new offshore structures may take place over a period of a week (for smaller structures) to over a month (for large, complex structures). The time to complete the pile-driving portion of the construction activities depends on the number of piles required for a structure, the complexity of the structure (e.g., connected platforms), mooring needs, and the depth to which piles will be driven into the substrate. Pile driving can be completed in one day for simple structures, or over a week or more for large structures. BOEM expects most structures to be installed in depths less than 200 m. BOEM estimates three to twelve well drive pipe installations per year will use impact pile driving (including new wells and side tracking with slot recovery) for exploratory and development drilling operations in the action area. In addition, BOEM estimates zero to two structure installations or major modifications (three to four piles per structure) per year will use impact pile driving in the action area. Suction embedding is used to install deepwater and subsea structures in depths greater than 200 m. Therefore, no impact pile driving is anticipated to occur in waters deeper than 200 m.

Construction may occur during daylight and nighttime hours in offshore environments. BOEM does not have detailed information on the installation time for piles for different structure types. In general, larger structures will probably be required in the future to meet the demands of deepwater drilling and to increase structural resilience to wind and wave damage from hurricanes. For this analysis, we assume pile driving occurs every day of the year for the 20 drive pipe installations and structure installations or major modifications (i.e., 12 drive pipe installations plus 2 structure installations with four piles per structure) annually.

To determine the effects of cumulative sound exposure on sea turtles and sperm whales, we reviewed the literature to determine how much pile driving is possible over a 24-hr period. For the analysis, we assume daily exposures are possible because adult sea turtles and sperm whales may remain in an area for a short period feeding or resting, but are unlikely to remain within the area around a platform construction site longer than 24 hours. Therefore, the exposure analysis "resets" every day and the number of days of pile driving expected is assumed to have the potential to expose new animals on a daily basis.

To determine how many piles may be installed per day, we reviewed information compiled on platform piles (Dos Santos 2008). A typical pile installation requires 30 strikes per foot to install a pile to a typical depth below the mudline of 164 ft (50 m). The reported pile driver blow rates for offshore structures averages 40 per minute. Therefore, a typical platform pile would require approximately 4,920 strikes (30 strikes x 164-ft-depth below mudline) over a period of about two hours (4,920 total strikes/40 strikes per minute=123 min). Based on this information, up to five piles can be driven per day for typical offshore construction. About 10 total hours (five piles

taking about two hours each to drive) of actual pile driving will occur each day with the remaining time dedicated to pile placement, welding and pile attachments, and movement of personnel, vessels, and equipment.

For our analysis of pile driving sound effects to sea turtles and sperm whales, we calculated ZOIs for SEL and peak pressure to determine the dominant metric of the dual criteria for PTS and TTS in sea turtles and sperm whales. We analyzed the potential SEL_{cum} area as the area impacted over a 24-hr period by the installation of five piles. As animals are exposed to sound over greater periods of time (measured as 40 pile strikes per minute), the distance over which sound levels can cause hearing-related effects of PTS and TTS is also greater. As discussed, each pile is estimated to require 4,920 strikes to install, although there are many factors (sediment type, water depth, pile type/diameter, drive depth below mud line, etc.) that play into how many strikes are needed to drive each pile. As many as 24,600 pile strikes from the installation of five piles could occur each day (Table 73).

Table 73. Metrics used to estimate the effects of pile driving sound on the hearing of sea turtles and sperm whales

Number of Piles Installed/Day	Number of Strikes to Install Each Pile	Accumulated dB from Multiple Exposures 10 LOG (strikes)
5	4,920	33.91

We compared the SEL_{cum} ZOIs to the peak pressure ZOI to determine which metric of the dual criteria has the greater ZOI (Table 74). When we consider that animals could be exposed to sound from the installation of five piles per day, our comparison shows the SEL_{cum} areas dominate in terms of the potential for hearing injury and hearing loss. The SEL_{cum} metric has a larger zone of influence that could affect sea turtles and sperm whales. The SEL metric and associated zone of influence will be used for the remainder of this analysis to assess the potential for the occurrence of auditory injury in sea turtles, and for potential of both hearing injury and temporary hearing loss in sperm whales.

Table 74. A comparison of the dual criteria of cumulative sound exposure level and peak pressure criteria to assess the potential for auditory effects under the Oil and Gas Program

	PTS cumulative SEL radial distance to threshold (m)	PTS cumulative SEL zone of influence (km^2)	PTS peak radial distance to threshold (m)	PTS peak zone of influence (km2)	TTS cumulative SEL radial distance to threshold (m)	TTS cumulative SEL zone of influence (km^2)	TTS peak radial distance to threshold (m)	TTS peak zone of influence (km^2)
Sperm Whale	--	--	--	--	623.8	1.22	--	--

	PTS cumulative SEL radial distance to threshold (m)	PTS cumulative SEL zone of influence (km^2)	PTS peak radial distance to threshold (m)	PTS peak zone of influence (km2)	TTS cumulative SEL radial distance to threshold (m)	TTS cumulative SEL zone of influence (km^2)	TTS peak radial distance to threshold (m)	TTS peak zone of influence (km^2)
Sea Turtles	176.1	0.097	--	--	989.6	3.08	1.6	$8.04x10^{-6}$

The following exposure analysis for sea turtles and sperm whales assesses the number of animals exposed to pile driving sound in each exposure category. We calculated the size of the zone of influence (ZOI) and calculated how many individuals of each species could be exposed. The following information was used to estimate the ZOI and the number of sea turtle and sperm whale exposures:

1. 20 LOGR spreading of the sound in offshore lease areas.
2. Distance of 20 LOGR radial distance was converted to an area (km^2), also known as the ZOI.
3. Sound levels are from CalTrans (2020).
4. Densities for sea turtles are provided in Section 8.1.2.2 and sperm whale density used is 0.00576 whales per km^2.
5. Up to five piles per day can be driven.
6. The number of sea turtles exposed will be determined by:
   ZOI x density x 365 days.
7. The number of sperm whales exposed will be determined by:
   ZOI x density x 4 days of pile driving in water depths approaching but not exceeding 200 m.

Sperm Whale Sound Exposure

We calculated the ZOIs for disturbance from temporary hearing impairment and behavioral disturbances to analyze the potential effects on sperm whales. As described above, disturbance of sperm whales is evaluated using the Wood et al. (2012) behavioral step function and TTS ZOIs. We evaluated the ZOIs and the number of animals responding in each exposure category to determine the criteria best represent the risk of sperm whales being exposed to pile-driving sound. The sound exposure level for whales exposed to five piles per day results in the largest ZOI at TTS levels (Table 74) and, consequently, more disturbed whales. The radial distance to onset of TTS is greater than the radial distance to behavioral onset; therefore, the TTS sets the entirety or limit of extent for potential effects for the area. Because of high source level and long periods of pile driving, the daily ZOI for disturbance from TTS levels of exposure occur over the greatest area (Figure 91). Within this area, spanning from outside the injury zone to the TTS

isopleth, an animal could experience temporary hearing impairment, or exhibit behavioral responses.

SEL_{cum} estimates assume the highest source levels, but result in less than 1 annual exposure to sound that could cause TTS or other behavioral responses, and 2 exposures over the 45-year Oil and Gas Program.

Our analysis determined sperm whales may be exposed to sound levels from daily sound exposure to five pile installations per day, for 4 days per year, leading to TTS and/or behavioral response in animals exposed to these sounds, including local displacement from the area while pile driving is ongoing. The results of this analysis show that the cumulative exposure of sperm whales to pile-driving sound has the greatest potential to disturb the largest number of sperm whales. We do not anticipate exposure to sound at PTS levels in the area because sperm whales are expected to be moving rather than remaining stationary during pile driving events and are unlikely to be in the immediate area where PTS levels could occur.

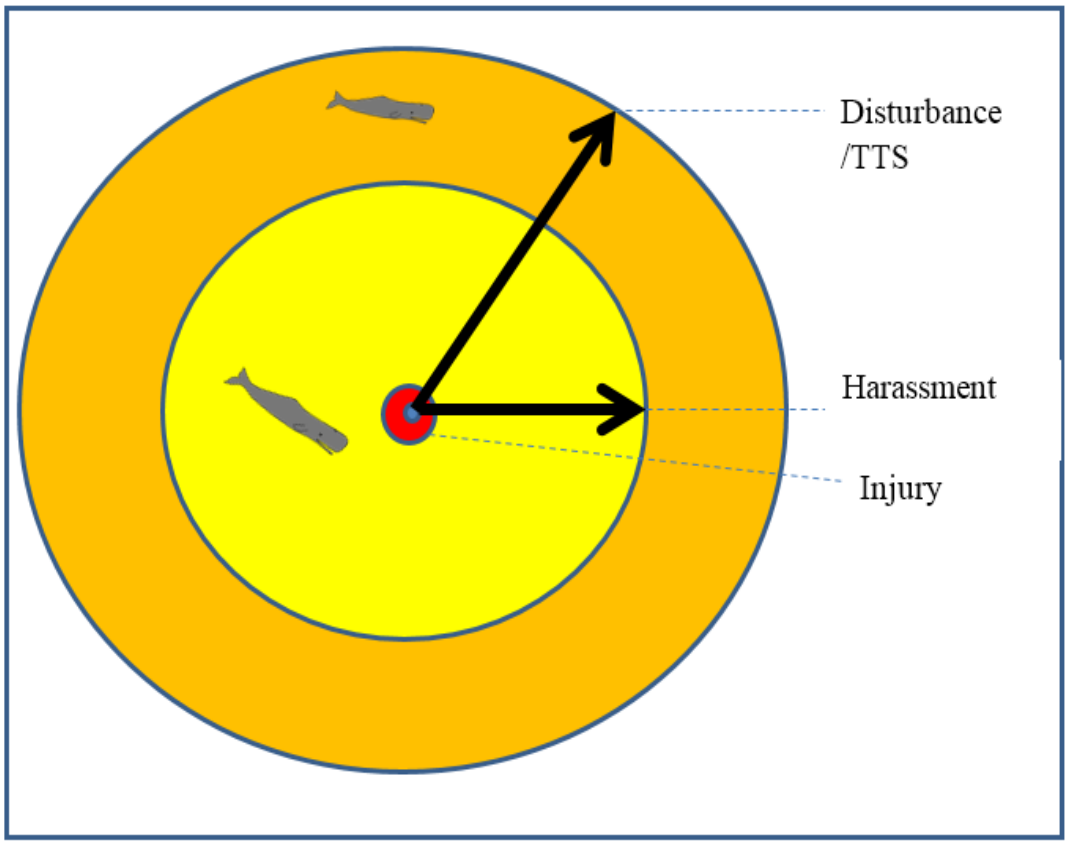


Figure 91. Diagram showing the relative distances of the response categories for sperm whales exposed to daily pile-driving sound

Sea Turtle Sound Exposure

To calculate the number of animals that could be exposed in each of the two response categories of auditory injury or behavioral disturbance, we multiplied the area of each ZOI (km^2) times the density of each species (number/km^2 from Section 8.1.2.2) to determine a reasonable estimate of the number of sea turtles that may be exposed annually to pile driving sound (Table 75). As for sperm whales, we used the highest reported source levels for pile driving of 185 dB (SEL) and 210 dB (peak) to calculate cumulative exposure that could result in auditory injury in sea turtles. At levels greater than 200 dB (peak), behavioral responses to pile driving sounds are expected in sea turtles. The results of these calculations for each species and oceanic juvenile and adult life stages are shown in Table 75.

We expect the consequences of exposure to pile driving sound to be different for adults and oceanic juveniles. Pile-driving could result in temporary loss of available habitat for adult sea turtles that use the ensonified area. The continuous "banging" of a pile should provide ample warning to an adult sea turtle to avoid the immediate pile-driving area. Adult sea turtles affected in this way will relocate to an adjacent area; however, because adult sea turtles use large oceanic areas, the temporary displacement from a small area during pile driving is not likely to result in measurable changes to a turtle's ability to perform functions such as foraging. Therefore, the effects of displacement of adult sea turtles from pile-driving sound will be insignificant.

Table 75. Annual take estimates for sea turtles exposed to pile-driving sound

Sea Turtle Species	Annual Takes of Sea Turtles from Pile Driving			
	PTS ZOI		TTS/Disturbance ZOI	
	Adults	Oceanic Juveniles	Adults	Oceanic Juveniles
Kemp's Ridley	7	1	206	19
Loggerhead	11	5	323	142
Green	1	9	8	260
Leatherback	1	0	8	0

Adult sea turtles may be within the cumulative sound exposure area for pile driving sound, which covers larger oceanic areas. Therefore, the hearing injury in some adult sea turtles is possible because of the large areas ensonified during pile driving activities. The number of turtles that may be found in each ZOI and experience PTS (Table 75). Oceanic juvenile turtles may remain in *Sargassum* habitat and may not leave the area, which could cause hearing injury or impairment (Table 75), while others may leave at exposure levels of 200 dB (peak) or higher.

Oceanic juveniles exposed to loud sound levels from pile driving that do leave the area will also be adversely affected by displacement from *Sargassum* habitat. Although avoidance responses are advantageous at preventing direct injury, we consider that displacement from *Sargassum* may disrupt feeding and sheltering, or indirectly increase the risk to individuals (e.g., via predation). Some oceanic juveniles may be biologically motivated to remain in *Sargassum* habitat for protection, but, as exposure levels increase beyond 200 dB (peak), they may abandon use of the habitat due to exposure to very loud sound levels, and may have already suffered hearing

impairment. Abandonment of developmental habitat decreases foraging success and movement from sheltering habitat increases the risk of predation, particularly for younger oceanic juveniles that are more readily preyed upon by a number of predatory fish. The annual number of predicted disturbances of oceanic juveniles, however, is relatively low (Table 75). Because predation rates are naturally high and oceanic juveniles swim between *Sargassum* patches in search of new food resources, the impact of disturbance on predation risk will be undetectable from natural predation rate and, thus, insignificant. The expected adverse effects on oceanic juvenile sea turtles of the disturbance are displacement from preferred sheltering and foraging areas, and the reduction in foraging resulting from that displacement. The duration of the disturbance will be widely variable (hours to days) and will depend on the time it takes a juvenile to locate a new *Sargassum* patch.

8.5.5 Effects of Sound from Vessels

Sounds caused by vessels (Table 76) in transit as part of activities under the Oil and Gas Program have the potential to disturb ESA-listed species. Acute effects of such exposure can range from none to minor depending on how close in proximity the sounds are to an individual animal. In addition, chronic exposure to vessel sound may result in stress and masking of biologically important sounds.

Table 76. Sources of vessel sound

Source of Sound	Source Level (dB)	Frequency (Hz)
Service, crew, and support vessels	160-180 (rms) 187 (peak)	20-10,000
Tug (4 engine)	173-177 (rms) 188-191 (peak)	broadband
Seismic Survey Vessel	125-132 (rms) at 500 m (approx. 179-186 [rms] at source)	broadband
Semi-submersible Pipeline Barge	161 (rms) 171 (peak)	10,10,000
Pipe-laying Vessel	170-182 (rms) 179-191 (peak)	broadband
Drilling Ship (MODU) with positioning thrusters (Dynamic Positioning)	195 (rms) 195 (peak)	10-10,000

In addition to the risk of a vessel strike (addressed in Section 8.4above), vessels associated with the Oil and Gas Program may produce visual or acoustic disturbance that may affect sperm whale, Rice's whale, sea turtles, and Gulf sturgeon. Given the magnitude of vessel traffic associated with the Oil and Gas Program (approximately 43% of all vessel traffic in the Gulf of

America; see Section 8.4) we anticipate that all individual sperm whales, Rice's whales, sea turtles, and Gulf sturgeon within the action area will be exposed to some level of vessel sound. The operation of vessels may result in acute visual or auditory disturbances caused by a vessel passing a sperm whale, Rice's whale, sea turtle, or Gulf sturgeon, disrupting their behavior (Parsons 2012). Sound from vessels also has the potential to accumulate from multiple vessels and increase the ambient sound level (Hildebrand 2009). Long-term, chronic exposure to such sound may result in stress and masking of important biological sounds (Clark et al. 2009b; Hatch et al. 2012; Rolland et al. 2012).

Studies have shown that vessel operation can result in changes in the behavior of cetaceans and sea turtles (Arcangeli and Crosti 2009; Hazel et al. 2007; Holt et al. 2009; Luksenburg and Parsons 2009b; Noren et al. 2009; Patenaude et al. 2002a; Richter et al. 2006b; Richter et al. 2003b; Smultea et al. 2008b). In many cases, particularly when responses are observed at great distances, it is thought that animals are likely responding to sound more than the visual presence of vessels(Blane and Jaakson 1994; Evans et al. 1992; Evans et al. 1994). Nonetheless, it is generally not possible to distinguish responses to the visual presence of vessels from those to vessel noise. Moreover, at close distances, animals may not even differentiate between visual and acoustic disturbances created by vessels and simply respond to the combined disturbance.

Whales

Cetacean's behavioral responses to vessel disturbance range from little to no observable change in behavior to momentary changes in swimming speed and orientation, diving, surface and foraging behavior, and respiratory patterns, as well as changes in vocalizations (Au and Green. 2000; Baker et al. 1983; Baumgartner and Mate 2003; Hall 1982; Isojunno and Miller 2015; Jahoda et al. 2003; Koehler 2006; Lesage et al. 1999; Malme et al. 1983; Richardson et al. 1985a; Scheidat et al. 2006; Watkins et al. 1981). Watkins et al. (1981) found that both fin whales and humpback whales appeared to react when approached by small vessels by increasing swim speed, exhibiting a startle reaction and moving away from the vessel with strong fluke motions. In a study on North Atlantic right whales, 71% of 42 whales that were closely approached by a research vessel (within 10 m) showed no observable reaction. When reactions occurred, they included lifting of the head or flukes, arching the back, rolling to one side, rolling to one side and beating the flukes, or performing a head lunge (Baumgartner and Mate 2003). In another study on North Atlantic right whales, Nowacek et al. (2004)observed no noticeable behavioral responses to passing vessels nor to simulated vessel sounds. Studies of other baleen whales, specifically bowhead and gray whales, documented short-term behavioral responses to a variety of actual and simulated vessel activity and sounds (Malme et al. 1983; Richardson et al. 1985b). Close approaches by small research vessels caused fin whales (n = 25) in the Ligurian Sea to stop feeding and swim away from the approaching vessel (Jahoda et al. 2003). A study on the effects of research vessel presence on sperm whale behavior found that sperm whales (n = 12) off the coast of Norway spent 34% less time at the surface and 60% more time in a non-foraging silent active state when in the presence of the vessel than in the post-vessel baseline

period, indicating costs in terms of lost feeding opportunities and recovery time at the surface (Isojunno and Miller 2015). Regardless of the response, cetaceans appear to resume species' typical behavior within minutes of vessels leaving the area (Au and Green. 2000; Baker et al. 1983; Baumgartner and Mate 2003; Hall 1982; Isojunno and Miller 2015; Jahoda et al. 2003; Koehler 2006; Malme et al. 1983; Richardson et al. 1985a; Scheidat et al. 2006; Watkins et al. 1981).

The nature of the behavioral response cetaceans exhibit to vessels may depend on vessel speed, size, and distance from the animal, as well as the number and frequency of vessel encounters (Baker et al. 1988; Beale and Monaghan 2004). In addition, characteristics of the individual animal and/or the context of the vessel encounter, including the animal's age and sex, the presence of offspring, whether or not habituation to vessels has occurred, individual differences in reactions to vessels, and the behavioral state of the whales (Baker et al. 1988; Gauthier and Sears 1999; Hooker et al. 2001; Koehler 2006; Lusseau 2004; Richter et al. 2006a; Weilgart 2007; Wursig et al. 1998) lead to different responses in individuals. Observations of large whales indicate that cow-calf pairs, smaller groups, and groups with calves appear to be more reactive to vessels (Bauer 1986; Bauer and Herman 1986; Clapham and Mattila 1993; Hall 1982; Williamson et al. 2016). Reactions to vessel sound by bowhead and gray whales were observed when engines were started at distances of approximately 914 m (Malme et al. 1983; Richardson et al. 1985a), suggesting some level of disturbance may result even if vessels do not come near the animals. It should be noted that human observations of a cetacean's behavioral response may not reflect a whale's actual experience; thus, our use of behavioral observations as indicators of a whale's response to vessels may not be correct (Clapham and Mattila 1993).

Much less is known about the physiological responses cetaceans exhibit to vessel disturbance, but, based on their behavioral responses and studies of terrestrial species, it is often assumed that they may exhibit a stress-related response (Parsons 2012; Wright et al. 2007). We are aware of only one study specifically aimed at examining the physiological responses of cetaceans to vessel disturbance (but see Ayres et al. 2012). Following a decrease in shipping traffic in the Bay of Fundy, Rolland et al. (2012) found that North Atlantic right whales had reduced fecal stress-related hormone metabolites (glucocorticoids), suggesting that, despite no overt behavioral response to passing vessels (Nowacek et al. 2004), at least some North Atlantic right whales may exhibit a physiological hormonal response when exposed to chronic vessel disturbance. Based on these data, we assume some sperm and Rice's whales will exhibit a short-term stress response to a passing vessel associated with the Oil and Gas Program.

In addition to acute effects such as a short-term behavioral and stress response, regular, ongoing vessel traffic has the potential to significantly add to ambient ocean sound levels (Hildebrand 2009). The dominant source of vessel sound from the Oil and Gas Program is propeller cavitation, although other ancillary sounds may be produced. The intensity of sound from service vessels is roughly related to ship size and speed. Large ships tend to be noisier than small ones,

and ships underway with a full load (or towing or pushing a load) produce more sound than unladen vessels.

Unlike sperm whales, Rice's whales are expected to hear best and communicate at the same low frequencies at which many large vessels produce the most sound. As such, the effects of chronic vessel sound are more likely to have adverse effects on Rice's whales when compared to sperm whales. Some low frequency sounds, such as those produced by large commercial vessels, are estimated to have reduced the communication space for North Atlantic right whales in the Northeastern United States by up to 67% compared to historically lower sound conditions (Hatch et al. 2012). While masking due to vessel sound may be more severe for North Atlantic right whales compared to fin whales (Clark et al. 2009a), masking of other baleen whale sounds still likely occurs. Chronic exposure to vessel sound has been correlated with changes in stress hormones (Rolland et al. 2012) and long and short-term changes in vocalizations (Parks et al. 2007; Parks et al. 2011; Parks et al. 2012).

Given the substantial frequency overlap between vessel sounds and the vocalizations of baleen whales such as Rice's whales, vessels associated with the Oil and Gas Program could mask Rice's whale calls at some of the lower frequencies for this species. While the range of Rice's whales is not within the busiest vessel traffic regions of the action area, a variety of Oil and Gas-related Program vessels are expected to transit through and around habitat where Rice's whale are more common. The sound of these vessels, in combination with other vessels in the action area, is likely to lead to an increase in ambient low-frequency sound, leading to exposure of all Rice's whales in the action area. Such exposure is expected to result in chronic stress in some individuals (Rolland et al. 2012), which may lead to an overall reduction in health and could have negative effects on reproduction (Rolland et al. 2017; Rolland et al. 2012; Rolland et al. 2016). Chronic exposure to vessel sound is also expected to interfere with Rice's whale communication and mask important biological cues (Clark et al. 2009c; Hatch et al. 2012; Richardson 1995), which is expected to negatively affect individual Rice's whales by interfering with an individual's ability to find mates and, in the case of mother-calf pairs, by disrupting mother-calf communication. While it is possible that Rice's whales may adjust their communication to cope with changes in ambient sound, as has been suggested in North Atlantic right whales (Parks et al. 2007; Parks et al. 2011; Tennessen and Parks 2016), if such adaptation were to occur, we expect it would require many years and there would be negative effects to individuals during the adaptation period.

In summary, sound sources associated with vessel movement as part of the Oil and Gas Program are likely to adversely affect Rice's whales. Sperm whales are not likely to be adversely affected by vessel sound due to the low frequencies produced by many large vessels in comparison to the primary hearing and vocalization range of sperm whales.

Sea Turtles

Potential responses of sea turtles to vessel disturbance, both behavioral and physiological, are likely similar to those of cetaceans and may include startle responses, avoidance, other behavioral reaction, and/or a physiological stress response. However, very little research exists on sea turtle responses to vessel disturbance. We were unable to find a study specifically aimed at quantifying sea turtle response to vessel disturbance in our literature reviews conducted in the preparation of this opinion. A study examining vessel strike risk to green sea turtles suggested that sea turtles may habituate to vessel sound and be more likely to respond to the sight of a vessel rather than the sound of a vessel, although both sight and sound may play a role in prompting reactions (Hazel et al. 2007). Regardless of the specific stressor associated with vessels to which turtles are responding, they only appear to show responses (avoidance behavior) at approximately 10 m or closer to a vessel (Hazel et al. 2007). Based on this study, and a recent programmatic evaluation of NMFS' scientific research permitting program for ESA-listed turtles, vessels are expect to cause minimal disturbance to sea turtles (NMFS 2017d). As a result, effects of exposure to sound sources associated with vessel movement as part of the Oil and Gas Program are insignificant and, therefore, are not likely to adversely affect sea turtles.

Gulf Sturgeon

Gulf sturgeon are not found in the areas of oil and gas development, but may be exposed to vessel sound from transiting work and crew boats. It is not likely that lease sales in the WPA will result in any trips east of the Mississippi River that would affect habitat occupied by the Gulf sturgeon. Some ports in the CPA and EPA may service oil and gas lease areas that involve transit across Gulf sturgeon habitat where these fishes are present. Gulf sturgeon may be able to detect the sounds of passing vessels, but they are not expected to be affected by the sound, therefore effects are insignificant.

8.5.6 Summary of the Effects of Sound

We conclude that G&G survey activity is likely to adversely affect sperm whales, Rice's whales and North Atlantic DPS green sea turtle, Kemp's ridley sea turtle, hawksbill sea turtle, leatherback sea turtle, and Northwest Atlantic DPS loggerhead sea turtle. Conservation measures implemented under the final MMPA rule minimize the duration of exposure to sounds above hearing thresholds. The use of a ramp-up procedure should alert whales to the nearby acoustic source before the airgun array is at full power, giving them an opportunity to leave the area prior to exposure to sound levels that would cause PTS (Stone et al. 2017, although see Dunlop et al. 2016). It is reasonable to assume the same ramp-up and shutdown measures also provide some benefit to sea turtles.

Sea turtles are not likely to be adversely affected by pre-severance activities, non-explosive severance techniques, or the removal and transport of the offshore structure to shore. Sea turtles will be adversely affected by the use of underwater explosions associated with decommissioning activities. The effects of exposure to detonation can range from injury and death, temporary impairment, or disturbance of oceanic juvenile sea turtles. In addition to injurious impacts

associated with exposure to high pressure levels, oceanic juvenile sea turtles may be displaced from developmental habitat after exposure to very loud sound. Behavioral disturbance is not expected to adversely affect adults, but is likely to adversely affect oceanic juveniles due to their dependence on *Sargassum* for food, shelter, and protection from predators.

Pile driving is the main sound source of concern from offshore construction and operational activities for sea turtles and sperm whales. Pile driving produces very loud levels of underwater sound that can affect large areas of ocean surrounding the activity and result in adverse effects to sea turtles and sperm whales. We concluded that the other non-pile driving sources of construction and operational sound are not likely to adversely affect sea turtles and sperm whales (Section 8.2). Adult sea turtles and oceanic juveniles in offshore developmental habitat will be adversely affected by PTS and oceanic juveniles will also be adversely affected through behavioral disturbance from sound from pile-driving activities. Oceanic juveniles exposed to pile driving sound will be adversely affected by being displaced from *Sargassum* habitat or other surface-pelagic habitats occurring near pile driving activities.

Considering the proposed conservation measures to minimize and avoid disturbance from vessels, and the level of disturbance that may result from the vessel activity associated with the Oil and Gas Program, we find the effects of vessel sound on sperm whales and sea turtles are not likely to adversely affect these species. Conversely, we find that exposure to chronic vessel sound produced during activities associated with the Oil and Gas Program is likely to adversely affect Rice's whales because of chronic stress and masking. These responses are only expected for Rice's whales because Rice's whale hearing and communication largely overlap with the low frequency sounds produced by vessels. Because the RWA area was removed from the Oil and Gas Program, these effects will be minimized but not removed.

The sound produced by passing vessels would be brief, and the sound levels received by sturgeon would not cause any harmful behavioral responses. Vessel sound will have insignificant effects on sturgeon.

8.6 Effects of Entanglement and Entrapment

Entanglement and entrapment can result in death or injury of marine mammals and sea turtles (Moore et al. 2009; Van Der Hoop et al. 2012). Entangled marine mammals may drown or starve due to being restricted by gear, suffer physical trauma and systemic infections at the point of entanglement, and/ or be hit by vessels due to an inability to avoid them because of injury or restricted movement. Entanglement can also cause injury that can lead to secondary infection, or death (Moore 2014). During consultation, we identified entanglement as a stressor from seismic survey equipment such as ocean bottom nodes, hydrophones, geophones and other cables; and other survey activities, including sediment sampling and installation of mooring buoys; and marine debris generated from these activities. We identified entrapment as a stressor created by moon pools, seismic survey gear, and trawl gear used for site clearance associated with decommissioning activities. A moon pool is a large wall-sided hole in the bottom of a ship or

other offshore structure such as drilling platforms. Moon pools are used on many types of vessels: cable-laying vessels, exploration and drilling vessels, production barges, research and offshore support vessels. They are used to launch and retrieve equipment, divers, or diving bells, or lay cables or risers, in an environment protected from the waves.

BOEM has implemented mitigation measures through their permits to reduce the possibility of entanglement in seismic survey equipment. The measures include the use of stiff non-buoyant lines, acoustic pingers to alert marine mammals of the presence of the line in the water column, and having PSOs on node retrieval vessels to watch for signs of entangled animals. Even with these measures, we determined that entanglement and entrapment may affect marine mammals and sea turtles. Our analysis of the effects to these species follows.

8.6.1 Whales

Sperm whales could be exposed to hydrophone streamers, bottom cables, geophones, and ship-based receivers, buoy mooring lines, and other lines or cables. The hydrophones or geophones are encased in plastic tubing and either towed behind the survey vessel, laid on the sea floor, or, in rare instances, spaced at various depths along vertically positioned cables suspended from a vessel. Equipment locations are determined by GPS and acoustic pingers, and installed equipment does not contain buoy lines to mark the location for retrieval.

While it is possible that towed seismic equipment will come into contact with sperm or Rice's whales, we are not aware of any reports of such interactions. If such interactions were to occur, we do not anticipate they would result in entanglement for several reasons. The towed equipment is rigid and, as such, would not encircle, wrap around, or in any other way entangle a sperm or Rice's whale. Furthermore, baleen whales, and possibly sperm whales, are expected to avoid areas where airguns are actively being used (see Section8.5), meaning they would also inadvertently avoid towed seismic equipment.

With the implementation of the former BOEM NTL 2016-G02 as a national protocol (Attachment 2), permit conditions of approval, and other mitigation measures such as the protected species stipulation, sperm and Rice's whale entanglement in hydrophone cables and streamers, geophones, bottom cables, and other associated gear is extremely unlikely to occur. We find the risk of entanglement in Oil and Gas Program equipment so low as to be discountable. No cases of marine mammals entering moon pools have been documented and moon pools are too small to allow a sperm whale or Rice's whale to enter and be entrapped. There have been no reported interactions between large whales and trawls in the Atlantic or Gulf of America (NMFS 2021; 76 FR 73912). Therefore, sperm and Rice's whales are not likely to be adversely affected by entanglement in gear and equipment associated with Oil and Gas Program activities, and will not be affected by entrapment in moon pools or trawls.

8.6.2 Sea Turtles

Sea turtles could come into contact with any part of the towed seismic equipment, moored buoy lines, bottom cables, or other lines and cables associated with the Oil and Gas Program. Sea

turtles have become entrapped in power plant intake structures and dredge equipment (NRC 1990a) and have the potential to become entrapped in any submerged structure that an individual is able to enter. Sea turtles appear to find their way into submerged structures, but some individuals cannot find their way out and the subsequent entrapment can lead to drowning. Since 2004, sea turtles have been reported entrapped in moon pools associated with oil and gas activities. Fish and other animals can enter moon pools, and, in the case of sea turtles, surface within moon pools. Prolonged entrapment within moon pools may have adverse consequences on animals, including stress and an inability to forage or shelter.

8.6.2.1 Entrapment or Entanglement from Site Clearance Post-Removal Trawling

Following severance, a structure is typically transported to a service base for salvage. Some "jacket-hopping," or reuse of a removed structure for another structure may occur but is rarely used. After all decommissioning work is completed, operators are required to perform site-clearance work on leases in depths less than or equal to 200 m to ensure that the sea floor of their lease(s) have been restored to pre-lease conditions. Based upon requirements found in Subpart Q of the OCSLA implementing regulations (30 CFR §250.1740 to 250.1743), operators have the option of either trawling with commercial nets or conducting diver or high-resolution sonar surveys over the area. The high-resolution sonars are of high frequencies that are not heard by sea turtles. The diver surveys have no detectable impact on sea turtles. Site clearance activities using trawl nets may affect sea turtles, as demonstrated in fisheries that use trawl nets.

After OCS structures are removed, contractors are employed to trawl the salvage area with commercial nets (i.e., otter/shrimp trawls) to retrieve any objects or obstructions (e.g., tools, containers, batteries) that may have been lost or discarded during the operational life of the structure. Current guidelines in MMS's Notice to Lessees and Operators (Wright et al. 2007) No. 98-26, "Minimum Interim Requirements for Site Clearance (and Verification) of Abandoned Oil and Gas Structures in the Gulf of Mexico", instruct trawling contractors to remove turtle-excluder devices (TED's) from their nets to allow for debris collection. However, without TED's, sea turtles near the sea floor in a trawl path could be captured with the salvaged debris. In addition to discomfort and/or injuries from contact with the netted debris, captured sea turtles could become exhausted from struggling because forced submergence leads to energy consumption, oxygen depletion, and other stress-related impacts (NRC 1990a).

Site clearance with trawls typically occurs over two to six days, depending on the size of the clearance area required for the particular structure type (Table 77) and distance from shore. Trawling may use multiple nets and must be conducted in two directions (North-South and East-West) over a grid of the entire area. Trawlers drag the net along the bottom, meaning animals on the sea floor, rather than any using surface waters of the OCS, will be affected by site clearance trawling.

Table 77. Site clearance distance requirements for different structure types

Structure Type	Radius (ft)
Dry Hole Wells	300 ft
Single Wells/Platform (No Significant Facilities)	400 ft
Single Well Caissons and Protectors	600 ft
Platforms (Significant Facilities)	1,320 ft

We estimated the annual number of adult sea turtle interactions based on the nearshore and offshore shrimp fishery catches per unit effort (CPUE) rates that use bottom trawls for each species of sea turtle in the western Gulf of America (Epperly et al. 2002) between March and November, the months in which most removals occur. Because there are no reported captures of hawksbill sea turtles in site clearance trawling, and given the sparse distribution and overall low density of the species in the Gulf, we do not expect capture of hawksbill sea turtles during site clearance trawling.

Similarly, we did not consider effects to oceanic juvenile sea turtles for a few reasons. First, NTL-2019-G05 requires that trawl nets must have a minimum stretched mesh size of 4 in at the cod end and 2 in elsewhere, and a maximum stretched mesh size of 6 in. We would expect the smaller, oceanic juveniles to not be caught in trawl nets of this mesh size. Second, the purpose of the site clearance trawling is to remove debris and obstructions from the seafloor, and so they use bottom trawls. Oceanic juveniles occupy surface waters, particularly *Sargassum* mats, making it unlikely that they would be captured during site clearance bottom trawling.

CPUEs were calculated for nearshore waters (0 - 60 ft) and offshore waters (greater than 60 ft). From the total numbers of structures expected to be removed in each depth strata (Table 78), approximately one-half will be removed in nearshore waters and one-half in offshore waters. Site-clearance trawlers work during daylight hours. Time is spent transiting back and forth from the site, checking nets every 30 minutes, and removing debris. We estimate net effort in the water is approximately four hours per day based on travel to the removal location, trawl time, and travel back to port before dark.

Based on information provided to us by the Bureaus, there will be an estimated annual activity level of 60-110 removals per year. Because removals are equally divided between nearshore and offshore, 880 hours of site clearance effort are expected in zero to 60 ft depths, and 880 hours of effort in greater than 60 ft depths each year. Using the site clearance effort estimated to occur annually, we calculate expected captures for each species of sea turtle (Table 78).

Because site clearance occurs over two to six days, we estimate the following annual site clearance effort:

Annual Site Clearance Effort (Net Hours) = 110 removals per year x four days of work each removal x four net hours per day = 1,760 hours

Table 78. Number of annual sea turtle captures (harassment) from site clearance activities with trawl nets

Species	CPUE Nearshore	Captures	CPUE Offshore	Captures	Annual Total Captures
Kemp's ridley	0.0371	33	0.0003	0	33
Loggerhead	0.0124	11	0.0006	1	12
Green	0.0026	3	0.0023	2	5
Leatherback	0.00012	1	0.00019	1	2

Note: Captures = CPUE species, area, time x Effort area, time

Depending on the animal's condition at the time of capture, the turtle could drown if kept submerged, especially if tow times exceed 60 minutes (NRC 1990; 50 CFR 223.206(d)((3)). To minimize effects to sea turtles if they are caught in the trawl net, site clearance trawling is limited to 30 minutes to avoid the likelihood of turtles drowning in the nets (NTL-2019-G05). Net tow times are often shorter if significant debris is gathered in the net. Thirty minute tow times are effective in minimizing the stress of sea turtles caught in the net and prevent drowning (NMFS 2021). Therefore, we predict the captures shown in Table 78 will be non-lethal. Thirty minute limits on tow times and proper handling and release of sea turtles caught in trawl nets minimizes the likelihood of injury to captured individuals. We conclude that the non-lethal capture of sea turtles in Table 79 will occur over the 45–year program from site clearance trawling.

Table 79. Estimated number of adult and neritic juvenile sea turtle takes by capture (harassment) in site-clearance trawls over 45 years

Species	Adult/Neritic Juvenile
Kemp's Ridley	1,485
Loggerhead	540
Green	225
Leatherback	90

8.6.2.2 Rigs to Reefs

BSEE's "Rigs-to-Reefs" policy allows some obsolete, nonproductive offshore oil and gas platforms to be converted to artificial reefs to support marine habitat instead of being removed and transported to shore for salvage and disposal (see Section 3.1.4 for details). When approved by the appropriate states and the USACE, BSEE may approve a variance to the operator's contractual obligations for the decommissioning of some offshore platforms.

BSEE is responsible for insuring that, when an operator is no longer producing oil or gas from a well, the well is correctly decommissioned, which entails permanently sealing the well to protect the environment and removing all structures that could affect the environment and impede navigation or other uses of the area. These obligations are part of the original lease term, but BSEE is not involved in any programs to create artificial reefs. Consultation under section 7 of the ESA for decommissioned structures to be used as artificial reefs is the responsibility of the USACE. Any effects to ESA-listed species from artificial reef creation using obsolete oil and gas platforms would be evaluated in consultation with the USACE and the applicant-proponent of the reef creation.

8.6.2.3 Entanglement in Ocean Bottom Node (OBN) Survey Lines

OBNs are a method of receiving and recording seismic survey data. An airgun is towed over the survey area as in typical seismic surveys. However, instead of towing hydrophone streamers to receive the seismic signals, ocean bottom nodes are deployed on the sea floor that receive and record the data. The nodes are deployed along miles of line laid directly on the sea floor (Figure 92). Vertical lines are used to locate and recover the survey lines once a survey is complete.

OBN surveys have reported entanglement of several animals, including a loggerhead sea turtle, manta ray, and Atlantic spotted dolphin. Line entanglements were associated with acoustic buoy release lines, acoustic pinger lanyards, nodal tether cables, and nodal lanyards. In 2013, a manta ray was documented as entangled in a vertical buoy line. On February 13, 2014, a sea turtle became entangled in a pinger line associated with OBN seismic survey receiver equipment. The pinger line was attached near a node on the sea floor at about a 40 m depth. The turtle was brought onboard, disentangled, and released by the crew. Photographs suggest the turtle was injured, near death, and should not have been released without further coordination with the stranding network or NMFS veterinarian. Another reported entanglement is the drowning death of an Atlantic spotted dolphin in the bottom line connecting many miles of deployed nodes.

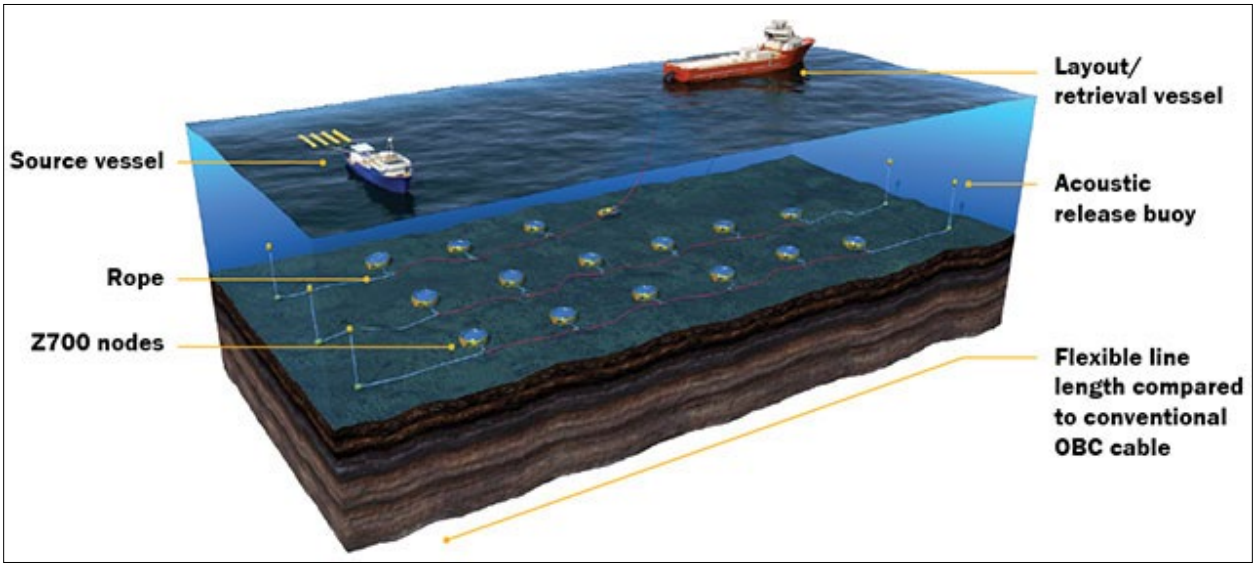


Figure 92. Diagram showing OBNs deployed on the sea floor

Because of past entanglements, a number of coordination calls between NMFS, BOEM, BSEE, and the operator occurred to understand the entanglement risks and recommend solutions to reduce those risks. Some updates to lines and equipment have occurred to reduce risk. However, some entanglement risk will continue in the future, therefore, these effects are considered further in this opinion.

Additional companies have requested seismic survey permits from BOEM to use the OBN seismic survey method of collecting data. We believe OBN surveys will continue to pose an entanglement risk to sea turtles. PSOs have not been required on OBN vessels and data are limited to a single report where a PSO on a nearby airgun vessel observed an entanglement. Entanglement of sea turtles in OBN lines has likely been under-reported. The OBN surveys may occur over periods of several months or be continually occurring with lines repeatedly deployed, data collected, the lines retrieved, and then deployed again in an adjacent area. Based on an estimated two to three OBN surveys occurring each year, we believe that three turtles (one per survey) may be entangled and succumb to injury or die in the lines associated with ocean-bottom-node surveys annually. We used densities and abundances presented in Section 8.1.2. Based on the relative abundance of each species in the Gulf, up to 17 Kemp's ridley, 27 loggerhead, and one green sea turtles may be lethally taken by entanglement over the 45 years of the Oil and Gas Program.

8.6.2.4 Tail Buoys

The most likely equipment to entangle sea turtles is the streamer tail buoy (Keatos Ecology 2009). Nelms et al. (2016) notes that, while they could not find any peer-reviewed literature documenting sea turtle entanglement in seismic equipment, they did receive anecdotal reports of entanglement in tail buoys and airgun strings during seismic surveys off the west coast of Africa, which Weir (2007) also reports on and notes that these incidents were fatal. Keatos Ecology

(2009) also notes that turtles have been entangled in seismic equipment off the coasts of India and Australia and in the Gulf of America, with at least some of these resulting in mortality. For these incidents, they did not specify what equipment caused the entanglements (tail buoys or other towed equipment), so it is unclear how they relate to the proposed seismic surveys. A 2011 seismic survey off the coast of Costa Rica recovered a dead olive ridley turtle (*Lepidochelys olivacea*) in the foil of towed seismic equipment, but it was unclear whether the sea turtle became entangled pre- or post-mortem (Spring 2011).

There have been reports of sea turtles being entrapped by seismic tail buoys; however, design improvements now prevent this entrapment (Ecology 2009; Ketos Ecology 2007) and BOEM has indicated that the majority of industry in the Gulf of America uses tail buoys with turtle guards.

In contrast to these accounts, there are several observations of sea turtles investigating streamers and not becoming entangled, along with seismic operations occurring in regions of high sea turtle density elsewhere in the world with no entanglements occurring (Hauser and Holst 2008; Holst et al. 2005a; Holst et al. 2005b; Holst and Smultea 2008). The likelihood of entanglement may, in large part, depend on the design of the equipment, (e.g., the tail buoy, Keatos Ecology 2009), so it is possible that the contradictory cases mentioned above are the result of differences in equipment used. In particular, the use of properly designed 'turtle guards' that have both a deflector and an exclusion element likely reduce or may even eliminate entanglements in tail buoys (Keatos Ecology 2009).

8.6.2.5 Other Receiving Devices and Equipment, Including Moon Pools

ESA-listed species have been documented to interact directly with the towed hydrophone streamers. For example, during a 2011 survey in the eastern tropical Pacific, a dead olive ridley sea turtle was recovered from within the towed seismic gear. It could not be determined if the sea turtle became lodged in the gear pre- or post-mortem (Spring 2011). Observations of sea turtles investigating streamers and not becoming entangled are also available (Hauser et al. 2008; Holst and Smultea 2008; Holst et al. 2005c; Holst et al. 2005d). Although the towed hydrophone streamers could come in direct contact with an ESA-listed species, entanglements are highly unlikely to occur and, thus, discountable, meaning the effects of exposure to other devices is not likely to adversely affect sea turtles.

Since 2004, sea turtles have been reported entrapped in moon pools associated with oil and gas activities. Sea turtles have been reported to have surfaced in moon pools and become trapped (Table 80). Three of the turtles required rescue and release after remaining in the moon pool for more than a day, while a single animal eventually swam out of the pool under its own volition. Although the bottom remained open, three sea turtles remained in the moon pool. Based on information provided to us during consultation, from 2020-2022, there were six reports of sea turtles in moon pools during offshore activity. All sea turtles exited the moon pool by itself, alive and apparently unharmed. We surmise the tall, narrow nature of the moon pools may confuse the

turtles and they become entrapped in the vertical column of moon pools. No sea turtles were reported in moon pools from 2023-2024.

Table 80. Reported occurrences of sea turtles trapped in moon pools

Date	Species	Lease Area, Block	Structure Type	Water Depth (ft)	Moon Pool Depth (ft)
December 4, 2004	loggerhead	Mississippi Canyon, Block 243	Matterhorn Fixed Spar (Platform A)	2,816	120
December 20, 2004	loggerhead	Mississippi Canyon, Block 243	Matterhorn Fixed Spar (Platform A)	2,816	120
October 24, 2011	leatherback	Ship Shoal, South Addition	Drill Ship ENSCO DS-3	184	100
September 25, 2014	leatherback	Grand Isle, Block 70	Drill Ship	120	39

Note: Measurements and tags put on the released animals show that the loggerhead was not the same individual surfacing in the platform.

BOEM and BSEE have included moon pool monitoring as part of their action (Appendix A.5). It applies to all vessels with moon pools that are open and accessible during OCS activities. The Bureaus provide protocols for the use of moon pools, preventing entrapment, and if entrapped, prompt detection and release. The number of sea turtles entering moon pools is possibly underreported, since many sea turtles may exit moon pools under their own volition and the occurrences of the animals in the moon pools go unreported.

In addition to the six sea turtles reported in moon pools from 2020-2022, older information indicates that the number of sea turtles reported entrapped in moon pools has been sporadic (e.g., two in a single year, four in ten years; Table 80). Based on the cases of sea turtles reported to be entrapped in moon pools, and successful rescues and releases that have occurred (Figure 93), we approximate about one sea turtle, on average, will be sub-lethally entrapped in moon pools every year, or 45 sea turtles (half loggerheads and half leatherbacks) every 45 years.



Figure 93. NMFS rescue of an entrapped leatherback sea turtle from a moon pool on the drillship *West Vela* on September 25, 2014

Entangling gear can interfere with an animal's ability to swim or surface, affecting the animal's ability to breathe, feed, breed, or migrate. Sea turtles are particularly prone to entanglement because of their anatomy and behavior. Records of stranded or entangled sea turtles demonstrate lines can wrap around the neck, flipper, or body of a sea turtle and severely restrict swimming or feeding. If the sea turtle is entangled when young, the line may become tighter and more constricting as the sea turtle grows, cutting off blood flow and causing deep gashes, some severe enough to remove an appendage. Sea turtles that survive an initial entanglement may later succumb to injuries sustained at the time of capture or from exacerbated trauma from entangling lines or lines otherwise still attached.

Mortality is less likely than minor injury from entanglement and entrapment. Once an entanglement occurs, the turtle maybe expected to die if it was prevented from surfacing for 30 or more minutes, or its ability to swim or feed was restricted. We are aware of only one report of turtle entanglement under BOEM's previous permits to other seismic operators in the Gulf of America based on 15 years of PSO data. Furthermore, during consultation BOEM informed us that the vast majority of seismic companies in the Gulf of America use turtle guards on their streamer tail buoys, and some even use some form of a turtle guard on the airgun array itself. This is perhaps not surprising because, if a turtle were to become entangled, it would cost the seismic operator time and money to untangle the turtle and re-survey tracklines where the data have been compromised. Since these turtle guards have been in place, there have been no reports of entangled sea turtles in the Gulf of America. Based on the above, we find it is extremely

unlikely and, thus, discountable that sea turtles would become entangled in Oil and Gas Program equipment, meaning entanglement is not likely to adversely affect sea turtles.

The deployment and recovery of equipment could result in direct contact by sea turtles investigating the equipment or temporary avoidance reactions of animals in the immediate area around the equipment. The vessel strike NTL requires all vessels to maintain a distance of 100 yards from sperm whales and 50 yards from sea turtles at all times, which makes it extremely unlikely entanglement of sea turtles in hydrophone cables and streamers, geophones, bottom cables and other associated gear will occur.

Sea turtles entrapped in moon pools could starve to death, become injured as a drilling vessel moved to a new location, become injured from unauthorized rescue attempts by offshore personnel, or exit moon pools under their own volition. During previous oil and gas development activities in the Gulf of America, instances of sea turtle entrapment in moon pools resulted in NMFS being contacted and the turtles successfully rescued, assessed, measured, tagged, and released under NMFS authorities. While we expect turtles will be entrapped in moon pools over the program lifetime, effects will be sub-lethal because operators will take steps, including contacting NMFS or other authorized turtle stranding network personnel if a turtle is entrapped in a moon pool.

8.6.3 Gulf Sturgeon

There have been no reported incidences of Gulf sturgeon entanglement as a result of Oil and Gas Program activities. While it is possible a Gulf sturgeon could be entangled, entanglement in Oil and Gas Program equipment or lines is extremely unlikely to occur. The distribution of the species far from the areas where the majority of Oil and Gas Program activity using equipment and lines that could result in Gulf sturgeon entanglement occur mean the effects to this species from this stressor are discountable and not likely to adversely affect the species.

8.6.4 Summary of the Effects of Entanglement and Entrapment

We conclude that capture in site clearance equipment, entanglement in seismic gear and/or entrapment in moon pools are likely to adversely affect the following listed sea turtles: green North Atlantic DPS, Kemp's ridley, leatherback, and loggerhead Northwest Atlantic Ocean DPS. Entanglement and entrapment is not likely to adversely affect sperm and Rice's whales and Gulf sturgeon and will not affect giant manta ray and oceanic whitetip shark based on the implementation of conservation measures and the rarity of previous reported entanglement, including of giant manta ray. Conservation measures BOEM now requires be implemented by industry to mitigate effects of entanglement include the use of taut lines/cables/chains, turtle guards on tail buoys, and the exclusion of vertical lines, such as acoustic pinger lines used in OBN surveys. These measures reduce, but do not eliminate the risk of entanglement. The summary of estimated incidents of entanglement and entrapment of sea turtles associated with 45 years of the Oil and Gas Program are displayed in Table 81.

Table 81. Estimated number of sea turtle entanglement or entrapment expected over 45 years of the Oil and Gas Program

	Loggerhead	Leatherback	Kemp's ridley	Green
Capture from site clearance activities (non-lethal)	540	90	1,485	225
Entanglement in lines (lethal)	27	0	17	1
Entrapment in moon pools (non-lethal)	22	23	0	0

8.7 Effects of Marine Debris

The Oil and Gas Program may lead to marine debris such as trash - paper, plastic, wood, glass, and metal associated with offshore operations being discharged to the marine environment. While disturbance or strike from marine debris as it falls through the water column is possible, it is not likely because the objects will slow in velocity as they sink toward the bottom and can be avoided by highly mobile organisms. Intentional discharge of marine debris is prohibited by law (30 CFR §250.40 and MARPOL, Annex V, P.L. 100-220 [101 St. 1458]), yet accidental losses of debris into the marine environment do occur. Release of trash and debris is prohibited in the ocean unless it is broken up by a comminutor (machine to cut or grind solid waste material) to less than 25 mm in diameter (33 CFR §151.51-77). Inadvertent polluting from trash and debris is possible because of the Oil and Gas Program, including lost equipment such as hard hats, gloves, etc., and USCG and the U.S. EPA regulations require proactive avoidance of accidental loss of trash and debris (BSEE NTL 2015-G03, Attachment 2). Furthermore, all permits from BOEM include guidance for handling and disposing of marine trash and debris, similar to BSEE NTL 2015-G03. Additionally, site clearance trawls are required for cleaning up after a site is decommissioned, meaning trash and debris from structures and their operation are collected as part of decommissioning. The amount of trash and debris that would enter the marine environment as the result of the Oil and Gas Program is expected to be minimal. These releases of trash and debris are not part of the action because they are not a lawful action. However, we include an analysis of the effects of marine debris on ESA-listed sperm and Rice's whales, sea turtles, and Gulf sturgeon because releases of trash and debris are reasonably certain to occur and would not occur but for the Oil and Gas Program activities.

Marine debris may originate from a variety of sources, though specific origins of debris are difficult to identify. Reports indicate up to 80% of marine debris results from land-based sources in some parts of the world (Allsopp et al. 2006; GESAMP 2010), and a worldwide review of marine debris identifies plastic as the primary form (Derraik 2002). Microplastic accumulation on Northern Gulf of America beaches is similar to other places in the world with nearly 60% of content on beaches found in the dunes, which likely exposes sea turtle nesting sites (Beckwith and Fuentes 2018). Another published study regarding shoreline trash at Padre Island National Seashore, reported that from 1994 to 1998, approximately 10% of marine trash that washed

ashore originated from offshore structures and/or vessels associated with the oil and gas industry (Miller and Jones 2003). There are many types of materials used in offshore energy production, including a variety of plastics, pallets, hard hats, gloves, tools, ropes, and storage drums that could accidentally be lost overboard. The Miller and Jones (2003) study indicated that the majority (76%) of items originating from the oil and gas industry consisted of wood (e.g., lumber, wooden pallets, and wood spools). While wood is less concerning in regards to potential effects to protected species, many of the plastics used by industry can withstand years of saltwater exposure without disintegrating or dissolving. Further, floating materials have been shown to concentrate in ocean gyres and convergence zones where *Sargassum*, and consequently juvenile sea turtles, are known to occur (Carr 1987). Marine debris has the potential to impact protected species through ingestion or entanglement (GESAMP 1990; Gregory 2009). These effects could result in reduced feeding, reduced reproductive success, and potential injury, infection, or death of protected marine organisms (Laist et al. 1999).

Accidental release of debris from OCS activities is known to occur offshore, and ingestion of or entanglement in discarded material could affect ESA-listed species. BOEM and BSEE have taken steps to raise awareness of this potential hazard. BSEE requires an annual training and certification for marine debris education and elimination for all offshore personnel that includes information regarding the potential for adverse effects to listed species (NTL-2015-G03, "Marine Trash and Debris Awareness and Elimination"). The debris awareness training, instruction, and placards required by the Protected Species Lease Stipulation minimize the amount of debris accidentally lost overboard by offshore personnel. According to the protocols in A.2 (Attachment 2), lessees are required to recover marine debris that is lost or discarded in the marine environment while performing OCS activities. Lessees are also required to submit a report to BSEE within 48 hours of the marine debris incident. The report must describe recovery efforts or explain in detail if the Lessee determined that debris recovery is not warranted because (a) conditions are unsafe; (b) debris is insignificant and unrecoverable because it has floated away or sunk to the seafloor; or (c) debris is insignificant and immediate recovery is cost prohibitive. If conditions are unsafe, recovery must be attempted when conditions become safe. The lessee must recover the marine debris lost or discarded if BSEE does not agree with the reasons provided by the lessee. However, despite these efforts to raise awareness and reduce accidental pollution, NMFS believes marine debris still poses a risk to sperm whale, Rice's whale, and sea turtles, in particular. The risk of ingestion remains because even small pieces of debris can be consumed by sperm whales, Rice's whales, and sea turtles. Entanglement in floating debris is most likely to affect sperm whales, Rice's whales and sea turtles.

Quantifying potential adverse effects associated with oil and gas industry-generated marine debris is difficult for several reasons. As described above, land-based sources and the fishing industry are major contributors to marine debris, with a relatively smaller proportion of marine debris thought to originate from the oil and gas industry. Only a small proportion of harmful interactions of any kind with listed species in offshore environments result in stranding, as most carcasses of animals that die offshore are unlikely to reach shore (Baulch and Perry 2014;

TEWG 1998). It is difficult to determine if sea turtles or whales consumed marine debris, as gut content analyses can only be conducted on captured or stranded animals. Lastly, there can be varying rates of ingestion or entanglement based on species distribution, species density, and sample location (Baulch and Perry 2014; Schuyler et al. 2013).

8.7.1 Whales

Sperm whales are susceptible to threats from marine debris given their habitat use and feeding habits. Marine debris can affect sperm whales through entanglement and ingestion. While most entanglements of protected species involve fishing line or net fragments (Balazs 1985), strapping bands and ropes from a variety of vessels are also a concern. A 2014 literature review (Baulch and Perry 2014) evaluated the impacts of marine debris on cetaceans from around the world. Sperm whale ingestion of marine debris is a concern, particularly because their feeding behavior may include cruising along the bottom with their mouths open (Walker and Coe 1990). A review by Baulch and Perry (2014) noted nine baleen and 39 toothed whale species (including sperm whale) ingested debris. Ingestion rates of debris items by sperm whales varied from 0% in southern Australia to 100% along the coast of Belgium. However, as described above, numerous studies of examining the gut contents of stranded whales indicate that fishing gear is the majority type of marine debris (Jacobsen et al. 2010; Unger et al. 2017)).

We calculated a global average ingestion rate and mortality rate for sperm whales using the data provided in Baulch and Perry (2014). We used the total number of animals that were recorded with ingested debris and divided that by the total number of animals necropsied (15/91=16.5%) to calculate the ingestion rate. For mortality rate, we divided the number of animals where cause of death was determined to be from marine debris by the total number sperm whales necropsied (4/65= 6.2%). These values were then applied to density estimates of sperm whales within the Gulf of America to determine the effect of marine debris on sperm whales within the action area. We only considered the portion of the action area beyond the continental shelf as these deeper waters are the areas of known habitat use by sperm whales. To refine the calculation to account for marine debris generated only by offshore oil and gas operations, we considered the percent of non-wood marine debris identified as originating from the oil and gas industry (2.4%), as reported by Miller and Jones (2003). The results (Table 82) indicate that few sperm whales will be impacted by the ingestion of marine debris within the action area at any given time. Though we do not have annual rates of impact, we believe that, because sperm whales are long-lived (life expectancy up to 60 years) and the rate of population growth is small (4%), there will not be a lot of turnover in the number of individual sperm whales entering or exiting the population. Therefore, we do not expect increases in the number of individuals affected by marine debris over the course of the 45-year action. Based on our analysis and the 4.96% calculated mortality rate for sperm whales (Baulch and Perry 2014), we believe no more than three sperm whales will be nonlethally taken and one sperm whale lethally taken through the ingestion of marine debris over the course of the action.

Table 82. Estimated interactions between sperm whales and marine debris over 45 years

Planning Area	Off-shelf Area (km^2)	Sperm Whale Density (Number/km^2)	Impact Ingestion Rate from Oil and Gas Industry (16.5 percent x 2.4 percent)	Mortality Rate from Oil and Gas Industry (6.2 percent x2.4 percent)	Estimated Sublethal Take	Estimated Lethal Take
Western	60,044	0.002	0.00396	0.001488	0.48	0.18
Central	196,506	0.002	0.00396	0.001488	1.56	0.58
Eastern	121,883	0.002	0.00396	0.001488	0.97	0.36
Totals	378,433				3.01	1.12

A sperm whale caught in marine debris may suffer from acute impaired mobility that quickly compromises its health, or it may decline slowly from diminished feeding and reduced reproductive capability (BOEM 2013; Smith et al. 2011). The increased energy required to overcome the handicap of entanglement may require more food than the entangled whale can capture. Ingested debris may block the digestive tract or remain in the stomach for extended periods, thereby reducing the feeding drive, causing ulcerations and injury to the stomach lining, or perhaps even providing a source of toxic chemicals (Laist 1987; Laist 1997). Weakened animals are more susceptible to disease and less fit to breed or reproduce (Laist et al. 1999).

Rice's whales are more susceptible to threats from marine debris given their habitat use and feeding habits. Rice's whales, like all baleen whales are filter feeders, meaning they are susceptible to microplastic ingestion. Several polymer types (polyethylene, polypropylene, polyvinylchloride, polyethylene terephthalate, nylon) have been documented in baleen whales, which can bioaccumulate toxic chemicals (Besseling et al. 2015; Fossi et al. 2016). However, the likelihood of Oil and Gas Program-related marine debris affecting Rice's whales is low because there are not many leases or production activities in the EPA. Oil and Gas Program-associated vessel transit through the EPA, could expose Rice's whale to marine debris. Ocean currents could carry marine debris to parts of the action area where Rice's whales occur. At least one death of a stranded Rice's whale has been attributed to marine debris. The animal was found at Everglades National Park in January 2019. A plastic shard was lodged in the gut of the animal, which succumbed to emaciation, stranding and drowning from the injuries sustained from the shard (FMMSN1908 necropsy report), although the origin of the plastic shard has not yet been identified.

While plastic debris is a threat to Rice's whale and other large whales (Derraik 2002; Baulch and Perry 2014), the majority of marine debris from the Oil and Gas Program is wood, rubber (e.g., bumper tires), and steel based on information provided to us by BSEE from their marine debris inspections and (Miller and Jones 2003). While wooden debris like pallets and dunnage do occur

from oil and gas activities, BSEE notes that almost all such items used in transporting equipment offshore are required to be returned on the service vessel for yard credit (incentivizing the careful handling of these items, and lowering the likelihood of them becoming debris). Single-use plastics and other items from personal consumption (e.g., bottles) may be accidentally lost from platforms and oil and gas vessels, and could pose a risk of exposure.

Fishing-related gear constitutes a large component of the debris found in the guts of dead, stranded whales (Baulch and Perry 2014; Unger et al. 2016; Jacobsen et al. 2010). It is possible that Rice's whales could be exposed to plastic marine debris originating from the Oil and Gas Program over the 45-duration of the action. However, because of the low density of Rice's whales within the action area, and the small overall proportion of debris from the Oil and Gas Program that could cause harm to Rice's whale (i.e., plastic), this leads us to believe that the likelihood of encounter would be small. Exposure to marine debris originating from the Oil and Gas Program is expected to be low, and mortality is not expected.

8.7.2 Sea Turtles

Sea turtles caught in marine debris may drown, become unable to forage or avoid predators, sustain wounds and infections from the abrasive or cutting action of attached debris, or exhibit altered behavior that threatens their survival (Balazs 1985; Laist 1997). All sea turtles are susceptible to ingesting marine debris, though leatherbacks show a marked tendency to ingest plastic that they misidentify as jellyfish – a primary food source (Balazs 1985). Ingested debris may block the digestive tract or remain in the stomach for extended periods, thereby reducing the feeding drive, causing ulcerations and injury to the stomach lining, or perhaps even providing a source of toxic chemicals (Laist 1987; Laist 1997). Weakened animals are more susceptible to predators and disease and are less fit to migrate, breed, or, in the case of turtles, nest successfully (Katsanevakis 2008; McCauley and Bjorndal 1999).

Stanley et al. (1988) reported that marine debris ingestion was evident in 32.9% of stranded turtle carcasses (loggerheads, greens, and Kemp's ridley) from off the coast of Texas between 1986 and 1987. A more recent and comprehensive study of stranded green turtles in the same area from 1987-2002 showed that 48.7% of individuals had ingested debris, with plastic sheeting, fragments, and threads being the most common items(Choi et al. 2021). Subsequent necropsy studies of stranded turtles indicate varying rates of debris ingestion by species and location. A worldwide review of marine debris ingestion by sea turtles determined that approximately 47% of hawksbill, 42% of green, 34% of leatherback, 23% of loggerhead, and 15% of Kemp's ridley sea turtles sampled had ingested debris, and found exclusively plastic debris in this study (Schuyler et al. 2013). We expect sublethal and lethal effects to sea turtles from marine debris will be similar regardless of the species. We are not aware of a study that provides marine debris ingestion rates for each sea turtle species in the action area. We consider these are global estimates, based on a literature review, the most comprehensive, current and best available information.

We consider the global percentages from Schuyler et al. (2013) relevant to our analysis because of the larger data set for global averages, which provides a better estimate than a smaller data set that covers a shorter period in a more localized area. Therefore, assuming that marine debris ingestion in the Gulf of America is similar to the worldwide values identified previously, we estimate the number of sea turtles affected by marine debris within the Gulf of America at any given time by multiplying the global percentages by sea turtle density estimates (Section 8.1.2.2) and spatial coverage data for each sea turtle species in the Gulf of America. To account for marine debris generated only by offshore oil and gas operations, we considered the percent of non-wood marine debris identified as originating from the oil and gas industry (2.4%), as reported by Miller and Jones (2003), to estimate the number of sea turtles affected by marine debris from the Oil and Gas Program in the Gulf of America (Table 83), as follows:

> Sea turtles affected by oil and gas-related marine debris in Gulf of America = Global percentage of marine debris ingestion x sea turtle densities x spatial coverage x 2.4%.

Table 83. Estimated number of adult and neritic juvenile sea turtles affected by marine debris from oil and gas operations in the Gulf of America at any given point in time

Species	Total
Kemp's ridley	1152
Loggerhead	1,769
Green	87
Leatherback	76

We consider a sea turtle affected by marine debris once it has ingested debris, and it remains affected as long as it survives. Therefore, an individual should be counted once for the year in which the ingestion occurred. Increases in adult population numbers due to recruitment from younger age classes, and decreases in mortality, can be used to discern the number of new injuries occurring annually. In order to estimate the number of newly impacted sea turtles annually, we applied survivorship probabilities for the population to estimate the number and percentage of each sea turtle species that: 1) leaves this age class each year, and 2) newly recruits to this age/size class. We assumed the individual species' populations are stable and the number of mortalities will be replaced with an equal amount of individuals at risk of ingestion each year. According to the recovery plans for loggerhead and Kemp's ridley sea turtles, annual survival probabilities average 0.853 and 0.935, respectively, corresponding to annual mortality rates of 14.7% for loggerheads and 6.5% for Kemp's ridley for neritic juveniles and adults combined. We do not have species-specific survivorship probabilities for the age classes of other species of sea turtles in the Gulf of America, but we expect them to be similar based on similar biological characteristics, such as life history.

We conservatively applied the higher mortality rate of 14.7% for loggerheads to the neritic and adult age classes of green and leatherback sea turtles as a surrogate value for this analysis

(similar to the approach used for the vessel strike analysis in Section 8.4). Multiplying the mortality rates by the estimated number of sea turtles affected by marine debris at any given time provides an annual number of affected animals (Table 84).

Table 84. Estimated number of adult and neritic juvenile sea turtles that may be affected by marine debris from the oil and gas industry per year

Species	Correction factor	N Turtles ingesting marine debris	Total
Kemp's ridley	0.065	1,113	72
Loggerhead	0.147	1,769	260
Green	0.147	87	13
Leatherback	0.147	76	11

Mortality because of exposure to marine debris is variable. In a review of 37 studies, 15 of which noted the cause of mortality was marine debris, Schuyler et al. (2013) reported that mortality rates varied in 11 of the 15 studies from 2-17% for total mortality and 5-35% for mortality due to ingestion. We use the high end of the range for total mortality and consider that 17% of all sea turtles affected by marine debris will die as a result of this stressor in our calculations (Table 85).

Table 85. Annual mortality of adult and neritic juvenile sea turtles associated with marine debris from the oil and gas industry

Species	Rounded Total
Kemp's ridley	13
Loggerhead	45
Green	3
Leatherback	2

We used the calculated abundances presented in Section 8.1.2 to estimate the number of pelagic stage green, Kemp's ridley, and loggerhead juveniles that could be affected by marine debris. We did not calculate exposure to marine debris for oceanic juvenile leatherbacks because of the lack of this life stage in the Gulf of America. The number of pelagic stage juveniles that could be affected by marine debris originating from the oil and gas industry at a given time was determined using the following equation:

Abundance x rate of interaction with debris (from above) x 2.4%.

The number of lethal takes was then calculated by applying the mortality rate of 17% (Table 86).

Table 86. Estimated number of pelagic stage juvenile sea turtles affected by marine debris associated with the oil and gas industry

Species	Abundance	Number of Interactions at Any Point in Time	Number of Lethal Interactions at Any Point in Time
Kemp's ridley	21,998	528	9
Loggerhead	115,718	2,777	47
Green	215,551	5,173	88

To calculate the number of pelagic juveniles that could be impacted annually by marine debris from the Oil and Gas Program, we multiplied the total number of interactions in Table 86 by a correction factor that considers the number of years juveniles spend in the pelagic/oceanic stage. Although a proportion of the juvenile population interacts with marine debris, not all those interactions occur in a single year. Instead of applying survivorship probabilities to obtain a correction factor to estimate annual numbers of interactions as we did for adults and neritic juveniles, for oceanic juveniles we determined annual interactions by dividing the total number of juvenile sea turtles interacting with marine debris at any given time by the number of years a juvenile remains in the oceanic stage (similar to the approach used for the vessel strike analysis in Section 8.4). Juvenile Kemp's ridley spend up to four years in the oceanic stage, green turtles up to 4.6 years (rounded up to five)(Reich et al. 2007), and loggerheads about 8.2 years (rounded down to eight)(Bjorndal and Bolten 2000). We expect the number of marine debris interactions with each species' oceanic juvenile sea turtle population in any given year to represent the total number of years turtles spend in the oceanic stage. For example, if a Kemp's ridley juvenile is injured through the ingestion of marine debris in Year one of the oceanic stage and survives to Year four, only one of the four years represents the annual rate of exposure for the oceanic age class (or 0.25). To determine the annual number of marine debris interactions with oceanic juvenile sea turtles from the Oil and Gas Program for each species, we divide by the total number of interactions by the total number of years juveniles spend in this age class. Annual exposure rates for the oceanic stage are represented in 25% of the total Kemp's ridley interactions, 20% of green sea turtle interactions, and 12.5% of the total interactions in loggerheads (Table 87). We again apply the 17% mortality rate to calculate the annual number of lethal interactions with marine debris for oceanic juvenile sea turtles.

Table 87. Estimated number of annual interactions between pelagic-stage juvenile sea turtles and oil- and gas-generated marine debris

Species	Correction for the Number of Individuals Ingesting Marine Debris Annually (1/years of life stage)	Annual Occurrence of Nonlethal Interactions with Marine Debris	Annual Occurrence of Lethal Interactions with Marine Debris
Kemp's ridley	0.250	132	22

Species	Correction for the Number of Individuals Ingesting Marine Debris Annually (1/years of life stage)	Annual Occurrence of Nonlethal Interactions with Marine Debris	Annual Occurrence of Lethal Interactions with Marine Debris
Loggerhead	0.125	347	59
Green	0.200	1,035	176

Because the actions under this opinion may extend 45 years into the future, we extrapolated the calculations over 45 years (Table 88).

Table 88. Estimated interactions between sea turtles and marine debris over 45 years

Species	Sublethal Interactions			Lethal Interactions		
	Oceanic Juveniles	Adults	Total	Oceanic Juveniles	Adults	Total
Kemp's ridley	5,940	55,650	61,590	1,010	553	1,563
Loggerhead	15,621	88,450	104,071	2,656	1,989	4,645
Green	46,557	4,350	50,907	7,915	98	8,013
Leatherback	0	3,800	3,800	0	85	85

Individual sea turtles are likely to be adversely affected from exposure to marine debris (through ingestion) because of the Oil and Gas Program. Exposure to marine debris may have sublethal effects on individuals, including reduced fitness, or could lead to death. However, there are several reasons as to why the exposure estimates are conservative. While plastic represents the majority type of debris that is ingested by sea turtles (Choi et al. 2021), information from BSEE indicates that the type of plastic marine debris lost from oil and gas activities is minimal compared to other types of debris. The size of the debris matters as it relates to whether or not a sea turtle is capable of ingesting it. The plastic debris found onshore by Miller and Jones (1993) that could be attributed to the oil and gas industry were items like intact hard hats. Items of this size would not be available to sea turtles to ingest unless it broke down, which would happen over years once the plastic degraded. Studies indicate that fishing-related items are a prominent type of marine debris ingested by sea turtles (Bjorndal et al. 1994); however the fragments of plastic and sheeting most commonly found in sea turtles guts (Choi et al. 2021; Clukey et al. 2017) are not able to be attributed to a particular source. Further, there is a variety of documented impacts to sea turtles who ingest plastic debris, ranging from mortality (Bjorndal et al. 1994), to no obvious health impacts (Clukey et al. 2017). With these factors in mind, we anticipate this stressor will result in a small proportion of individuals being adversely affected.

8.7.3 Gulf Sturgeon

Gulf sturgeon are a coastal species that selectively feed on a variety of benthic invertebrates. Debris from the Oil and Gas Program will generally be lost in offshore areas, meaning it is extremely unlikely material will be transported to and settle in coastal benthic habitat where Gulf sturgeon reside. We believe that the likelihood of Gulf sturgeon encountering or ingesting marine debris from the Oil and Gas Program is discountable. Therefore, we determined marine debris from the Oil and Gas Program is not likely to adversely affect Gulf sturgeon.

8.8 Effects of Oil Spills

Oil spills are accidental and unpredictable events, but may result from oil and gas development and production from federally-regulated oil and gas activities in the Gulf of America. Oil releases can occur during the exploration, development (construction), production (oil and gas extraction), and transport of oil. Oil spills associated with the Oil and Gas Program may occur for a number of reasons including equipment failure, human error, natural forces such as hurricanes, or a combination of causal factors. Sources of spills include drilling platforms, well-heads, vessels, pipelines, and oil barges. The volume of oil released can range from spills less than 1 bbl, which make up the vast majority, to rare, catastrophic events. When spills do occur, the size of the spill depends on the volume (in a container or within the earth), the flow rate (a low-pressure/low-flow leak up to a high-pressure/high-flow event), and the capability of the responsible party or response agencies to contain and control the source of the spill and clean up the post-spill oil. An oil release will continue until either the reservoir is depleted or the release is brought under control.

Any discharge of hydrocarbons or hazardous substances into U.S. navigable waters is prohibited under U.S. law under Section 311(b)(3) of the Clean Water Act. Consequently, there are stringent regulatory mechanisms, industry best practices, and BSEE-required spill response plans (30 C.F.R. §254.1) in place to reduce the risks associated with oil spills. Despite the mechanisms in place, there are still many spills each year in the Gulf of America because of the region's large number of subsea wells, offshore production structures, pipelines, vessels, and other infrastructure supporting oil and gas activities. Spills have shifted more to offshore waters than nearshore/coastal waters (NAS 2022) as offshore oil exploration and production activities have increased. However, over the last two decades, there has been a decrease in the action rate of spillage per amount of production (NAS 2023) despite the increase in offshore oil and gas activity.

In 2022, the National Academies of Sciences (NAS) released their fourth report on oil in the sea, which describes sources, fate and effects, and major changes since the third report (NAS 2022). Notably, the authors mention the new regulations for safety of offshore oil and gas and shipping industries. They report sources of oil in the sea from the most to least common as:

- Land-based sources (runoff);
- Natural oil seeps;

- Oil spills (even with a 10-year annualized estimate from DWH) with more frequent spills in offshore waters than nearshore waters, and predominantly in the Gulf; and
- Operational discharges of produced water, including from marine transportation and hydrocarbon extraction, with the volume of produced water being greater than 20 years ago, likely because of increased oil production.

Oil spills are known to damage the environment and adversely affect animals that are exposed to oil. From the DWH PDARP Trustees (2016):

> When crude oil is released, it immediately begins the degradation process, called weathering. Some oil compounds will weather, by evaporation, dispersion into water, or bacterial degradation, while others will not, such as polycyclic aromatic hydrocarbons or PAHs. Different crude oils have different chemical compositions that are governed primarily by the geologic conditions under which they were formed, migrated, and accumulated. These conditions can result in oil from a given location or geologic formation having a unique chemical composition, including specific compounds that help experts distinguish one crude oil from another. The fate and transport of oil and gas after a spill differs. Oils may sink, become entrained in the water column, or surface. The moment oil reaches the surface, it begins to evaporate the aromatic compounds and the remaining heavier compounds react to other environmental conditions (i.e., sun, wind, waves, currents). Natural gas may remain submerged and be degraded by bacteria prior to reaching the surface, depending on the depth of the spill. The same bacteria produce mucus that may form with oil droplets and cause marine oil snow that then settles to the seafloor.

Evaporation, dilution, weathering, emulsification, shore contact, and degradation limit the fate of oil such that it will no longer continue spreading on the water surface. In other words, oil spilled over an extended period spreads until other forces evaporate, break down, or redistribute oil (Figure 94). For a spill in deep water, oil-weathering rates are much lower than for shallower surface waters, potentially resulting in extended exposure to toxic products (Murawski 2020a).

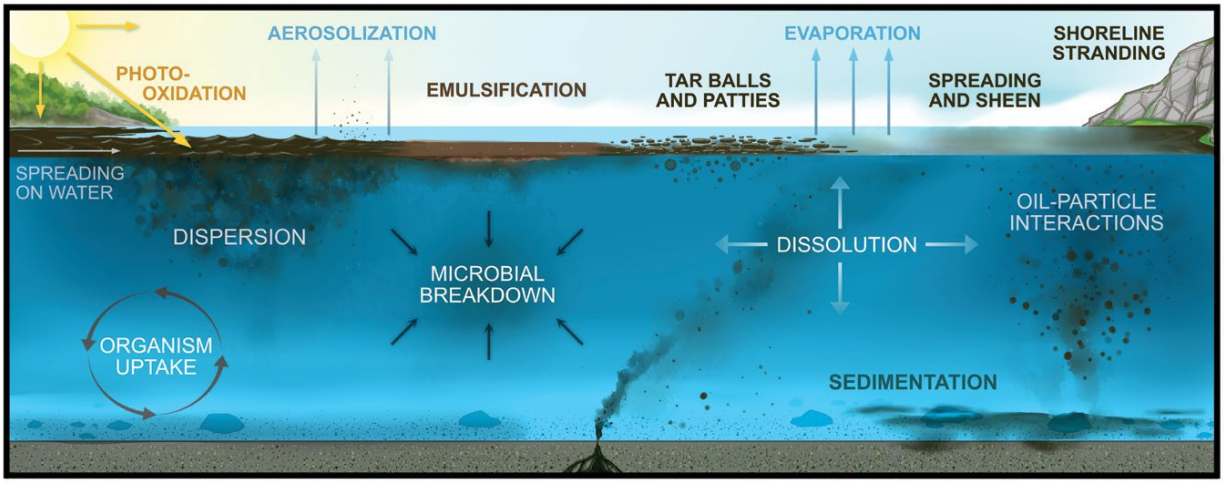


Figure 94. Summary of processes affecting the fate of oil in the sea (NAS 2022)

Berenshtein et al. (2020) suggested that toxic concentrations of oil are present in the water after a spill is no longer visible using satellite imagery. While satellite detection remains the primary and most reliable method for identifying the presence of visible oil at the surface, especially for

oil spill response and cleanup efforts, it is limited to surface oil and does not detect dissolved or subsurface compounds (Berenshtein et al. 2020). In oil spill response science, visible oil detection using vessels, aircraft, and satellite images is the standard method for responders to locate oil, allowing for mitigation efforts. In NMFS's view, it is the most reliable method for determining a distinct and undeniable minimum area of impact, and, thus, the most reasonable method to estimate future impacts of spills, although the affected area is larger than what is visible on the water surface because of factors such as a possible subsurface plume.

As one of the two types of unseen oil, the DWH (a low probability catastrophic event) subsurface plume, which may have been the result of subsea injection of dispersants in addition to the high pressures at the depth of the plume, was the first documented subsea oil spill (BOEM and BSEE 2024). Subsurface plumes can retain concentrations of oil components over a distance of 11 km (White et al. 2012), as cited in BOEM and BSEE (2024). The other type of oil not detected by satellite imagery is described in Berenshtein et al. (2020), where the authors used in situ observations and oil spill transport modeling to examine the full extent of the DWH spill, beyond the satellite-visible footprint, and identify areas with potentially toxic concentrations of dissolved hydrocarbons that might impact marine organisms. Figure 95 displays visible and toxic (brown); invisible (oil that is below the surface in the water column and not detected by satellite imagery) and toxic (yellow); and non-toxic (blue) oil concentrations.

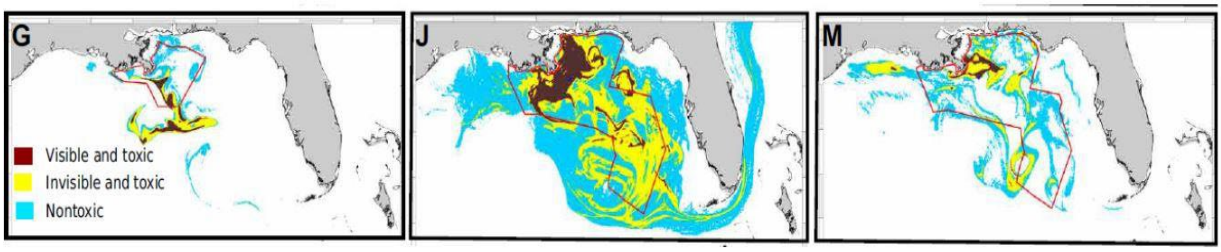


Figure 95. Figure from Berenshtein et al. (2020a) showing spatiotemporal dynamics of the spill for dates showing cumulative oil concentrations in figures G- 15 May 2010; J- 18 June 2010; and M- 2 July 2010

Oil spills affect ESA-listed species through various direct exposure pathways, including external contact (through the skin and eyes), inhalation, aspiration, and oil ingestion (through oiled prey or accidental oil ingestion). External contact with oil can cause irritation of the eyes, skin, and mucus membranes. In addition, oil present around a blowhole or in the mouth could lead to aspiration of oil. External contact can transfer to the bloodstream although uptake through the skin is considered unlikely for healthy cetacean skin in high salinity waters because of the tight intercellular bridges and thick epidermis (O'Hara and O'Shea 2001). The effects of long-term skin exposure during long duration spills have not been determined; however, oil was applied to the skin of a live, stranded sperm whale and skin lesions formed (Trustees 2016). Disruption of essential behaviors, such as breeding, communication, and feeding may also occur. Campelo et al. (2021)describe the effects to microzooplankton from oil spills, and note that the complexity of interactions in the marine planktonic food web reinforces the need for long-term environmental monitoring because post-spill impacts appear to last many years. As discussed below, our

analysis of the effects of oil spills from the Oil and Gas Program relies on the best available information, including the DWH event and the effects reported through the extensive research and monitoring supporting the natural resources damage assessment that also analyzed the effects of the subsurface plume. We incorporate that analysis of the subsurface plume into our considerations here. In order to present available information and establish a reasonable spill range with minimum and maximum values, we considered the following main factors:

- The pre-DWH spill risk predicted in the 2007 biological opinion.
- Post-DWH information from BOEM, federal reports, and independent studies on oil spill risk, and estimates of the frequency of very large spills (defined by BOEM as ≥ 10,000 bbl) from peer-reviewed literature. This information includes:
- The volume of oil that could be spilled in the future using BOEM's estimated flow rates and other relevant information, and the anticipated flow duration for an uncontrolled blowout based on our assessment of the ability of industry to rapidly respond to a blowout and bring a well under permanent control.
- The causes of blowout, loss of well control and other potential risks that cause spills, and the Bureaus' predicted occurrence of future spills.
- Regulatory reforms and improvements in offshore drilling safety since DWH.

Pre-Deepwater Horizon Oil Spill Risk

In the 2007 biological opinion, NMFS predicted that a single, catastrophic (defined by BOEM as over 1.1 MMbbl) spill would occur approximately every 40 years.

Following that opinion, the DWH event occurred, resulting in a larger release than predicted in the 2007 biological opinion, due to the flow rate of oil from the well and the amount of time required to bring the well under control. During the reinitiated consultation requested by BOEM following DWH, we emphasized the necessity for additional information on the risk of catastrophic spills as part of the ESA section 7 consultation to complete the 2020 biological opinion, which is also true for this opinion.

Post-Deepwater Horizon Oil Spill Risk

This section summarizes relevant peer-reviewed literature and other information regarding oil spill risk and statistical methods to predict the risk of catastrophic spills since the DWH event. By their very nature, oil spill risk analyses rely on data from past spills to project future spill occurrences. At present, there is not an ideal, standardized approach to characterize the risk of spill occurrence and spill consequences.

Factors Contributing to Oil Spill Risk

Muehlenbachs et al. (2013)provides an empirical analysis of company-reported incidents (e.g. blowouts, injuries, spills) on oil and gas production platforms in the Gulf of America between 1996 and 2010. This period was characterized by a dramatic increase in the depths at which

offshore oil and gas extraction began to occur. One of the key findings was that, compared with platforms at water depths < 1,000 ft, the average number of company-reported incidents (such as blowouts, fires, injuries, and pollution) increased more than threefold for depths > 1,000 ft. Controlling for platform characteristics such as age, quantity of oil and gas produced, and number of producing wells, for an average platform, each 100 ft of added depth increased the probability of a company-reported incident by 8.5%. The paper did not demonstrate a causal link between water depth and incidents or violations, but did demonstrate there are statistically-significant relationships between the variables. As shown in Figure 96, in 2023, there were numerous deep water wells (400 m).

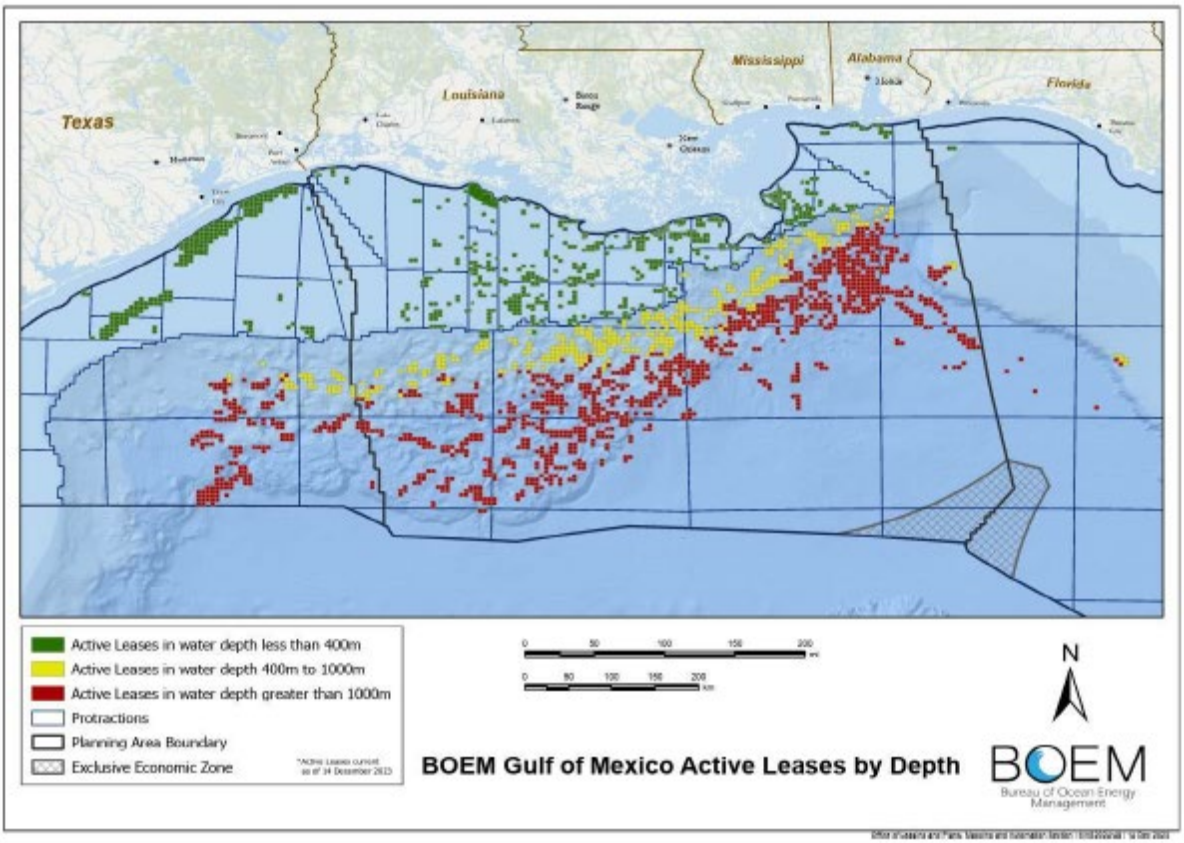


Figure 96. December 2023 Active Leases by Water Depth

Human factors have been commonly identified as the cause of major accidents and spills in the global oil and gas industry (NAS 2022; Nwankwo et al. 2022; Ye et al. 2020). From 2011-2013, BSEE investigated 139 accidents, which included various types of incidents such as equipment failures, human errors, and spills. Of the 139 accidents, 18 (12.9%) involved pollution releases, including oil spills. These spills ranged from minor incidents, such as spills of less than one gallon of gas/oil (enough to produce a sheen), to larger releases of compounds such as drilling fluid. These spills were primarily caused by human error such as the misuse of equipment or failure to notice an over-pressurized vessels.

The remaining 121 accidents (87%) did not involve spills or pollution releases. These included incidents caused by equipment failure, operational issues, and human errors that did not result in environmental contamination. Of these incidents, 115 (82.7%) were caused, at least in part, by human error, with 73 (52.5%) being entirely caused by human error (Figure 97). Brkić and Praks (2021) identified causes of major accidents, including human and procedural errors associated with poor training. Islam et al. (2019) estimated human error probability for maintenance procedures.

While human error is the most common reason for oil spills (Figure 97), loss of well control or pipeline damage/rupture may also be caused by increased hurricanes or other severe weather events, underwater landslides, anchor dragging/damage, corrosion/aging of equipment, and equipment failure. Vessel anchoring can cause physical crushing and compaction beneath the structure if anchors are dropped or drag too close to support structures or pipelines. During anchor recovery, or if a vessel loses footing, anchors can also be dragged across the seafloor and cause damage if they impact a structure or pipeline (BOEM and BSEE 2024). Anchors are used less frequently in ultra-deepwater operations where production structures are subsurface and dynamic positioning systems are used to drill wells. According to Dong et al. (2022), oil spills from ships, pipelines, tanks/facilities and wells/platforms (Figure 98) have increased over the previous 30 years with general shipping demonstrating the largest increase, and a correlation between oil spills, population density, and the production/use of petroleum. Historically, loss of well control events have been the principal cause of spills >10,000 bbl, but, according to ABS Consulting (2016), weather/natural causes, external factors, and other causal factors were not frequently reported in the data prior to 2000 (BOEM and BSEE 2024). It is possible that the lower number of incidents attributed to these factors may be due to limitations in reporting practices during that time, rather than a true reflection of the frequency of occurrence.

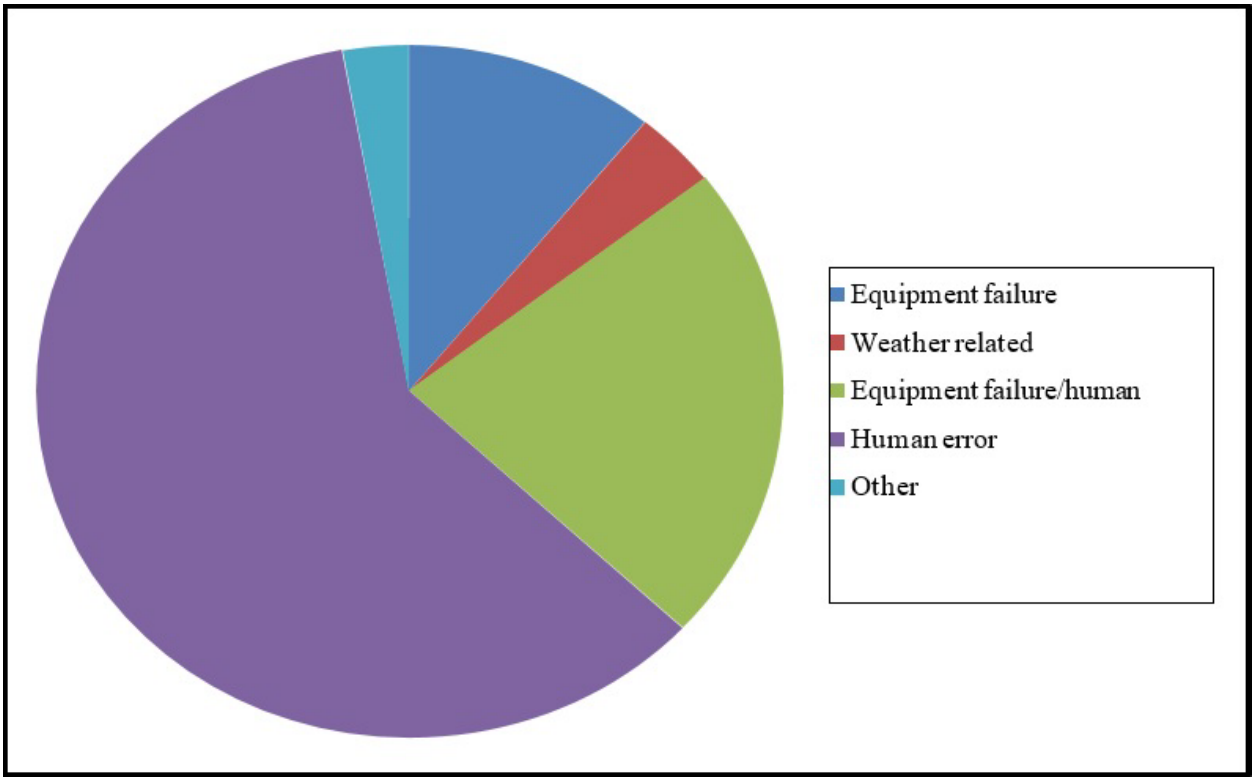


Figure 97. Causes of oil and gas accidents reported on the Gulf of America OCS from 2011-2013 as reported to BSEE. Source: BOEM BA supplemental information

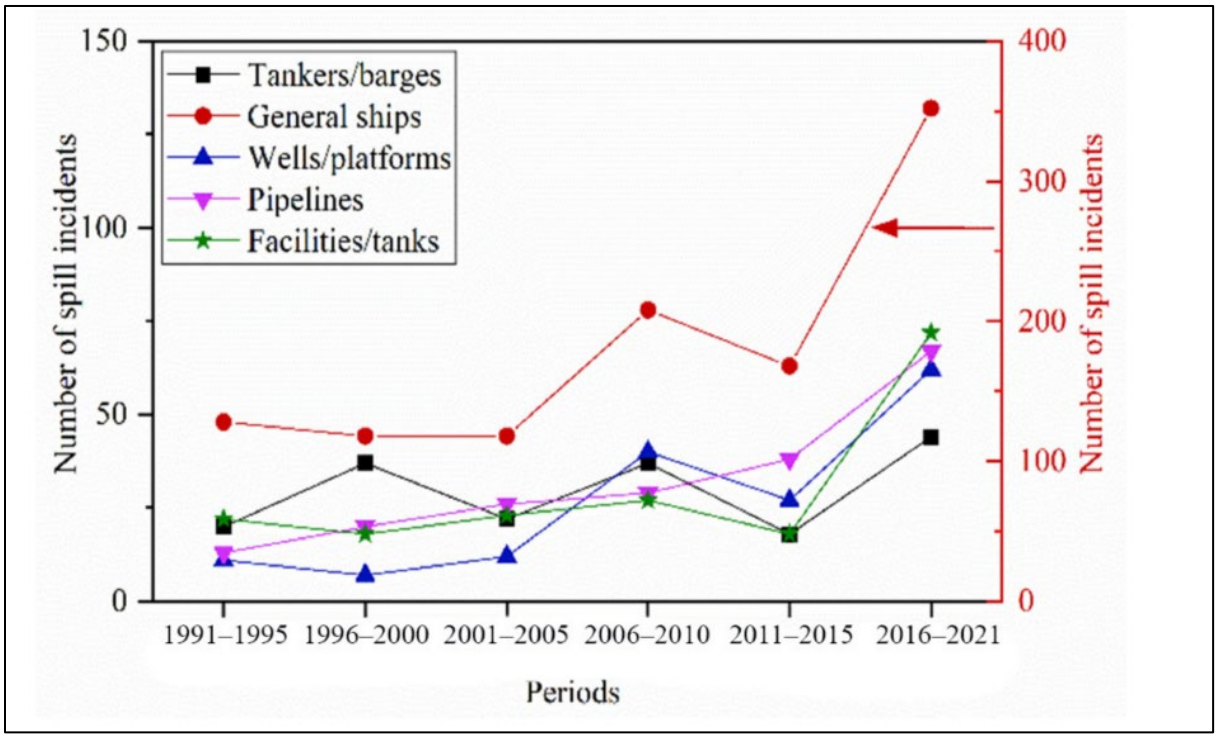


Figure 98. Numbers of reported oil spills in the United States from 1991 to 2021 (Dong et al. 2022)

Non-blowout-related spills have occurred in the past several decades largely because of hurricanes in 1964, 1980, 2004, and 2005; storage tank failures; vessel operation; and pipeline issues (Table 89). However, all but two of these non-blowout-related spills were less than 10,000 bbl. The spills over 10,000 bbl were because of pipeline breaks in 2017 and 2023 despite improvements made by industry to lessen the risk of spills due to loss of pipeline integrity (NAS 2022).

Table 89. Non-blowout Spills on the Outer Continental Shelf that Have Resulted in Spills ≥ 1,000 bbl

Year of Spill Event	Number of Structures	Water Depth (ft)	Volume Spilled (bbl)	Details
1964	1	94	2,559	Freighter struck platform in Eugene Island, block 208
1964	1	102	1,589	Storage tank lost during Hurricane Hilda in Ship Shoal, Block 149
1969	1	30	2,500	Supply vessel collided with a semisubmersible drilling rig in Ship Shoal, Block 72
1973	1	110	9,935	Storage tank failure in West Delta, Block 79
1973	1	61	7,000	Storage barge sank
1979	1	61	1,500	Workboat collided with a drilling rig putting a hole in a diesel tank, Main Pass, Block 151
1980	1	60	1,456	A storage tank overflowed during evacuation of platform during hurricane Jeanne, High Island, Block 206
2004	1		>1,000	Hurricane Ivan and underwater landslide toppled platforms and severed numerous wellheads. Low discharge, chronic oil seepage is still ongoing.
2005	3	182-238	5,066	Hurricane Rita destroyed 1 platform and 2 drilling rigs
2013	1		1,531	Drilling rig lost station; lower marine riser emergency disconnect activated
2015	1		2,200	Lower marine riser installation error

Year of Spill Event	Number of Structures	Water Depth (ft)	Volume Spilled (bbl)	Details
2016	1		2,100	Subsea flowline
2017	1		16,152	Subsea jumper (pipeline segment) damage
2023	1		26,190	Pipeline rupture

Source: BOEM BA supplemental information; see also https://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/largest-oil-spills-affecting-us-waters-1969.html

Worldwide, triggers for submarine landslides include earthquakes (33.5%), areas with high sedimentation rates (17.6%), and diapirism, or salt/mobile mass intruding into existing rocks (12.1%) (Shan et al. 2022). Key factors influencing the occurrence of submarine landslides include stratified sequences in weak layers and elevated pore pressure (Masson 2006). Submarine landslides frequently damage gas pipelines on the ocean floor (Wang et al. 2013). In the central Gulf, rapid sedimentation occurs because of the outflow of the Mississippi River. Salt domes have been deformed by the weight of the overlying sediment, leading to submarine landslides. Marine geophysical and mapping techniques can identify the variety of features associated with offshore slope failure and associated mass transport deposits (Urgeles et al. 2013). Information regarding near or shallow subsurface pore pressure and additional geotechnical borings allow a better understanding and ability to identify landslide triggers and destabilizing phenomena (Vanneste et al. 2013). Underwater landslides occur when large volumes of seafloor sediment, usually thick accumulations of soft sediment on steep slopes with high environmental loads, move downslope. In 2004, a subsea mudslide triggered by Hurricane Ivan toppled Taylor Energy Company Platform "A" in Mississippi Canyon Area Block 20, causing it to slide several hundred feet, shearing the piles and conductors, and disconnecting all the wellheads. Though currently being contained, the resultant spill has continued. The partially buried platform jacket remains horizontal on the seafloor and supports the spill containment, storage, and offloading system.

To help fill knowledge gaps and better inform offshore energy development, BOEM funded Louisiana State University to lead a collaborative partnership of Federal agencies, academic institutions, and private sector contractors to better understand mudslides on the Mississippi River Delta Front (MRDF). The study re-mapped the entire MRDF for the first time since 1980 and is seeking to understand the triggering mechanisms of submarine landslides, and how, where and when they occur to inform future decision-making related to offshore energy development and infrastructure. The study found the sediment lobe from the Mississippi River delta is greatly influenced by hurricane activity that increase movement of the sediment lobe, but, because parts of the delta are being depleted of sediment by mudflow activity faster than they can be resupplied by rivers, mudflow risk may decline in the future. Despite this, the authors noted that infrastructure on the seabed in the Gulf is still at risk from submarine landslides, especially in

greater depths where sediment-depleting flows will continue even if sediment accumulation continues to decline (Figueredo et al. 2024). Another project with the Department of Energy notes a connection between seafloor instability and risk of landslides (Dyer et al. 2024). This study used the northern Gulf as a case study for characterizing the susceptibility for submarine landslides in the EEZ where water depths are greater than 120 m by performing Landslide Susceptibility Mapping using a gradient-boosted decision tree model (Dyer et al. 2024; Mark-Moser et al. 2023). Using the known spatial extents of historical landslides, including the one that led to the Taylor Energy spill, and GIS, the model produced submarine landslide susceptibility maps (Figure 99) where areas of high and very high susceptibility were associated with terrain such as salt basins and escarpments (Dyer et al. 2024).

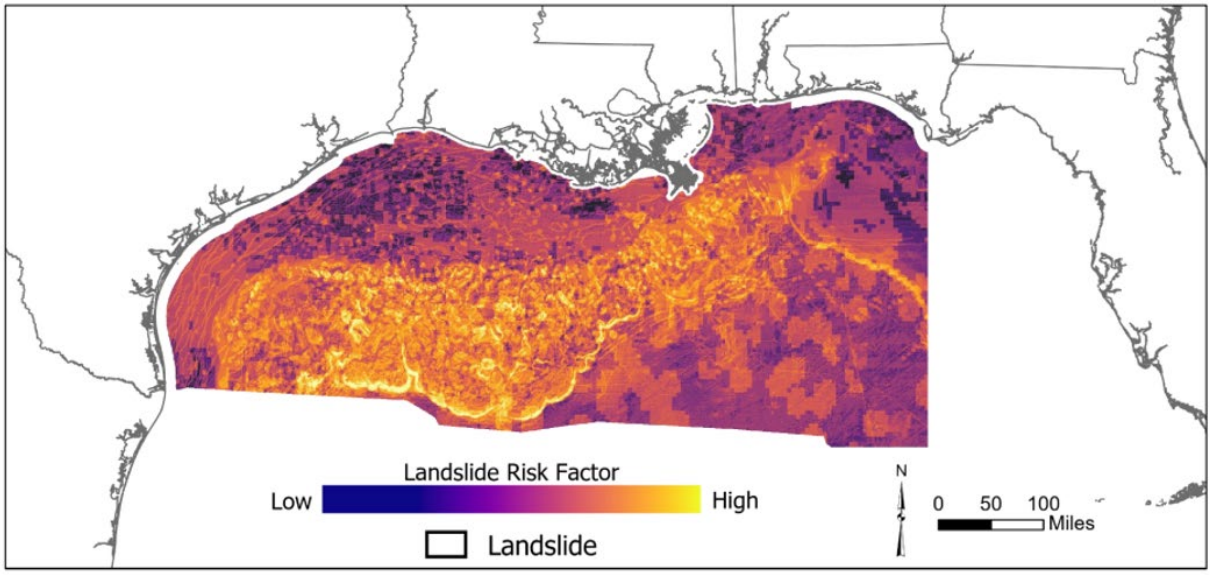


Figure 99. Case study GIS map used in technique to detect submarine landslide susceptibility (Mark-Moser et al. 2023)

Changes in temperature, precipitation, sea level, and storm frequency and intensity may affect the Oil and Gas Program over the period considered in this opinion (Table 90). Observations since the 1980s show an increasing trend in the intensity and rate of intensification of tropical cyclones in the North Atlantic basin, which includes the Atlantic Ocean, Caribbean Sea, and the Gulf (NOAA 2023b). However, evidence for the future continuation of this trend is weaker, partly due to limitations in observed data (NOAA 2023b).

In recent years, the North Atlantic basin, which includes the Gulf of America, has seen an increase in the intensity and rate of intensification of tropical cyclones, consistent with broader trends observed in the region (NOAA 2023b). However, evidence for the future continuation of this trend is weaker due to data limitations. This increase in storm intensity raises the likelihood of storm-related damage to infrastructure and, consequently, spill risk. For example, during a severe flooding event in 1994 in Texas, over 29 pipelines were impacted. Sea level rise also presents a potential risk to Oil and Gas Program activities, particularly along the coast, with the highest trends occurring in Louisiana (6.01-9.16 mm per year; (Sweet et al. 2022)). Many

facilities in the Gulf of America region are vulnerable to the impacts of sea level rise, as they were not originally designed to accommodate significant increases in sea level, such as the 61 cm rise observed by 2008 (Savonis et al. 2008).

Historical oil spill trends in the Gulf show that hurricanes have the potential to increase the frequency of spills, including by triggering submarine landslides as discussed previously. Savonis et al. (2008) note that Hurricanes Andrew, Ivan, Katrina, and Rita damaged over 1,105 pipelines and flowlines and coastal oil and gas infrastructure. Hurricane Rita also damaged gasoline supply stations leading to a disruption in gasoline supply (Reed et al. 2010). Over the last 20 years, hurricanes have caused severe impacts to production (BOEM and BSEE 2024). As a storm approaches, wells are shut-in and pressure tested to verify barriers are in place to reduce the oil spill risk. Damage from hurricanes can occur at various parts of the oil stream (e.g., at a given wellhead, at an offshore production facility, in a pipeline, or in a downstream processing facility) despite the apparent success of hurricane shut-ins (BOEM and BSEE 2024).

Table 90. Impacts on coastal and offshore petroleum infrastructure (adapted from Dong et al. 2022*) from changes in storm intensity and frequency and other environmental factors

Environmental Change	Affected Infrastructure	Potential Impact
Temperature	Transportation Extraction	• Decrease availability of ice-based transportation and stability of buildings laid upon permafrost • Reduce load capacity of structures • Increase degradation of construction materials • Temperature extremes cause maintenance problems and increase the cost
Precipitation patterns	Oil and gas pipeline Oil refinery Storage tank Transportation infrastructure	• Soil shrinkage caused by drought has negative influences on oil and gas pipelines • Heavy rain and high hwnidity may result in the overload of air filters and further damage downstream equipment • Increase the risk of mold presence and weaken storage structures • Floods can damage roads, bridges, and ports in the coastal region

Environmental Change	Affected Infrastructure	Potential Impact
Sea Level Rise	Oil and gas platform Oil refinery Gas processing plant Oil and gas pipeline	• Oil and gas platforms are at risk of damage and disruption • Oil refineries and gas processing plants are vulnerable to shoreline erosion and seawater inundation • Increased degradation of pipelines and infrastructure
Extreme storm	Oil and gas platform Oil and gas pipeline Storage tank Oil refinery Gasoline supply station	• Overturn and damage platforms, drilling rigs, offshore pipelines, and mobile offshore drilling unit • Storm surge flooding can affect storage tanks • Wave height increase can cause wave inundation of decks • and erosion and submergence of coastal infrastructure such as oil refineries • Surface damage to coastal infrastructure, e.g., gasoline supply station

*Source information from: Buck and Langan (2017); Burkett (2011); Cruz and Krausmann (2013); Dismukes and Narra (2018); (DOT 2012); Godoy (2007); Kaiser (2008); Katopodis and Sfetsos (2019); Mikellidou et al. (; Misuri et al. (2021); Patricola and Wehner (2018); Rusco (2014); Savonis et al. (2008) as referenced in Dong (2022).

In a mature industry that has been installing infrastructure for several decades, damage and corrosion are an intrinsic reality of the existing equipment/hardware in addition to human error. NAS (2022) notes that over one-third of the more than 15,000 mi of oil and gas pipelines in the Gulf of America are at least 30 years old (Table 91). Equipment and structural failure probability increase as components age, meaning effective maintenance is essential. Performing pressure tests and isolation leak tests had the highest probabilities for human error (Islam et al. 2019), and this error can lead to equipment failure and pipeline breaks. Identification of these causes of spills provides information to continue to improve safety and reduce the number of accidents and oil spills that occur because of human error. NAS (2022)notes typical causes of human error-related events include misinterpretation of control equipment readings and/or alarms, pipeline corrosion, and process defects during installation, as well as flaws during manufacturing processes.

Table 91. Age of Active Pipelines in Northern GOA Gulf (NAS 2022)

Product Transported	<10 years	10+ years	20+ years	30+ years	4o+ years	*50*+ years	60+ years	Total
Oil	1.393	2.253	1534	52;	788	242	48	6.783
Gas	879	2.056	1.138	653	1.797	537	61	7.120
Condensate	0	0	12	0	0	0	0	12
Gas/Oil	0	1	14	45	40	24	1	126
Gas/Condensate	21	86	582	186	174	94	0	1.144
Total	2.293	4.396	3.280	1.409	2.799	898	109	15.184

Offshore Reliability Data (OREDA) and equipment failure analyses/risk models are used to understand and promote safe operation of equipment. To estimate oil spill risk from equipment failure, Paltrinieri et al. (2017)conducted a quantitative risk assessment for offshore equipment and found that standard methods require periodic evaluation and updates of risk based on continuous monitoring activity and real-time data capturing, which are not common. Risk-based maintenance using the risk profile of particular equipment is an important tool to ensure critical safety equipment is working properly (Priyanta et al. 2024). Equipment reliability research is used to inform system improvements and ensure reliability to minimize oil spill risk. An example of equipment reliability research by Umofia (2014) focused on a reliability analysis of the tree-mounted electro-hydraulic subsea control module (SCM) for oil and gas production. This analysis revealed that understanding failure mode and mechanisms is fundamental for achieving optimum system reliability with the most critical reliability factors directly associated with the solenoid control valves and subsea electronic modules of the SCM (Umofia 2014).

Risk of Large Oil Spills

A fundamental challenge is to accurately describe the risk of a very large spill (defined by BOEM as ≥10,000 bbl), especially because there have been relatively few large oil spills that can serve as benchmarks. Prior to the DWH event, the three largest blowout spills on the U.S. OCS were 80,000 bbl, 65,000 bbl, and 53,000 bbl, and all occurred before 1971 (Anderson et al. 2012).

In Eckle et al. (2012), accidental global oil spills larger than 4,750 bbl between 1974 and 2010 were extracted from the global Energy-Related Severe Accident Database (https://www.ensad.ch/), yielding a total of 1,213 spills. This independent analysis with global data of marine exploration and production oil spills, including the DWH event, calculated an approximate return frequency (i.e., occurrence) of an event the size of DWH as once every 17 years with an uncertainty range between eight and 91 years (5 - 95% confidence interval), meaning the return frequency is more likely to be low (i.e., 91 years). The high uncertainty is a

direct result of the structure of the risk with few very severe events to enable more accurate predictions. Importantly, given that this analysis relied on a global dataset, the calculated return period represents the estimated occurrence on a global scale; however, environmental conditions and relevant laws are not identical world-wide, which also influences probability of an oil spill, and the relevant U.S. laws and regulatory context are robust relative to global standards.

BOEM updated the oil spill occurrence rates for their 2023 oil spill risk analysis (OSRA), which was based on information from ABS Consulting (2016). BOEM's 2023 OSRA (Ji and Schiff 2023) calculated the following:

- Probability of oil spill occurrence, based on estimated volumes of oil produced and transported and on spill rates derived from historical data;
- Trajectories of oil spills from hypothetical spill locations to locations of various environmental resources; and
- Combination of above results to estimate the overall oil spill risk of both spill occurrence and spill contact.

BOEM noted their analyses may indirectly account for some causal factors (e.g., weather patterns, underwater landslides) if they affect the spill rate over time and the calculated rates in the 2023 OSRA are not substantially different from those used in prior analyses (BOEM and BSEE 2024). BOEM uses OSRA modeling results in the evaluation of single lease sales and the cumulative Oil and Gas Program.

Table 92 displays the oil spill rates BOEM used for the 2023 OSRA. The spill rates in this table were published in the most recent comprehensive report on historical oil spill occurrence rates in the Gulf of America by Ji and Schiff (2023) that includes offshore spills from 2000 to 2015, in addition to examining a number of causal factors of spills.

Table 92. Oil spill rates from OCS spill sources based on a 15-year period (2000–2015) for OCS platforms and pipelines and a 15-year period (1999–2014) for tankers (Ji and Schiff 2023)

Spill Source	>1,000 bbl (spills/Bbbl)	>10,000 bbl (spills/Bbbl)
Plaforms	0.25	0.13
Pipelines	0.38	0.07
Tankers	0.12	0.02

Figure 99 shows the combined probabilities for BOEM's OSRA modeling of all oil spills greater than 1,000 bbl occurring and contacting surface waters within 30 days. Small spills (<1,000 bbl) are excluded from OSRA modeling because they are unlikely to persist in the aquatic environment long enough for trajectory modeling and simulation (Ji and Schiff 2023; Smith et al. 1982). Higher risk areas are displayed in green, moderate risk in yellow to orange, and lower risk areas in red to pink hues (Figure 100). The highest likelihood of occurrence of spills is from

pipelines, followed by platforms, followed by tankers. The high risk from pipeline incidents is because most of the oil produced in the Gulf of America is transported to shore via a vast offshore pipeline infrastructure. Accidental pipeline breaks from underwater landslides, anchoring, storms, and aging pipeline infrastructure are the causes of most pipeline spills. Several small and a few large pipeline spills are reasonably foreseeable in the next few decades (BOEM and BSEE 2024; Ji and Schiff 2023).

Table 93 and Table 94 display the oil spill occurrence probabilities for a single lease sale and region-wide totals based on low and high volume production scenarios for ≥1,000 bbl and ≥10,000 bbl, respectively. All spills are reported to the NRC and spills greater than or equal to 1 bbl are reported to BSEE using the reporting system described in NTL 2019-N05. BOEM develops production scenarios for a range of activity levels based on the lowest and highest volumes of oil that are projected to be produced because of a single lease sale (40 years) and the cumulative (70 years).

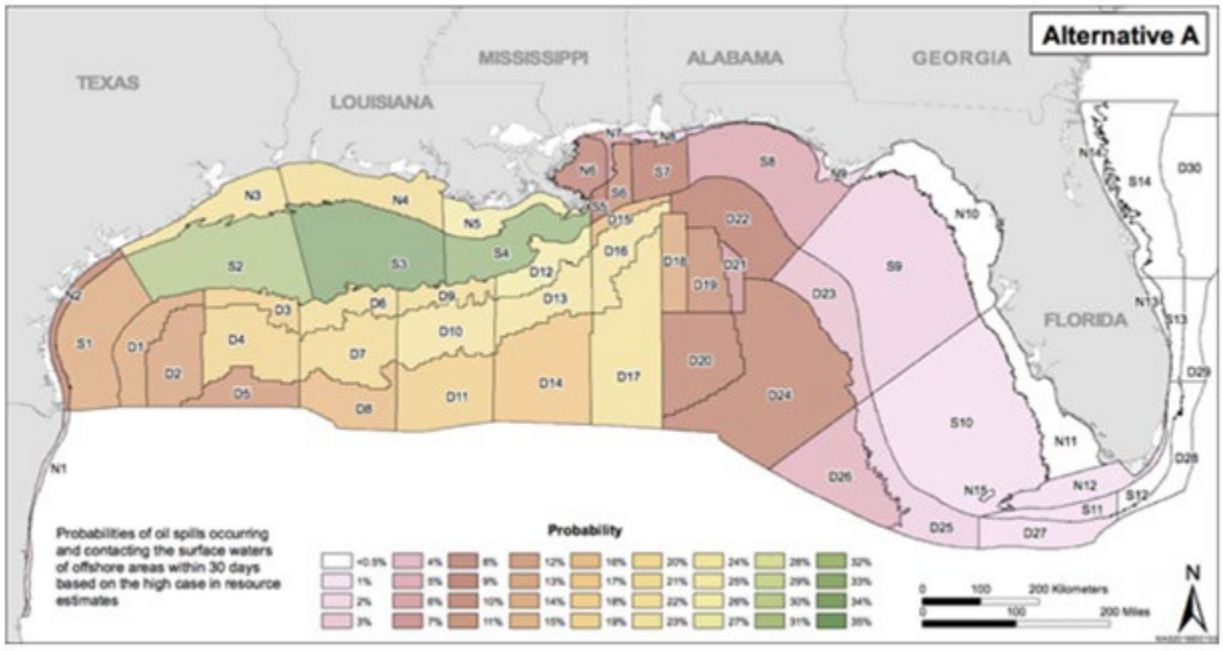


Figure 100. Combined probabilities (i.e., risk) of Oil Spills Greater than 1,000 bbl Occurring and Contacting Surface Waters within 30 Days [Nearshore ("N", 0-20m water depth), Shelf ("S", 20-300m), and Deepwater ("D", 300m)]. Polygons as a Result of the High Case in Resource Estimates. (Alternative A was the preferred alternative in BOEM's Gulf of America 2017-2022 Lease Sales EIS, Figure E-11 (BOEM 2017c)

Transporting crude oil from wells in the Gulf of America by tankers is uncommon because most crude oil is transported from wells to shore via pipelines. Tankers are most often used to transport produced oil from deepwater developments in the Gulf of America where pipeline infrastructure is not feasible. There is additional tanker traffic associated with the export of oil produced in the Gulf of America internationally, as well as the transportation of oil produced in the Gulf to other locations in the United States, but this transportation is not part of the Oil and Gas Program considered in this consultation (as described in Section 3). The small amount of oil

produced in the Gulf of America transported by tanker is reflected in the low risk of oil spills reported by BOEM for tankers compared to pipelines (Table 93 and Table 94). Overall, the highest likelihood for spills to occur is in the CPA, followed by the WPA then the EPA, corresponding to the amount of activity in each planning area (measured by volume of oil produced).

Table 93. Oil spill occurrence probability estimates for offshore spills ≥ 1,000 bbl resulting from a single lease sale and the cumulative OCS Program (Ji and Schiff 2023) in the Gulf of America

Area and High or Low Resource Estimate >	Region-wide Low	Region-wide High	CPA/EPA Low	CPA/EPA High	WPA Low	WPA High
Single Lease Sale	-	-	-	-	-	-
Forecasted Oil Production (Bbbl)	0.0559	0.7449	0.0526	0.7005	0.0033	0.0444
Mean Number of Spills Estimated to Occur						
Platforms	0.01	0.19	0.01	0.18	0.00	0.01
Pipelines	0.02	0.28	0.02	0.27	0.00	0.02
Tankers	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.04	0.47	0.03	0.44	0.00	0.03
Estimates of Probability (% chance) of One or More Spills						
Platforms	1	17	1	15	0	1
Pipelines	2	25	2	23	0	2
Tankers	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Total	3	37	3	36	0	3
Cumulative OCS Program	-	-	-	-	-	-
Forecasted Oil Production (Bbbl)	0.5590	7.6158	0.5257	7.1621	0.0333	0.4537
Mean Number of Spills Estimated to Occur						
Platforms	0.14	1.90	0.13	1.79	0.01	0.11
Pipelines	0.21	2.89	0.20	2.72	0.01	0.17
Tankers	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.35	4.80	0.33	4.51	0.02	0.29
Estimates of Probability (% chance) of One or More Spills						
Platforms	13	85	12	83	1	11
Pipelines	19	94	18	93	1	16
Tankers	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Total	30	99	28	99	2	25

Notes: "Platforms" refers to facilities used in exploration, development, or production.
[1]Low = low resource estimate; High = high resource estimate

Table 94. Oil spill occurrence probability estimates for offshore spills ≥ 10,000 bbl resulting from a single lease sale and the cumulative OCS Program (Ji and Schiff 2023) in the Gulf of America

Area and High or Low Resource Estimate >	Region-wide Low	Region-wide High	CPA/EPA Low	CPA/EPA High	WPA Low	WPA High
Single Lease Sale	-	-	-	-	-	-
Forecasted Oil Production (Bbbl)	0.0559	0.7449	0.0526	0.7005	0.0033	0.0444
Mean Number of Spills Estimated to Occur						
Platforms	0.01	0.10	0.01	0.09	0.00	0.01
Pipelines	0.00	0.05	0.00	0.05	0.00	0.00
Tankers	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.01	0.15	0.01	0.14	0.00	0.01
Estimates of Probability (% chance) of One or More Spills						
Platforms	1	9	1	9	<0.5	1
Pipelines	<0.5	5	<0.5	5	<0.5	<0.5
Tankers	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total	1	14	1	13	<0.5	1
Cumulative OCS Program	-	-	-	-	-	-
Forecasted Oil Production (Bbbl)	0.5590	7.6158	0.5257	7.1621	0.0333	0.4537
Mean Number of Spills Estimated to Occur						
Platforms	0.07	0.99	0.07	0.93	0.00	0.06
Pipelines	0.04	0.53	0.04	0.50	0.00	0.03
Tankers	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.11	1.52	0.11	1.43	0.01	0.09
Estimates of Probability (% chance) of One or More Spills						
Platforms	7	63	7	61	<0.5	6
Pipelines	4	41	4	39	<0.5	3
Tankers	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total	11	78	10	76	1	9

Notes: "Platforms" refers to facilities used in exploration, development, or production.
[1]Low = low resource estimate; High = high resource estimate

In comparison to the Ji and Schiff (2023) oil spill occurrence probability, the Bureaus also calculated the potential number of spills over a range of size categories for the 40-year operation period of a single lease sale in the Gulf based on high and low estimated production amounts and spill rates from ABS 2016 (Table 95). As for Ji and Schiff (2023), the spill sources considered were pipelines, platforms, and combined. According to the Bureaus, spill rates have decreased over time (ABS Consulting 2016; Anderson et al. 2012; BOEM and BSEE 2024).

Table 95. Spill rates and estimated production in each spill category based on information from the focused BA

Spill Size Category (bbl)*	Spill Source*	Spill Size Category*	Spill Rate (spills/BBO)*	single lease sale region wide estimated production (Bbbl) LOW**	single lease sale region wide estimated production (Bbbl) HIGH**
1 - <10	Combined	small	59	0.056	0.745
10 - <50	Combined	small	16.6	0.056	0.745
50 - <500	Combined	small	12.5	0.056	0.745
500 - <1,000	Combined	large	1.6	0.056	0.745
1,000 - <10,000	Combined	large	0.8	0.056	0.745
>10,000	Combined	large	0.1	0.056	0.745
≥1,000-9,999	Platform	large	0.25	0.056	0.745
≥10,000	Platform	large	0.13	0.056	0.745
≥1,000-9,999	Pipeline	large	0.38	0.056	0.745
≥10,000 bbl	Pipeline	large	0.07	0.056	0.745

Information from the Focused BA, Table 18, and Tables C-2 and C-3

Blowouts and subsequent losses of well control are the primary concern for very large spills. Blowouts are generally associated with equipment failures, human error, hurricane-related failures, or a combination of these events. The DWH event is the only documented blowout and loss of well control that resulted in a catastrophic spill on the U.S. OCS in the Gulf of America to date. According to NAS (2022), the loss of well control events for development drilling (>500 bbl spilled) were significantly higher in the action area than in other regulated areas of the world. (BOEM et al. 2018) presented a conceptual model of a deep water well blowout (Figure 101) to demonstrate the phases and movement of oil during a blowout.

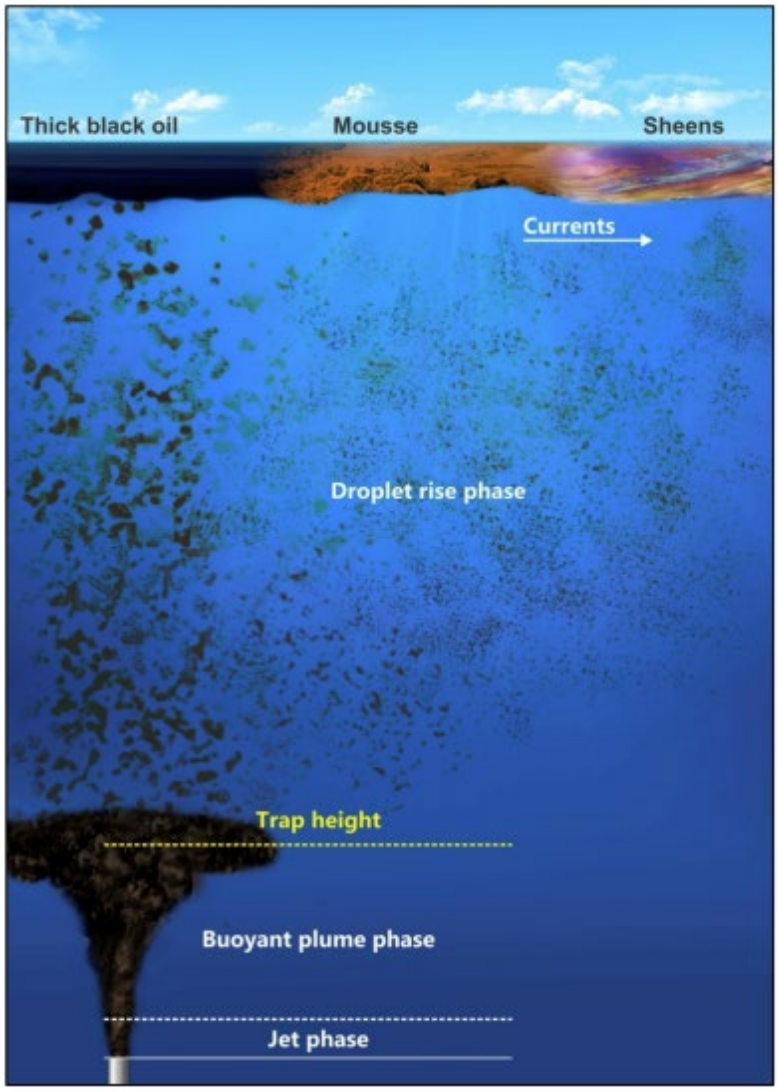


Figure 101. Conceptual model of a deep water oil and gas well blowout (BOEM et al. 2018).

The greatest risk of a loss of well control is during the exploration phase when reservoir characteristics are not well known, which is why there is a higher reported rate of kicks (uncontrolled influxes of formation fluids, such as oil, into the wellbore) that occur when the pressure found within the drilled rock is higher than the mud hydrostatic pressure acting on the borehole or rock face because this can force formation fluids into the wellbore (NAS 2022). Murawski (2020a) states that the inherent risks of catastrophic well blowouts increase exponentially with water depth, likely due, in part, to the extreme pressures, high temperatures, and uncertainties associated with using emerging technologies in deeper waters (BOEM and BSEE 2024; Murawski 2020a).

The Bureaus note that a blowout leading to a loss of well control and release of oil is most likely in water deeper than 3,000 ft, where the spill size and consequences from a blowout are estimated to be greater (BSEE 2012). There were 4,123 deepwater wells drilled between 1973

and 2010. Active leases and associated oil and gas activities have been moving into increasingly deeper waters over the last two decades and are continuing to move into ultra deepwater (i.e., water depths >1,600 m). Figure 102 displays the annual number of blowouts resulting in a loss of well control from 2007 through 2016.

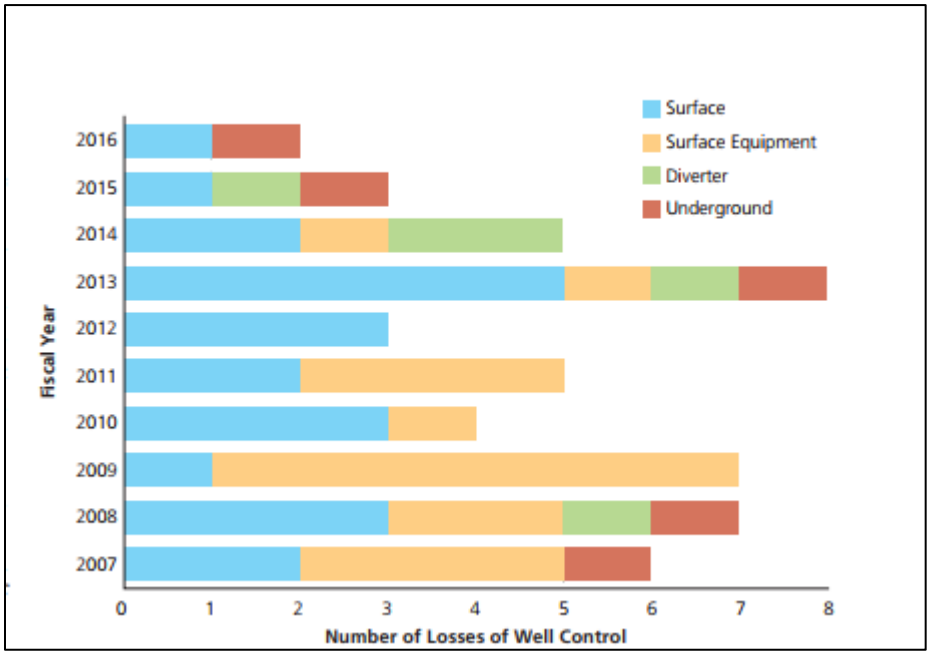


Figure 102. Annual losses of well control from 2007 to 2016 (BSEE 2016a)

Although blowouts may occur in shallow water, well pressures are generally lower because many reserves have been produced, resulting in lower well pressures. There is a high likelihood that well control will be maintained in shallow water because of lower reservoir pressure, the greater prevalence of gas rather than oil, and the presence of more accessible surface BOPs with diverters (BSEE 2012). If a release were to occur, it most likely will not be a large volume of oil and will be controlled quickly.

There have been 21 blowouts associated with seven individual failure events that resulted in a loss of well control in the Gulf of America (Table 96). Four of the spills associated with these events were the result of hurricane-related failures, another four were the result of blowouts during drilling, and the remaining spills resulted from a single event where a platform shifted position and blew out all the wells connected to it. Four of these blowout-related spills, including DWH, were > 10,000 bbl. Before the DWH event, blowout-related spills occurred between 1965 and 1970 and were in water depths less than 200 ft (Anderson et al. 2012; Table 96). ABS (2016) noted platform spills less than 50 bbl made up the majority of oil spills in the Gulf from 1974-2015 with the majority of spill volume from spills ranging from 50-99 bbl. Our review of the information for shallow and deep water wells leads us to agree with the Bureaus' finding of a low risk of an extremely large release of oil in shallow water.

Table 96. Blowouts on the Federal OCS that have resulted in a loss of well control and oil spills greater than 1,000 bbl

Year of Spill Event	Number of Blowouts	Duration (days)	Water Depth (ft)	Volume Spilled (bbl)	Details
1964	3	several days	48	5,180	Hurricane Hilda destroyed 3 platforms in Eugene Island, Block 208
1964	1	17	33	5,100	Hurricane Hilda destroyed a platform in Ship Shoal, Block 149
1965	1	8	190	1,688	Drilling Blowout in Ship Shoal, Block 29
1969	1	10	190	80,000	Drilling blowout in Santa Barbara Channel in lease area 6B 5165
1970	13	49	39	65,000	Rig shift and fire resulting in 13 blowouts in Main Pass, Block 41
1970	1	138	60	53,000	Drilling blowout and fire in South Timbalier, Block 26
2010	1	86	4,992	3.19 million	Blowout and fire in Mississippi Canyon, Block 252

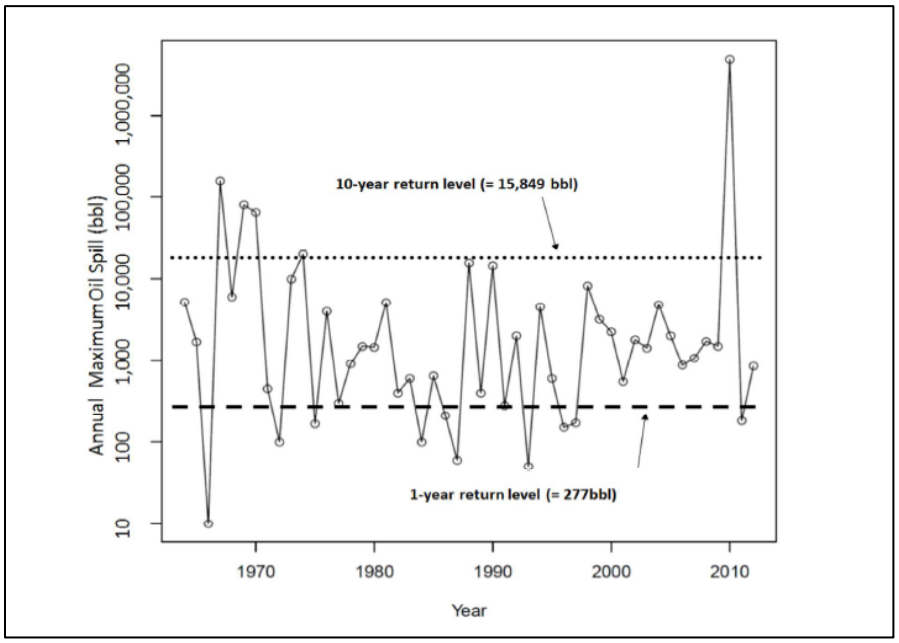
NOTE: While the Taylor Energy toppled platform resulted in a >10,000 bbl, it is not viewed as an acute event, rather the oil spilled over a long period (years). Source: BOEM BA supplemental information

Ji et al. (2014) used new methods to predict rare events and apply extreme value methods to predict the return period for catastrophic spills on the OCS. For oil spills with sizes less than 10,000 barrels on the OCS, there are historical data sufficient for risk analysis with commonly used statistical tools, due to the number of spills of that size. The authors used Federal OCS oil spill data from 1964-2012 to perform an EVT probability analysis. While this mainly consists of data from the Gulf of America, it also included information from the entire OCS, not just the Gulf of America by itself. Therefore, the results of that analysis represent an upper bound of oil spill risk in the Gulf. An analysis focused on a more geographic tailored area, such as the Gulf of America, would produce a lower oil spill risk, because a Gulf-focused analysis would not include the Santa Barbara spill (one of the largest spills to occur on the OCS) in the dataset. If this spill is excluded from the analysis, the oil spill risk for the GOM would decrease significantly.

A key requirement for the EVT method is to include the maximum spills for each year. The Ji study predicted the return period for a catastrophic spill (defined as a spill over 1 MMbbl) as 165 years with a 95% confidence interval between 41 and 500-plus years (Ji et al. 2014). BOEM defined very large spills as any spill volume ≥ 10,000 bbl, and provided NMFS with information estimating that 1.5 oil spills ≥ 10,000 bbl may occur over the duration of the Oil and Gas Program considered in this opinion in the high production scenario. BOEM's probabilistic spill estimates use an oil spill risk method based on historical spill rates per volume of oil produced.

The number of spills has been estimated for different spill sizes based on the anticipated volume of oil produced over this consultation period (Table 95). One data point, the DWH event, represents both the ≥ 10,000 bbl and catastrophic spill categories in BOEM's analyses. Because it is the only spill of this size, conventional statistical methods are not suited to analyze the risks of another spill of this size occurring. DWH was 8.5 times the cumulative 570,000 bbl that were spilled in the previous 46 years in the U.S. (Ji et al. 2014). Figure 103 shows the time series of annual largest oil spills derived from OCS data for 49 years from 1964 to 2012. The return level (or return frequency or value) of a random variable is the quantile value that is exceeded, on average, once in a period of time (called the return period). For example, the return period (such as 100-year flood) based on extreme precipitation (i.e., certain return value) is commonly used to assess the capacity of drainage systems (Ji et al. 2014).

BOEM does not consider catastrophic spill events as reasonably foreseeable, and also did not define an upper volume for very large spills, which they define as ≥10,000 bbl. For informational purposes, BOEM used current reservoir sizes to demonstrate the size and duration of releases in shallow and deep water areas. This conclusion was based on a model that used pre-2014 data and parameters, and included the entire U.S. OCS. BOEM characterized a catastrophic spill in shallow water as being uncontrolled flow for one to three months, resulting in an estimated range of 900,000-3,000,000 bbl released[42]. For deep water, BOEM provided information that, if a catastrophic spill occurred and remained uncontrolled up to four months, potentially 2.7-7.2 MMbbl could be released.



[42] BOEM 2014 Qualitative Review of Safety Measures to Minimize Frequency of Blowouts and Spills and Maximize Containment Capabilities

Figure 103. Annual largest oil spills derived from OCS data from 1964 to 2012. The dotted line is the 10-year return level and the dashed line is the 1-year return level. From Ji et al. (2014)

The Bureaus conducted separate analyses, one focused on rare, catastrophic oil spills and the other on all other (smaller) spills resulting from routine oil and gas activities. The analysis of catastrophic oil spills conducted by BOEM (2021) employed a distinct, two-part approach. The first part provided a general impact assessment of catastrophic events, including defining a catastrophic spill, identifying impact-producing factors, and evaluating potential effects on resources like water quality and wildlife. This assessment was specifically for the Gulf of America and used the Ixtoc spill as a qualitative comparison. The second part used an OSRA model to simulate the trajectory of seven hypothetical catastrophic spills and assess the likelihood that these spills would contact resource areas. Unlike traditional OSRA models, this analysis did not aim to estimate the probability of a catastrophic spill occurring but, instead, modeled the spread of oil and its potential effect on resources.

The 90-day model run for catastrophic oil spills was based on events similar to DWH for deepwater (>1,000 ft; 305 m) and Ixtoc I (Myer 1984) for shallow water (<1,000 ft; 305 m). The speed and extent of surface spreading is influenced by the type and volume of oil released, but can extend hundreds of square miles. Subsurface oil can also spread significant distances influenced by factors such as environmental conditions, oil chemistry and weathering, the application of subsea dispersants, or other release point conditions. The volume of oil spilled during an uncontrolled blowout is highly dependent on the flow rate per day and the duration of the flow. For a shallow water catastrophic blowout scenario, BOEM (2021b)used a flow rate of 30,000 bbl/day, estimating the total volume of oil spilled to range from 900,000 bbl to 3 MMbbl over a 1-3 month release. For deepwater, BOEM (2021) modeled a flow rate range of 30,000-60,000 bbl/day, estimating the total volume of oil spilled to range from 0.9 to 7.2 MMbbl, with the release duration spanning 1-4 months. These flow rates were based on historical data, including well tests, the maximum flow rate from the 1979 Ixtoc blowout in shallow water, and the maximum flow rate estimated from the 2010 DWH oil spill in deep water. The analysis did not model surface oiling with different thicknesses of oil, but it did model the total area covered during different seasons and from different locations (Figure 104). The model does not account for response times and constraints affecting response times and capping in the prediction of release time. Even for non-catastrophic spills, considering the time to deploy a capping stack and accounting for poor weather or other logistical delays that could arise, an uncontrolled blowout release could last up to 30 days before containment. However, as described below in the Regulatory and Drilling Safety Approval section, it is now possible to deploy deepwater well containment systems in seven to 10 days, and BSEE requires operators to have access to containment systems for fast deployment.

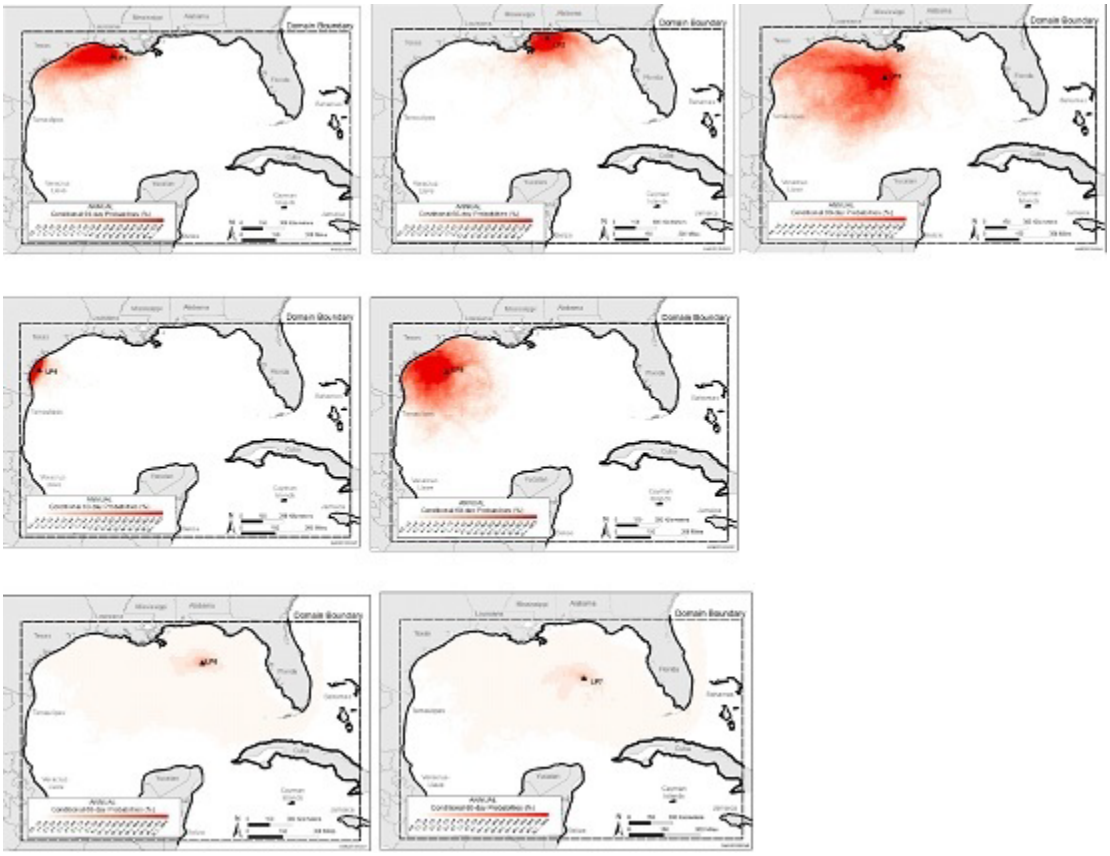


Figure 104. BOEM-modeled Annual Conditional Probabilities for a Hypothetical Oil Spill Initiated at Launch Points 1-3 (top panel); 4-5 (middle panel); and 6-7 (bottom panel), each Simulated Trajectory Tracked for up to 60 days or Until Contacting Land (BOEM 2021)

In a prior catastrophic spill analysis based on information from ABS Consulting (2016); Anderson et al. (2012), five hypothetical locations of oil spills on the OCS were modeled by BOEM with a flow rate of 60,000 bbl/day, releasing oil for 30 days (1.8 MMbbl) and calculated an average impact area of 200,000 km^2 (Table 97). These flow rates are the same as those modeled in the most recent OSRA (BOEM 2021). The statistically-estimated cumulative area of the DWH footprint calculated using satellite imagery was 112,115 km^2, which likely did not capture the entire spread of the thinnest (rainbow sheen) visible category in the satellite images, likely underestimating the total affected area (Trustees 2016; p. 4-57). This would also account for the difference between BOEM's total area calculation and the estimate of the total area affected by the DWH spill, which was a greater volume spill (3.9 MMbbl) than BOEM's catastrophic spill estimate.

Table 97. Modeled areas (using OSRA) impacted for a 30-day spill from five different launch points in the Gulf of America (Total Averate 200,990 lM^2; NMFS 2020 from BOEM 2013)

Launch Point	Spill Area (km^2)			
	Winter	Spring	Summer	Fall
LP1 - Central Gulf of America shelf area west of the Mississippi River	198,000	82,100	185,700	296,000
LP2 - Central Gulf of America shelf area east of the Mississippi River	220,600	128,300	128,000	178,600
LP3 - Central Gulf of America slope area	442,900	325,000	557,100	525,000
LP4 - Western Gulf of America shelf area	75,000	17,900	25,000	71,000
LP5 - Western Gulf of America slope area	28,600	35,700	264,300	260,000
Average	193,020	117,800	227,020	266,120

A separate spill risk assessment was conducted through the Bureaus' studies program. The study included 72 well blowouts representing a range of possible events from sites across the Gulf (Li et al. 2021). The study simulated a continuous release of 45,000 bbl per day for 30 days, and fate/transport over 75 days, including the 30-day release period. The parameters included environmental inputs (salinity, temperature, suspended sediment, shoreline, and habitats), as well as the chemical composition of the oils and weathering properties. The study also modeled subsurface total hydrocarbon concentrations (Figure 105). This risk model appears to provide a similar result to the reported oil release dispersed at depth during DWH, which moved with deepwater currents resulting in a subsurface plume (Trustees 2016).

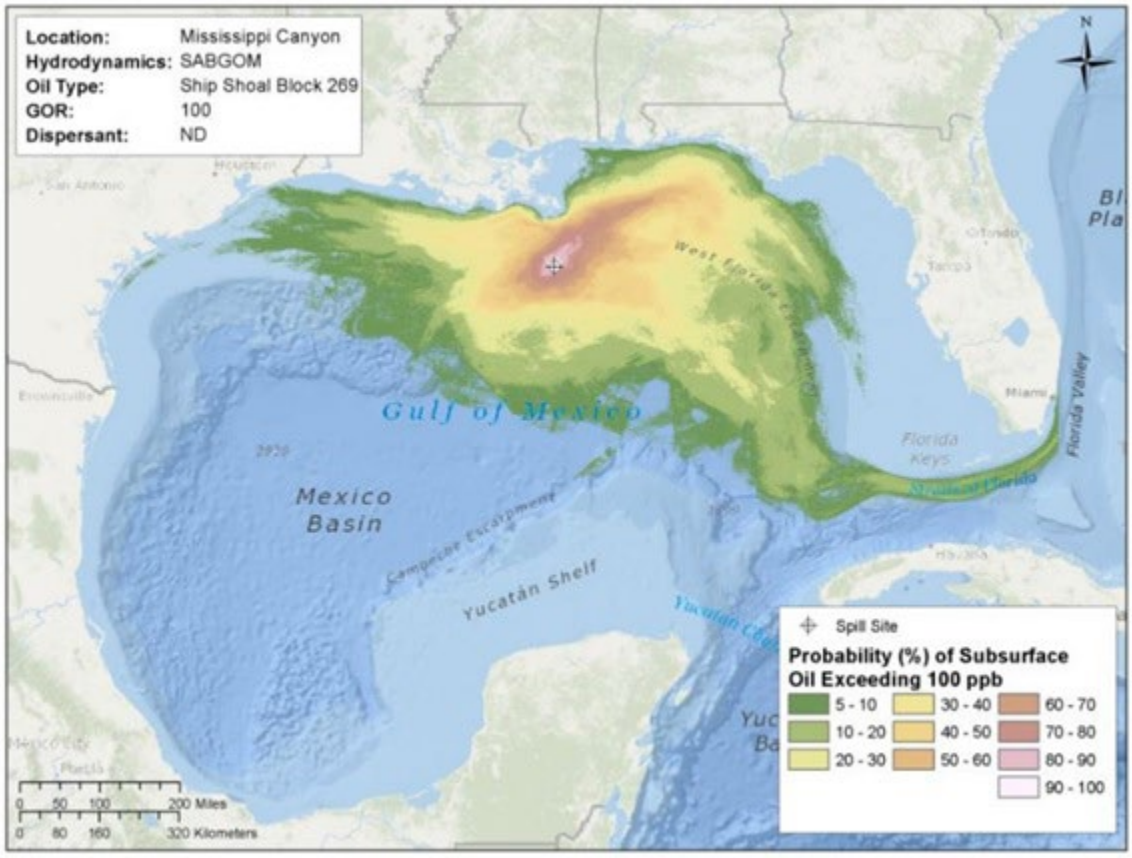


Figure 105. Example map of the probability of subsurface total hydrocarbon concentration exceeding 100 part per billion (Li et al. 2021)

Regulatory Reform and Drilling Safety Improvements

As drilling occurs at deeper depths, there is an increased risk of loss of well control. Muehlenbachs et al. (2013) reported the probability of offshore oil and gas accidents increases by 8.5% for every 100 ft of increasing depth. Nelson et al. (2015) ran a spatial vulnerability model for six blowout sites spilling for a week in the Gulf and found that ultra deepwater sites had larger spatial spill coverages. Pressure and temperature in deeper waters provide extreme conditions where equipment, including safety-critical systems, is more likely to fail and these depths are more difficult to reach quickly. NAS (2022) stated that exploration drilling (as opposed to development or production drilling), especially from a floating vessel (drilling rig) rather than from a fixed platform, is a key contributor to the probability of a spill from 500 to 5,000 bbl. Vessels have to travel much farther to reach deeper sites, which increases spill response times. There may also be fewer response vessels available that are designed for extended time offshore. Further, NAS (2023) recognized the risk of complacency following periods of reduced spillage, advising that vigilance be maintained to ensure best practices of prevention continue.

BOEM and BSEE have carried out many regulatory reforms in response to reviews of the DWH event to improve offshore safety and oversight related to blowout prevention and source control

(Figure 106). These reforms are expected to reduce the volume of oil spilled during accidental events by reducing risks and improving control and response measures. BOEM provided NMFS a qualitative analysis of oil spill literature, regulatory changes, and improvements in response since DWH. The key points of the 2014 Qualitative Review of Safety Measures to Minimize Frequency of Blowouts and Spills and Maximize Containment Capabilities appear in the description of the action section of this opinion (see Section 3.1.5.1). Pertinent to this section of our analysis, we looked at the improvements in the well-containment system and responses that are specifically designed to cap a well after a blowout in order to assess how long a drilling-related extremely large release might last. While the blowout preventer is designed to manage drilling operations and prevent a blowout, a capping stack is designed to be deployed after a subsea blowout has already occurred.

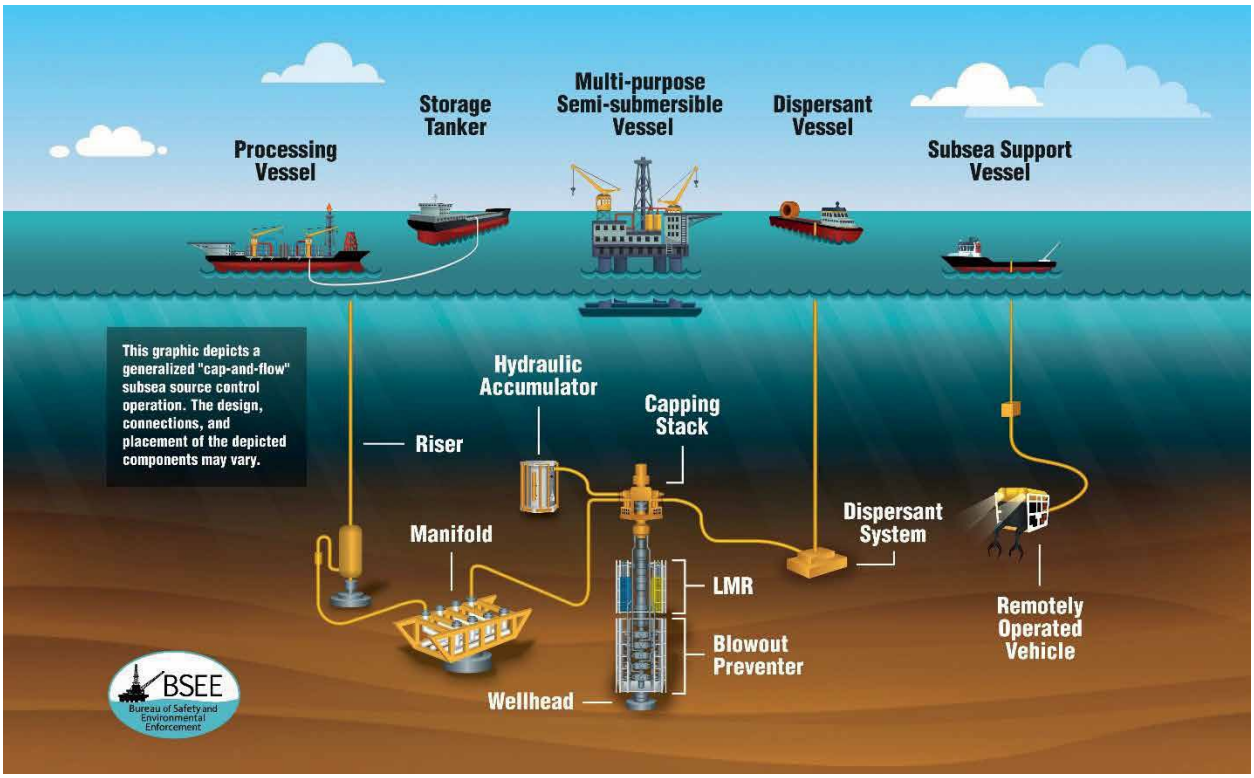


Figure 106. Illustration of source control related equipment. Credit: BSEE in NAS 2022

At the time of the DWH event, there were few capping stacks in existence, and capabilities to support subsea well containment were limited. Subsequent improvements have increased industry's capacity to respond to a subsea well blowout in the Gulf of America. The new well-containment response capability includes multiple vessels for assessment of the well, clearance of debris from the well, and launch and installation of the capping stack. BSEE conducted field testing with installation and testing of capping stacks for Shell and the Marine Well Containment Corporation (MWCC) in July 2012 and Noble Energy and Helix Well Containment Group (HWCG) in April 2013 to assess compliance with their regulations for oil-spill-response/containment systems. In addition to ongoing, annual stack, vessel and equipment

inspections, BSEE also conducted drills with Beach Offshore Energy and HWCG, and Chevron USA, Inc. and MWCC in May 2023, which involved the loadouts, transits, installations, and pressure testing of the capping stacks on the seafloor in about 6,000 ft of water. In all of the field tests, the capping stacks were installed and tested in less than seven days. The total process takes about 21 days under ideal sea conditions. BOEM indicated a new capping system has the capacity to contain about 55,000 bbl for transfer to storage vessels and includes a 15,000 psi single or dual ram capping stack. New regulatory measures under 30 C.F.R. §250.462 require twice-annual pressure testing of the stacks to maintain readiness, and improvements in the capping stack technology are effective in bringing a spill under control in shorter periods than those during DWH. However, capping deepwater wells is not a regularly-occurring activity, so lack of experience can affect the risk of spills.

BSEE now requires operators to have access to capping systems designed to fully contain oil flow in an underwater blowout under a variety of scenarios. MWCC containment system can be used in water depths up to 3,048 m (10,000 ft) and has the capacity to hold 100,000 bbl of liquid per day or 200 million standard cubic feet of gas per day. There are several other capping stack consortiums/organizations in the Gulf of America (BSEE 2016). The HWCG consortium has a capping system that is expected to be deployed within seven to 10 days of an incident during a response.

NMFS Approach to the Oil Spill Analysis

NMFS reviewed the best available information regarding oil spill risk, including very large and catastrophic oil spills, and assessed the information from OSRAs and other analyses provided by BOEM to determine whether a very large (up to 100,000 bbl in our analysis, ≥10,000 bbl by BOEM) and catastrophic oil spill from activities associated with the Oil and Gas Program are reasonably certain to occur over the 45-year period considered in this consultation

BOEM estimates that, in an average year, operators will drill between five and 82 wells in water depths of 0-200 m and six to 31 exploration and delineation and development and production wells in water depths of 201-800 m, one to six development and production wells in depths of 801-1,600 m, and 27 and 57 wells in depths greater than 1,600 m on the federal OCS (based on Table 1 in the FBA). The lower range estimates include data from extremely low activity periods during the COVID-19 pandemic (Zeringue et al. 2022), which are unlikely to represent typical activity levels over the period considered in this opinion. For this reason, we use the higher end of the activity level annual estimates for our analysis to ensure higher activity years are captured and focus on wells in water depths greater than 800 m based on information such as from Muehlenbachs et al. (2013) and Murawski (2020a) suggesting a relationship between increased accidents and an increase in the depth of oil and gas development. BSEE (2012) noted that a blowout leading to a loss of well control and oil release is most likely in water depths greater than 3,000 ft (approximately 900 m), supporting our use of greater than 800 m in our analysis as reasonable. Based on the estimated annual activity levels, this yields a total of 63 wells drilled annually in waters greater than 800 m (grouping exploration, delineation, development, and

production wells). There are an estimated 24 and 57 annual total permanent plug and abandon wells in water depths from 801-1,600 m and >1,600 m, respectively. We do not include these in our estimates and instead focus on drilling of new wells; although there is the possibility of a release while wells are being closed, we find the possibility is low enough to be discountable.

According to BSEE's loss of well control data (available at BSEE's website; www.bsee.gov), from 2006 to 2023 and including DWH, there were 20 blowouts resulting in a loss of well control in >2,000 ft of water, 17 of which were in >3,000 ft of water, and three of which resulted in spills. Since 1990, the frequency of deepwater blowouts is about one blowout for every 275 deepwater wells. Using the estimate of 63 wells drilled annually in water depths greater than 800 m based on activity levels in Table 2, up to 2,835 wells may be drilled over the period considered in this opinion. Using these estimates and, because 63 is 23% of 275, we predict up to two (rounding up) blowouts [((1/275)*2385)*0.23] will occur in water depths greater than 800 m over the next 45 years.

While very large spills are low probability, given the history of spill occurrence in the Gulf of America, NMFS analyzes the effects of spill volumes up to 100,000 bbl over the next 45 years. We are adopting an approach that considers the effects from a range of potential spill volumes, up to 100,000 bbl. Therefore, one of the two deep water blowouts predicted based on the total number of wells that may be drilled (exploration, delineation, development and production wells) over the 45-year period considered in this consultation could result in a very large spill. NMFS determined that this volume would be most reasonable after considering the best available science and the 2012 drilling rule and subsequent safety measures.

Based on the historical data, BOEM's estimate of the number of spills, and the best available information presented in this opinion, we believe oil spills (≥ 10,000 bbl) are reasonably certain to occur over the next 45 years. The best available information presented in this opinion leads us to conclude that at least one spill resulting in a release of up to 100,000 bbl because of a blowout in deep water is reasonably certain to occur over the next 45 years of Oil and Gas Program activities on the OCS. This information includes historical blowout spills before the DWH event, the largest of which on the U.S. OCS were 80,000 bbl, 65,000 bbl, and 53,000 bbl, and all of which occurred before 1971 (Anderson et al. 2012), which was also before the increase in wells in very deep water (maximum depth from these blowouts was 190 ft). Ji et al. (2014) predicted an approximately 50-year return period (Figure 107) for a 100,000 bbl spill. The selection of 100,000 bbl as the upper limit of the very large spill volume in our analysis is further supported by a USCG and Department of Transportation Maritime Administration for the "Gulf of Mexico deepwater ports BA" (NMFS 2023a; Risknology 2020; RPS 2020), which evaluated a worst credible discharge scenario range from approximately 100,000 – 500,000 bbl spills. BOEM provided NMFS with information that 1.5 oil spills ≥ 10,000 bbl may occur over the duration of the Oil and Gas Program considered in this opinion for the high production scenario. This estimate is a total from categories including tankers/barges, platforms, and pipelines in the 2023

OSRA report. For platforms only in the high production scenario, BOEM estimates one spill ≥10,000 bbl could occur under the high production scenario.

We agree with BOEM that a worst-case, catastrophic spill (defined as a spill over 1 MMbbl for the purposes of the statistical modeling with Extreme Value Theorem used by Ji et al. 2014) is not reasonably foreseeable over the next 45 years given the best available information, including the uncertainty associated with estimates of the probability of a catastrophic (up to a 91-year return interval for a 95% CI for global risk in Eckle et al. 2012; up to 500-year return interval for a 95% CI in Ji et al. 2014), and the many safety measures required by the Bureaus post-DWH.

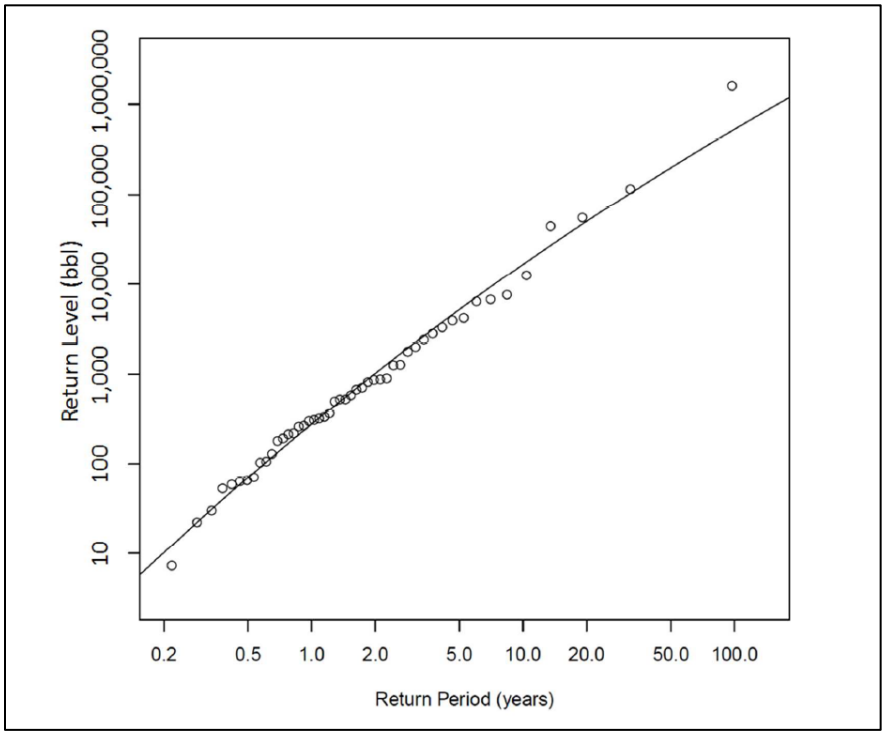


Figure 107. Modified Figure 4 from Ji et al. (2014), Return levels under different return periods. Arrows display the return level over a 50-year period.

We acknowledge that the court in *Sierra Club v. NMFS* found that the 2020 opinion inappropriately deferred to BOEM's conclusion that an oil spill of greater than one million barrels was not reasonably certain to occur, and that NMFS has a legal duty to reach its own conclusion on the issue. The court ruled that NMFS may consider the action agency's opinion on the impact of the proposed action, but must formulate our own final conclusion on the matter. In this opinion, per the court's direction, NMFS has carefully and independently assessed the risk that the proposed action would result in oil spills of all sizes, including catastrophic spills, and comes to its own conclusion on the matter. As described above, we find that oil spills will occur, and certain large oil spills are reasonably certain to occur, but that catastrophic spills are not reasonably certain to occur during the time period covered by the consultation.

While we again incorporate the Ji study and information provided by the action agencies into our analysis, we consider this part of our assessment of the best available science, not an adoption or deferral in any way to the opinion of the action agency. We describe in great detail above the Ji study, as well as many other sources of information on oil spill risk that NMFS considered in this opinion, including, in particular, science rendered from observations and analysis of the DWH spill. We believe the Ji study is a reliable portion of the best available science presented to the agency. As discussed in depth above, that study presents a critical quantitative assessment of catastrophic spill risk using probability analysis necessary where, as here, there are very few data points available for statistical review. In our independent assessment, the Ji study is best available science and a useful building block for our ultimate conclusion. All of the information available on oil spill risk presented in this opinion, including the Ji study, was considered independently by NMFS to generate the final determination described here, without deferral to the opinions of the action agencies, though we recognize that collaboration with the action agencies and applicants is valuable in informing NMFS through its considerations.

The court also ruled that NMFS' 2020 opinion was inconsistent, in that it contained both an adoption of BOEM's analysis, through an impermissible deferral rather than an independent determination, but also inconsistent statements in Appendix G, which proffered an alternative oil spill risk analysis. NMFS has made changes here after a full review of the record before the agency and the best available science.

We have made new, independent conclusions based on the record before the agency here, and no longer include Appendix G. That analysis, provided as an Appendix only in the 2020 opinion and thus never relied upon by the agency to make its effects determinations, is inconsistent with the best available science. The appendix provided a qualitative assessment of possible catastrophic spills, not a quantitative assessment as provided in the Ji study and other science relied on here, and based its ultimate conclusion on a single data point, the Deepwater Horizon spill. We acknowledge again that significant regulatory changes and technological improvements have occurred since Deepwater Horizon, and no further spills of that magnitude have occurred. Because of these changes, we do not find sufficient support for the qualitative prediction of catastrophic spills embodied in the former Appendix G. We find that the appropriate source for assessing risk is the analysis described in this opinion, which relies in part on the action agencies' science and other best available science, including the Ji study. This is the current best available science and we therefore do not repeat the qualitative discussion contained in former Appendix G here.

8.8.1 Oil Spill Exposure and Response Analysis

Smaller spills do not persist in the environment for long due to weathering, dissipation, and evaporation, and, thus, have less overall impact on listed species. In contrast, large spills, because of their volume, generate greater impacts to ESA-listed species. As exploration and production move farther offshore into deeper water where larger oil and gas reservoirs may occur (BOEM 2021b), the risk of larger size and longer duration spills is higher because drilling in

deeper water is at higher pressures and wider ranging temperatures, and response to a potential spill may take longer (due to the distance from shore).

NMFS is required to use best available scientific and commercial information, including to determine effects that are reasonably certain to occur. Our effects analysis is based on the observed, reported, and modeled effects of the DWH event. The scientific research, monitoring, and modeling efforts following the DWH event produced some of the best scientific information available on the effects of oil spills in the Gulf. Those data come from a partnership among industry, federal, state, academic, and nonprofit partners, and we find it reliable, applicable here, and appropriate to use as the foundation for our effects analysis. We, therefore, consider the effects of oil spills from this action by scaling the effects from DWH, reported in the impact analysis developed in the DWH PDARP (Trustees 2016). Oil spills in the Gulf of America may affect ESA-listed species including whales, sea turtles, and Gulf sturgeon, and their prey and habitats over the 40-year lease lives from leases awarded up to 2029 (lease activities through the year 2069).

By adopting this science-based scaling approach informed by a real-world event, our analysis is rendered more accurate and comprehensive. The scaled approach allows us to consider the effects of potential oil spills of different sizes, from small (<1,000 bbl) to large spills (>10,000 bbl to 100,000 bbl) on listed species. Predicting the future exposure of listed species to oil is uniquely challenging because of the uncertainty of where a spill may occur, flow rate and duration, differences in oil type, surface thickness, dispersion factors, and the habitat areas that may be affected by spills. This applied scaling is a reasonable approach that allows us to meaningfully consider potential future effects in the face of uncertainty, including the discrete, acute effects of large oil spills on listed species and designated critical habitat.

We note here that the *Sierra Club v. NMFS* court found that the 2020 opinion's analysis lacked sufficient consideration of the discrete acute effects of an oil spill of 100,000 barrels on protected species and habitats. In explaining its finding, the court favorably referenced the manner in which NMFS addressed the discrete acute effects of oil spills on Gulf sturgeon, using a scaled application of the effects observed and estimated from the Deepwater Horizon spill. This is the approach NMFS has now applied throughout its oil spill effects analysis, representing a significant, comprehensive revision from the 2020 opinion. We believe this scaled approach is a reasonable method to estimate effects and allow for consideration of the discrete acute effects of large oil spills on listed species and their designated critical habitat.

The DWH spill resulted in adverse effects on ESA-listed sea turtles, sperm whales, and Rice's whales. The DWH oil spill extensively oiled vital foraging, migratory, and breeding habitats of ESA-listed species throughout much of the northern Gulf of America. Sargassum habitats, benthic foraging habitats, surface and water column waters, and sea turtle nesting beaches were all affected by DWH. Sea turtles and whales were exposed to DWH oil in contaminated habitats; breathing oil droplets, oil vapors, and smoke; ingesting oil-contaminated water and prey; and by maternal transfer of oil compounds to developing embryos. Because we are using the DWH

damage assessment as a proxy to estimate oil spill effects resulting from the program, our exposure analysis includes impacts from oiling both on the surface and in the water column, including subsurface plumes.

Oil could be transported by the Loop Current, a large gyre in the middle of the Gulf of America that circulates and eventually feeds into the Gulf Stream up the U.S. Atlantic Coast to wider areas. BOEM considered the potential for oil to contact south Florida and areas outside the Gulf in their OSRA model. These analyses considered factors such as multiple spill locations, water currents, and seasonality, and used release rates of 30,000-60,000 bbl/day. Based on the size of the largest spill expected and BOEM's modeling, we anticipate any oil entrained in the Loop Current would not reach the Straits of Florida within 30 days in any measurable concentration (Figure 104).

The severity of exposure leading to adverse effects, including to key biological processes depends on a number of factors, including the:

- size of a spill (the flow rate and duration);
- volume of oil available to be released (reservoir size);
- type of oil;
- location of spill;
- time of year;
- species, life history, or migratory stage;
- manner of exposure (external only or ingestion, inhalation, or aspiration); and
- oceanographic/environmental characteristics.

In general, oil spills may pose a variety of oiling conditions ranging from very thin silver sheens to fresh, dark, and thick oil. The number of animals that may suffer oil-induced effects is proportional to the water-surface area covered by oil. In addition, spills in areas with higher densities of animals are more likely to result in adverse effects than spills in areas with low densities. Animals can be affected outside of a main spill footprint through contact with oil transported by currents and oiled prey and habitat, depending on the species. The exposure to oil needs to be sufficient to produce adverse effects from external oiling, internal absorption from ingestion of oil and prey, aspiration of oil, inhalation of volatile vapors in the air, and/or a combination of these (Figure 108). It is important to note that the risk of exposure differs between each species based on their distribution, life history, and behavior. Generally, surface-active animals are more susceptible to oiling than benthic animals and may have greater ecological sensitivity (Murawski 2020a).

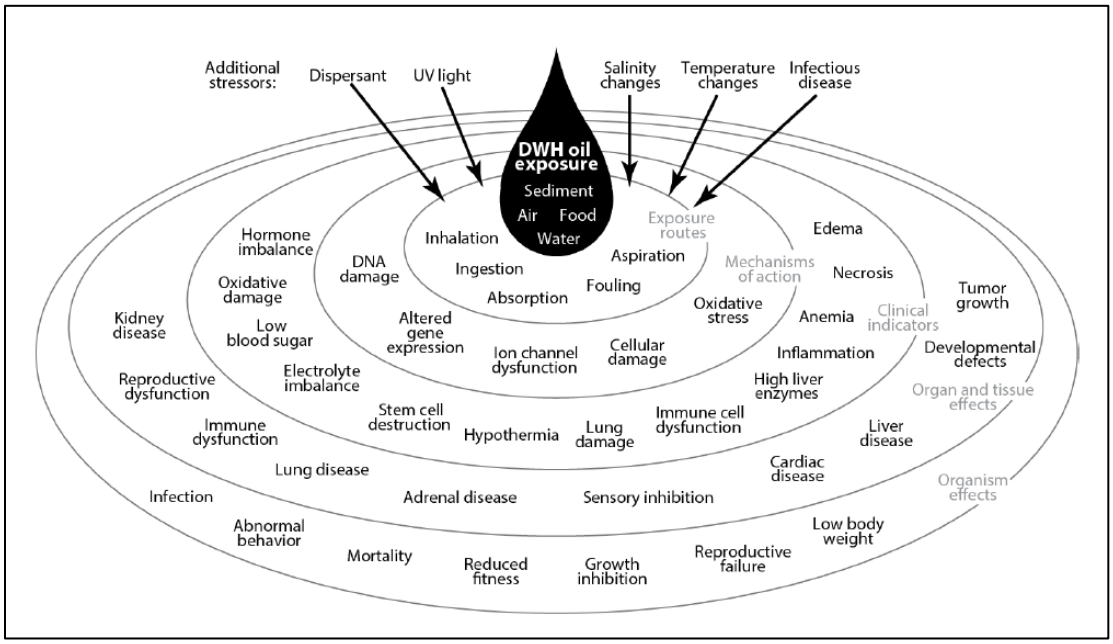


Figure 108. This conceptual model shows the interactions among oil exposure, exposure routes, mechanisms of action, clinical indicators, organ and tissue effects, and organism effects in marine organisms (Trustees 2016).

In order to estimate the effects future oil spills may have on listed species, generalized areal coverage for a large oil spill (100,000 bbl) is assessed. The maximum DWH footprint area was 28,200 km^2 (with a standard deviation of 5,028; (Macdonald et al. 2015)). Given that our very large spill estimate of 100,000 bbl is 2.5% the volume of the DWH spill, the area affected by oil could be up to 705 km^2.

In the following sections, we extrapolate the exposure of individuals of listed species in the action area to oil spills that may result from the Oil and Gas Program. As spill volumes increase, the surface area impacted increases, meaning more adverse consequences are expected and the likelihood of exposure proportionately increases.

8.8.1.1 Sperm and Rice's Whales

As noted previously, oil and gas development occurs in areas inhabited by sperm whales and Rice's whales. We looked at predicted densities of Rice's and sperm whales in the Gulf of America overlaid with active oil and gas leases and pipelines (Figure 109) and believe these whales may be exposed to oil spills.

A multi-year passive acoustic data project studied the impact of DWH on sperm whale presence in the DWH spill area (Ackleh et al. 2012). Prior to the spill (in 2007), the Littoral Acoustic Demonstration Center (LADC) collected baseline acoustic recordings near the area that became the spill site. These baseline data provide an opportunity to compare sperm whale activity in the area before and after the DWH spill event. In September 2010, LADC redeployed recording buoys at locations nine, 25, and 50 miles away from the incident site. A comparison of the 2007 and the 2010 recordings show a decrease in acoustic activity and abundance of sperm whales at

the nine-mile site by a factor of two, whereas acoustic activity and abundance at the 25-mile site clearly increased. This study suggested that sperm whales were displaced away from the spill site.

Trustees (2016)determined the majority of cetacean stocks within the DWH oil spill footprint were injured by some combination of increased mortality, increased reproductive failure, and/or adverse health effects, leading to reduced populations that will take decades to recover naturally. Studies have shown that while marine mammals may show irritation, annoyance, or distress from oil, for the most part, an animal's need to remain in an area for food, shelter, or other biological requirements overrides any avoidance behaviors in response to oil (McCay et al. 2004; Varoujean et al. 1983).

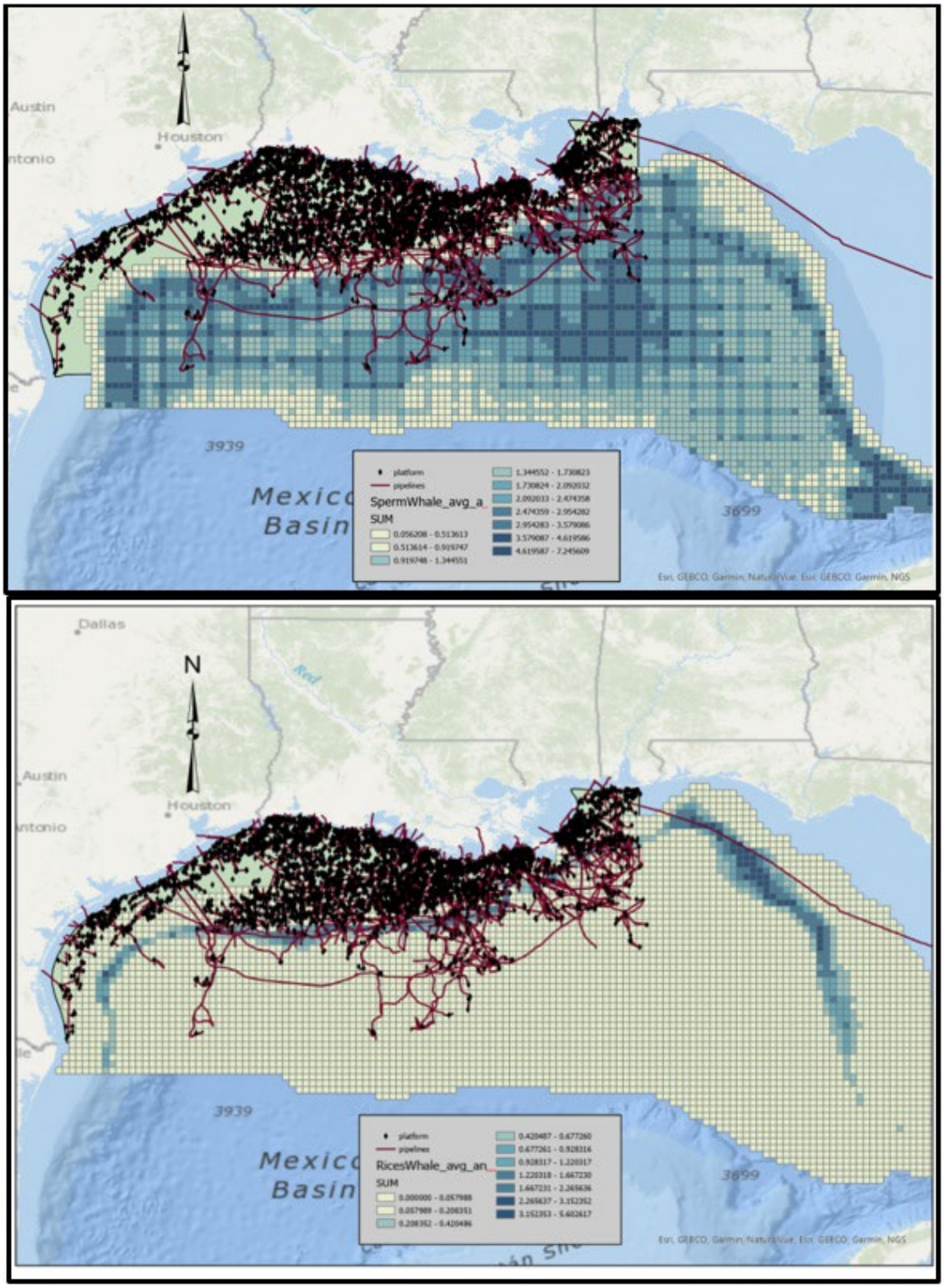


Figure 109. Sperm whale (upper panel) and Rice's whale (lower panel) habitat areas based on density modeling using sightings data per Garrison et al. (2023); Rappucci et al. (2023) in relation to active oil and gas leases and pipelines in the Gulf of America

Animals swimming in surface oil are likely to inhale contaminated air, ingest contaminated water, aspirate liquid oil, or come into contact with oil through their skin and mucus membranes. Animals may also come into contact with oil if they forage or capture prey in contaminated sediment. Thirty-three sperm whales were observed swimming in DWH surface oil or with oil on their bodies during response activities and as part of NRDA boat and helicopter surveys, and marine mammal habitat was degraded because of the spill (Trustees 2016). The NRDA process to assess the injuries to sperm and Rice's whales from DWH was completed based on dolphin health assessments conducted in contaminated areas (Barataria Bay in 2011 and 2013, and Mississippi Sound in 2013), and an area not exposed to the oil (Sarasota Bay in 2011 and 2013). Findings from the 2011 assessments indicate that bottlenose dolphins in Barataria Bay, which received heavy and prolonged exposure to oil, showed signs of severe ill health, including low body weight, anemia, low serum glucose and/or symptoms of liver and lung disease (Schwacke et al. 2014a). Nearly half of the 32 dolphins examined also had abnormally low levels of the hormones that regulate the stress response, metabolism and immune function. Additionally, there was an unusually high number of bottlenose dolphin strandings in the northern Gulf of America during and after the DWH spill with the highest number of strandings coinciding with areas that received the heaviest oiling (Venn-Watson et al. 2015). These effects are expected to have occurred in whales exposed to oil, such as sperm whales and Rice's whales.

Crude oil can release volatile vapors, such as benzene, butane, N-hexane, isopentane, and pentane, when it comes into contact with the air. Whales may be at particular risk for inhalation exposure to PAHs within or downwind of a spill due to unique physiological and behavioral characteristics. Whales breathe at the air/water interface, and exchange significantly more air and deeper inhalations than humans. Sperm whales, for instance, have deep inhalations followed by a long breath hold on deep dives. Sperm whales also float at the surface while recovering from deep dives. Because deep breaths increase chemical inhalation injury to tissues deeper within the lungs, whales may be particularly susceptible when they are at the surface to breathe after a dive to exhale "bad" gasses and replenish "good" gasses to prepare for the next dive. Nursing calves spend a significant amount of time at the surface because they do not conduct feeding dives and wait at the surface for their mothers and, thus, may be particularly susceptible to inhaled PAHs.

Benzene is a known carcinogen in many animals and may have similar adverse effects on sperm whales. Inhalation of crude oil vapors or smoke from in situ burning of oil could irritate or burn the respiratory system, and even small levels of benzene could cause cancers. A recent study found that in Barataria Bay, Louisiana, which experienced heavy and prolonged oiling during the DWH spill in 2010, bottlenose dolphins were five times more likely to have moderate to severe lung disease, which authors suggest may be related to inhalation exposure to PAHs (Schwacke et al. 2014a) (Figure 71). Lung injuries due to inhalation of PAHs in Rice's and sperm whales would severely impact their survivorship because they must hold their breath to feed. The rapid dissipation of toxic fumes into the atmosphere from rapid aging of fresh oil could limit the potential exposure of whales to prolonged inhalation of toxic fumes.

Reproductive impacts in pregnant whales exposed to oil are of particular concern. The effects on the overall health of pregnant females influences reproductive outcome. There is the potential for PAHs to be associated with reproductive failure and low birth weight. A study using mink as a model for reproductive success of sea otters showed that oil-exposed female mink had reduced reproductive success and kits had poor survival to weaning (Mazet et al. 2001). In addition, once mature, kits born to oil-exposed females had significantly reduced reproductive success even though their only exposure was in utero or while nursing (Mazet et al. 2001). However, the effects of in utero exposure to and transfer of PAHs through mothers' milk in marine mammals is largely unknown so these studies of terrestrial mammals may not be indicative of effects to marine species. There is the potential for PAHS to be associated with reproductive failure and low birth weight (Figure 110).

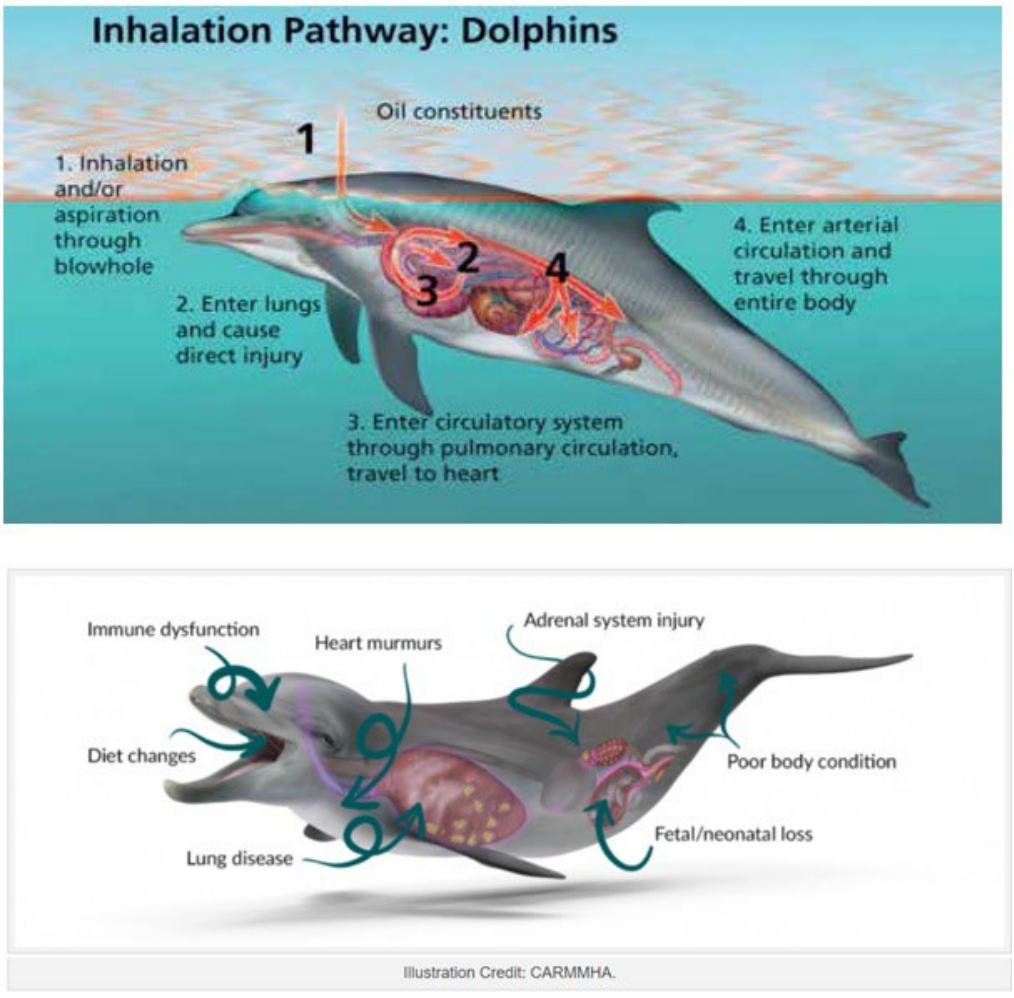


Figure 110. Various pathways by which marine mammals are affected by oil. Upper panel (NAS 2022) Lower panel (Rowles et al. 2020)

Trustees (2016)applied the expected effects from bottlenose dolphins to extrapolate effects to sperm whales and determined 16% of the Gulf of America population, or about 262 whales, were exposed to DWH oil. Thirty-five percent of those whales (or approximately 92 whales) were

likely killed, which equates to 6% of the Gulf of America sperm whale population. Initial exposure to oil likely resulted in whale deaths later in time from adrenal and lung disease, as was observed in bottlenose dolphins (Figure 110). In addition to the sperm whale deaths, an estimated 7 % of exposed females that survived suffered reproductive failure through aborted fetuses or early calf death. Thirty-seven percent of all exposed sperm whales, including pregnant females, likely suffered adverse health consequences as a result of DWH oil exposure (Trustees 2016). All cetaceans exposed to oil were considered injured/impaired (Takeshita et al 2017) and most observed animals had evidence of oil exposure (Aichinger et al 2017).

The DWH spill exposed an estimated 48% (95% CI 23-100) of the existing Rice's whale population with 18% (CI 7- 28%) likely suffering undefined adverse health effects, 22% suffering reproductive failures, and an estimated 17% (95% CI 7-24) killed (Trustees 2016). Applying these percentages to the current population estimate for Rice's whale (51 individuals), total DWH impacts included 25 animals exposed, 9 mortalities, 11 reproductive failures, and 9 animals likely experiencing other adverse health effects. There were few, if any, cetaceans considered 'not or lightly oiled' during the DWH response effort. Table 98 shows the results of our analysis of 3% of the DWH numbers representing anticipated discrete, acute impacts from the Oil and Gas Program from a very large spill of 100,000 bbl.

Table 98. Estimated number of oil exposures* to whales over the course of the Oil and Gas Program

Species	Estimated exposures to oil*	Mortality*	Sublethal injury*	Minor impacts likely to adversely affect*
Sperm whale	7.86	2.76	2.91	2.19
Rice's whale	0.75	0.27	0.33	0.27

**Percentage range of exposures expected based on 3% of DWH impacts. Note: Adverse health effects (represented by the minor impacts column) include lung disease, adrenal disease, and poor body condition. Other factors contributing to poor health include tooth loss, anemia, and liver injury (Trustees 2016).*

Marine mammals are at a risk of oil ingestion because of the spreading of oil in the water and the potential for contact with prey. Rice's whales may feed and groom at the surface, making them more susceptible to oil ingestion for surface spills than sperm whales that feed at depth and spend a significant amount of time below the surface. A few experimental studies fed dolphins relatively low doses of oil for three to four months and showed no clinical, hematological, or biochemical alterations (Engelhardt 1983). Whales are unlikely to ingest oil during the majority of the numerous small spills in the Gulf of America, unless the oil is dispersed or spilled at depth in high amounts or is accumulated in ingested prey. Deep sea blowouts or subsurface spills could contaminate prey and the subsurface habitat as oil rises through the water column or becomes entrained where prey items are found. Because sperm whales are suction feeders, they are more likely to suck in oil droplets if oil is dispersed in the water column. Rice's whales gulp water and then filter out prey from the water with a push through their baleen plates, so ingestion of oil would be dependent on where the oil is relative to prey sources. A concern from subsurface spills are tarballs or mats of oil that become entrained in the deep scattering layer where whales feed that could be mistaken as prey items and accidentally ingested. Ulcers, internal bleeding, and

other gastrointestinal disorders could result from ingested oil and oiled prey. Systemic PAH exposure could result from PAH ingestion. Ingestion of oil may result in temporary and permanent damage to whale endocrine function and reproductive system function, and, if sufficient amounts of oil are ingested, mortality of individuals. As noted previously, the Trustees (2016) determined exposure to DWH-related petroleum products caused a suite of adverse health effects, including lung disease, adrenal disease, reproductive failure, mortality, and poor body condition in bottlenose dolphins that we extrapolate to responses in sperm and Rice's whales.

The area of oil and gas development directly overlaps high-use habitats for sperm whales associated with a concentration of prey resources. Blowouts and subsequent high pressure spills in deepwater areas with high concentrations of sperm whales could have adverse consequences on exposed animals. Sperm whales are deep divers and generally forage over large areas, meaning the magnitude of oil exposure depends on the location of the spill, the composition of the spilled material, and the movement and fate of the spilled hydrocarbons/wastes in the offshore environment. The primary prey of sperm whales and other deep-diving marine mammals is deepwater squid that occupies water depths between 400-600 m. High levels of subsurface oil would have direct impacts on the prey community, lowering the foraging success of whales, or causing the whales to move out of an area to a lesser-quality forage area. A distribution shift may affect survival and productivity of the population. A very large spill in deepwater can result in prolonged and/or repeated exposure of sperm whales to oil and dispersed oil. Sperm whales could suffer similar effects to those observed in other more studied odontocetes (e.g., Barataria Bay dolphins). Because of the matriarchal social structure of sperm whales (Whitehead and Mesnick 2003) in the Gulf, an oil spill could have adverse consequences on matriarchal groups of whales, including related females, calves, and juveniles. Research has shown that female sperm whales and their calves are resident, while males leave the area, so females may are more susceptible to negative effects from oil spills that occur in their home range.

The effects of exposure described for sperm whales would be the same for Rice's whales with the exception of foraging ecology differences. Whereas sperm whales dive deep and their prey could be directly affected by deepwater blowouts, Rice's whale may feed on the surface or dive into deeper water to feed on their preferred prey source. Rice's whales may feed on fish or small crustaceans, either of which can be exposed to oil or dispersants in the water column (Trustees 2016). Oil dispersed in the water column or oil at the surface could affect Rice's whale prey, depending on the timing, location, magnitude, and duration of the spill. Surface feeding whales could ingest surface and near surface oil fractions with their prey, which may also be contaminated with oil components. Incidental ingestion of oil factions in benthic sediments can also occur during near-bottom feeding. To the extent that ingestion of crude oil affects the weight or condition of the mother, the dependent young could also be affected. Decreased food assimilation is particularly important in very young animals, those that seasonally feed, and those that need to accumulate high levels of fat to survive their environment.

Based on the results in Table 98, we estimate approximately two-thirds of these exposures will result in minor to moderate responses, and the remaining animals will suffer mortality. Sperm whales are more likely to be affected than Rice's whales because sperm whales are present in greater numbers than Rice's whales in areas where oil and gas activity is heavier, meaning there is a greater risk of spills.

We expect the range of severity includes whale mortalities, calf losses, and sublethal exposures, with lesser impacts on the minor end of the consequence spectrum. In addition to a reduction in population numbers due to mortality, persistent exposure to oil during larger spills could have reproductive consequences on some animals. We expect sublethal exposures of females to result in an increase in lost calves from exposures to oil. Because all females do not reproduce in the same year and have an inter-calving interval of four to seven years for sperm whales, and possibly longer for Rice's whales, reproductive effects could continue for several years following a very large spill and exposure to oil. Health effects to offspring will be the most pronounced in the first-born calf following oil exposure. Female sperm whales make up about 72% of the Gulf of America population (Engelhaupt et al. 2009); therefore, we assume exposed animals will be female resulting in reproductive consequences for up to five animals (Table 92).

Given their similar anatomy and physiology, we expect Rice's whale responses to exposure will be similar to that of sperm whales. However, we estimate only one animal may be exposed to a very large spill (up to 100,000 bbl) because Rice's whales are more common in areas of the Gulf outside the majority of locations where Oil and Gas Program activities occur. Thus, there is a low probability of mortality and sublethal effects such as declines in reproduction for Rice's whale.

Response severity may depend on the condition or vulnerability of the animal prior to the exposure. For instance, if an animal is exposed multiple times to lighter oiling within a short period of time, it does not have time to return to health prior to subsequent exposures. Therefore, the consequences are likely to be more severe for an animal exposed multiple times or possibly similar to an animal more heavily oiled with one exposure to a larger spill than for an animal that has not previously been exposed.

8.8.1.2 Sea Turtles

A large amount of oil and gas development overlaps with the range and habitats of sea turtles in the Gulf. Kemp's ridley and loggerhead, the two most common sea turtle species in the Gulf and for which we have the most information, substantially overlap with active oil and gas leases and pipelines (Figure 111). Spills that occur in offshore waters are less likely to affect adult hardshell sea turtles due to the lower densities of this age class in deep water. However, oceanic juveniles, especially those that prefer to congregate in *Sargassum*, which is the principal feature that defines habitat for hatchlings and oceanic juvenile sea turtles in the Gulf of America, are present in deep water and may be present in large densities in patches of *Sargassum*. *Sargassum* habitat supports abundant prey and provides cover that otherwise would not be available to oceanic stage sea turtles. The diet, high-affinity, and shallow dive behaviors reported for oceanic

juveniles associated with *Sargassum* habitat show that *Sargassum* is extremely important for young sea turtles (Witherington et al. 2012). Oceanic juveniles of four out of five sea turtle species found in the Gulf have been found in floating *Sargassum* (leatherback turtles are not known to use *Sargassum* habitat). If exposed, hatchlings and juveniles of hardshell sea turtle species in the Gulf of America are expected to be more vulnerable to the lethal effects of oiling because of their increased time at the surface, feeding habitats near the surface, and smaller size.

Direct exposure to heavy crude is likely lethal when heavy oiling covers the entire body surface. The risk of exposure to heavy crude is relatively lower than oil with lighter densities because the densest, heaviest oil is restricted to a smaller area near the spill source, but the risk increases for larger oil spills. Risk of exposure to lower-density sheens is greater because of the more expansive spread of oiled surface area. Weathered oil may persist in the environment over a longer period than the spill, and an additional number of turtles could be exposed to oil from ingestion of tarballs and oiled prey, which could have fitness consequences for affected individuals (Shigenaka and Milton 2003).

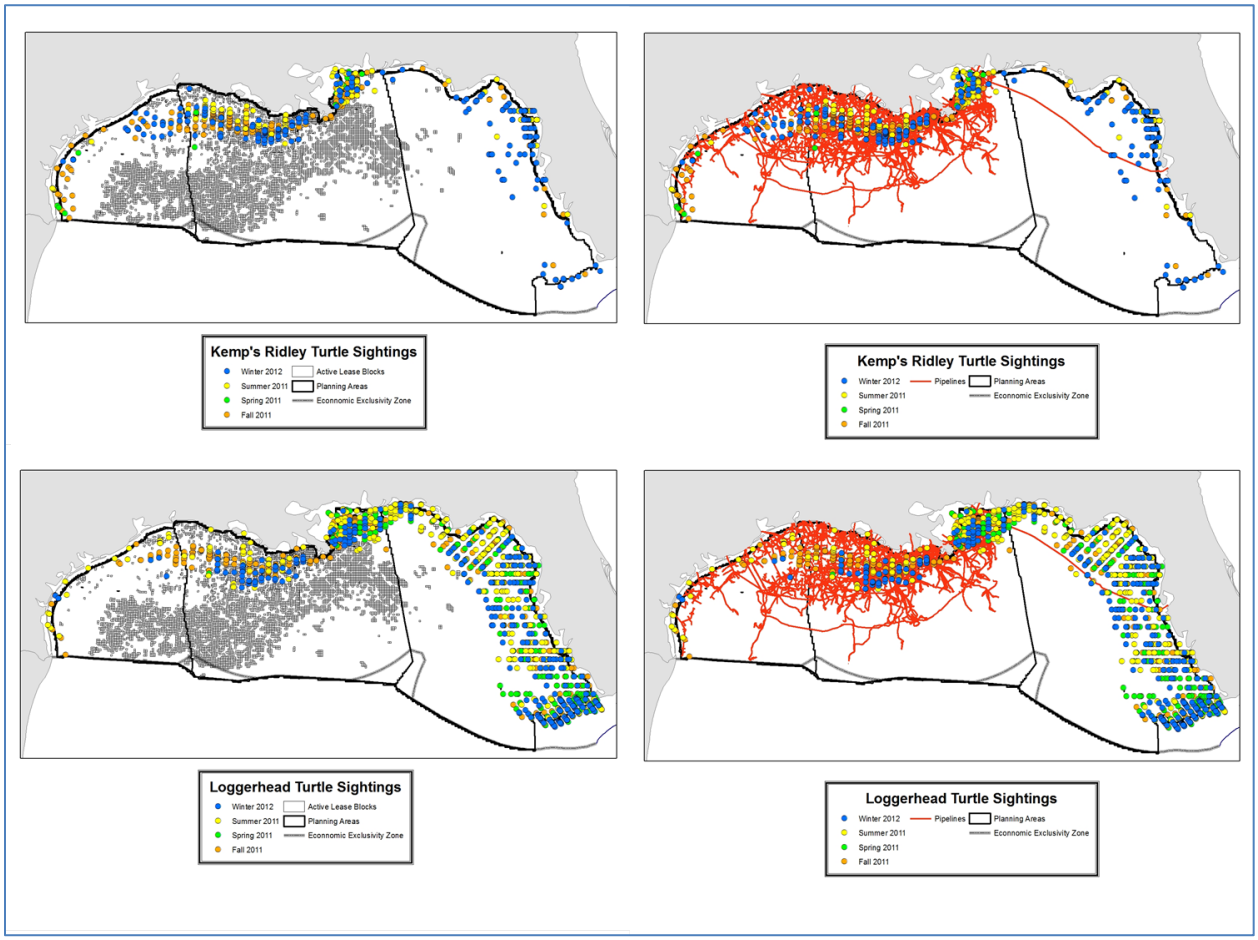


Figure 111. Aerial survey sightings of Kemp's ridley and loggerhead sea turtles in relation to active leases (gray squares) and pipelines (red lines) in the Gulf of America (SEFSC data)

Spills originating in or spreading through coastal waters may impact any of the five sea turtle species inhabiting the Gulf. Spilled oil could affect any life history stage or age class of sea turtles (Vargo et al. 1986). Sea turtle populations are most vulnerable when aggregating, which peaks around nesting season and when hatchlings or other life stages are present in convergence zones, such as when foraging (Shigenaka and Milton 2003). Effects from oil spills on sea turtles may be lethal or nonlethal, ranging from changes in biologically important behaviors to physiological injury and mortality. During DWH, approximately 1,800 turtles were directly observed within the footprint of the spill, 574 were documented during direct capture, and an additional 402,000 oceanic juveniles and 58,000 benthic juveniles and adults were estimated as likely having been exposed to oil (Trustees 2016). Of the large numbers of animals exposed to oil, an estimated 35,000 hatchlings, 56,000 to 159,000 small oceanic turtles, and 4,900 to 7,600 benthic juveniles and adults were killed because of DWH (Trustees 2016). Excluding the DWH spill, it was previously estimated that approximately 1% of annual sea turtle strandings are associated with oil spills, with higher percentages from South Florida (3%) and Texas (3-6%) (Lutcavage et al. 1997). Some potential pathways of oil effects on sea turtle life stages are shown in Figure 112. Studies using weathered oil and tests indicative of relative health have shown juvenile loggerhead sea turtles are highly sensitive to brief exposure to oil (Lutcavage et al. 1997).

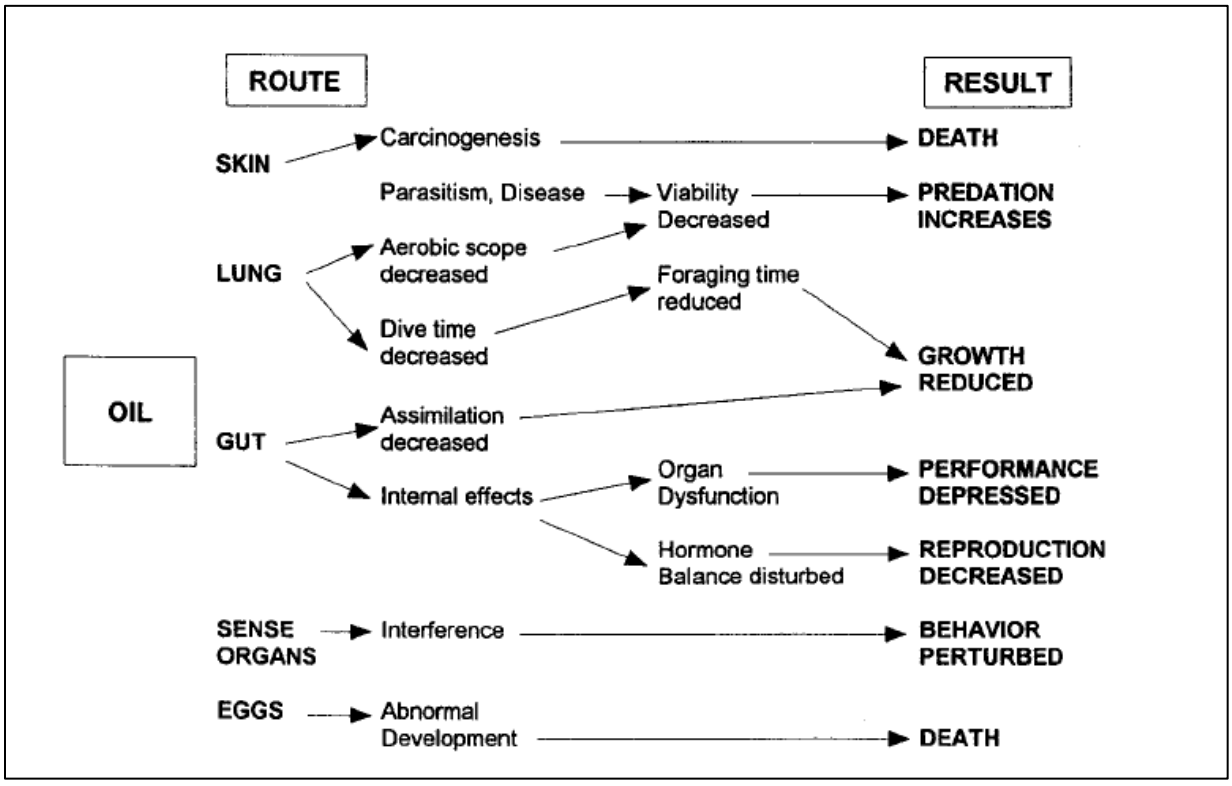


Figure 112. Different ways sea turtles may be affected by prolonged exposure to oil. Figure from Lutcavage et al. (1997a)

Direct contact of sea turtles by oil occurs as long as a slick persists, and physiological effects can continue for long periods once the slick dissipates. Direct oiling impairs swimming and blocks breathing passages. Oiling can cause thermal stress by acting as an insulator that interferes with thermoregulation. Basking turtles heat much faster and can rapidly overheat due to the higher temperature in oil. Inhalation of oil is another prominent route of exposure. Sea turtles rapidly inhale a large volume of air at the air-water interface where hydrocarbon vapors and aerosolized oil concentrations are highest, before submerging. Repeated surfacing results in multiple exposures to volatile hydrocarbon vapors and oil, compounding the risk of lung injury and other adverse physiological effects (Shigenaka and Milton 2003). Any of these mechanisms of exposure and subsequent response, including impaired swimming, blocked airways, overheating, or physical or chemical damage to lung tissues, could, if severe enough, result in mortality.

Sublethal physiological injury is more likely in larger turtles with lower degrees of oil exposure, and can impair a turtle's ability to withstand other stressors. The long-term effects of oil exposure on reproduction and health are relatively unknown. Lutcavage et al. (1997) provided qualitative evidence that oil exposure disrupted lachrymal gland (salt gland) function, with the glands physiologically not functioning for several days following exposure. Their experiments on physiological and clinicopathological effects of oil on loggerhead sea turtles showed that the turtles' major physiological systems are adversely affected by both chronic exposure (96-hr exposure to a 0.05 cm layer of South Louisiana crude oil) and acute exposure (0.5 cm of oil for 48 hr). The skin of the exposed turtles, particularly the soft pliable areas of the neck and flippers, sloughed off in layers for up to two weeks, with recovery taking up to three weeks. Oil was also detected in the nares, eyes, upper esophagus, and feces, indicating that turtles were ingesting oil, though not enough to cause intestinal bleeding and anemia. Internal effects of oil exposure also include significant changes in blood and blood chemistry. Hematocrits (red blood cell volume) decreased nearly 50% in oiled turtles and did not increase again during the recovery period. Immune responses included significant increases in white blood cells lasting more than a week in sea turtles exposed to oil (Lutcavage et al. 1997). Sublethal effects can compromise a turtle in the long-term, contributing to the possibility of death from predation, disease, or an inability to forage. Certain compounds such as VOCs have been shown to cause cancer and neurologic and reproductive harm in aquatic organisms (USGS 1997) and are part of the compounds sea turtles could be exposed to during a spill.

Oil impacts both surface and benthic foraging habitats, oiling both the prey and habitats where prey are located. Surface oil aggregates along convergence areas where turtles spend prolonged periods feeding. *Sargassum*, seagrass, and other oceanic juvenile habitats impacted by oil can lead to impairment or death of subadult sea turtles that depend on those habitats for shelter and food. Dispersed oil contaminates benthic areas, and weathered oil consolidated with sediments and vegetation sinks and contaminates benthic environments where some species of sea turtles

forage. Sea turtles can be oiled in these affected habitats and ingest contaminated prey. Larger volume spills can impact the entire foraging range of an individual.

Even if a sea turtle is not directly exposed to a slick, hydrocarbons persist in marine environments for decades or longer. Tarballs are a byproduct of accidentally spilled oil, normal and accepted ship operations (e.g., bilge tank flushing), illegal discharges from tank washings, and natural oil seeps on the seafloor. They are found in every ocean and on every beach; oceanographic features such as convergence zones and Langmuir cells can aggregate even widely dispersed tarballs in an area where sea turtles concentrate. Turtles indiscriminately eat anything that registers as being an appropriate size to be food (Lutz and Lutcavage 1989), including tarballs and other materials. Non-food items ingested by sea turtles do not pass rapidly through their digestive tract and may be retained for at least several days as the materials are absorbed, metabolized, stored, or excreted (Valente et al. 2008). Protracted retention increases internal contact and the likelihood that toxic compounds will be absorbed. The risk of gut impaction also increases for turtles that have ingested oil. Tarballs ingested by any age class of sea turtle are likely to have a variety of effects, including 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.

We estimated the number of sea turtles that may be exposed to an oil spill using the numbers of sea turtles from the DWH PDARP (Trustees 2016). For the PDARP assessment, about 20% of the total turtles documented during directed capture operations during the spill (110 of 574; Table 1.8-2 PDARP) were not visibly oiled and, thus, not considered in the exposure totals. As described above, we used 3% of DWH impacts (spill of 100,000 bbl) as the upper range for potential spills. Each of the five sea turtle species in the action area, and the unidentified hardshell category, that may be exposed to oil spills associated with the Oil and Gas Program were estimated for a spill of 100,000 bbl (Table 99).

Based on the totals in Table 99, we expect approximately two thirds of the predicted exposures to oil spills to have minor to moderate effects to sea turtles and the remaining animals to be more severely affected (i.e., mortality). Kemp's ridley is the most vulnerable species because of their restricted range and overlap with oil and gas activities in the Gulf of America (Figure 3), meaning they have the highest chance of exposure to any spill. Exposure to oil may have sublethal or fitness effects on individuals, depending on the frequency and duration of exposure, and individual body condition. Some individuals may be affected more than once with multiple exposures being more detrimental to an individual, especially if multiple exposures occurred over a short time.

Table 99. Estimated* number of sea turtles exposed to oil from the action

Species	Total Exposed*	Heavily Oiled, Dead*	Non-heavily Oiled, Dead*	Total Dead*
Kemp's ridley	7,500	1,190	1,589	2,781
Loggerhead	1,794	128	291	420
Green	4,440	459	1,194	1,653
Hawksbill	257	18	72	90
Unidentified	476	58	86	144
Total	14,466	1,854	3,232	5,088

**Percentage range of exposures expected based on 3% of DWH impacts.*

Based on the exposure analysis, over the period of the Oil and Gas Program, a large oil spill (up to 100,000 bbl) is reasonably certain to occur (see NMFS Approach to the Oil Spill Analysis, above), resulting in exposure of a large number of sea turtles to various levels of oil. There could be minor or moderate effects to individuals from exposure to numerous small spills, but several thousand sea turtles could experience severe effects from exposure to a large oil spill associated with the Oil and Gas Program. Kemp's ridleys, loggerheads, and greens would make up the majority of exposed species because they are more prevalent and occur in higher numbers in the Gulf of America, compared to hawksbills and leatherbacks.

Because oceanic juveniles have a high affinity for *Sargassum*, oiling of this habitat during spills is likely to continue exposing sea turtles to external oiling, inhalation of harmful vapors, and ingestion of oiled prey. In addition to hydrocarbons, oil also contains traces of heavy metals such as mercury, arsenic, and lead. The loss of large numbers of individual clumps, patches, or lines of *Sargassum* to oiling forces animals to seek another area to feed and shelter. Turtles having to seek alternative refuge are susceptible to increased predation and experience an energetic cost from searching for a new habitat. Hatchlings sticky with oil residue may have a more difficult time swimming and diving, rendering them more vulnerable to predation and interfering with successful feeding.

Oceanic juveniles that contact oil exhibit a range of responses from acute or chronic toxicity such as impaired movement and impairment of normal bodily functions. There may be a large energetic cost if turtles are unable to find adequate prey while seeking new habitat, as well as from expending more energy moving through oiled waters or with oiled body surfaces. Oil spills that reach nearshore waters impact benthic-stage juveniles and adults that spend considerably more time on the bottom foraging and resting. Oil remaining on the surface can oil sea turtles, but typically to a lesser extent than oil found near the source of a spill because the oil has dispersed and/or become weathered by the time it reaches nearshore areas. Weathered or

dispersed oil may be present in the water column or sink to the bottom where it can interact with sea turtles or contaminate their prey.

There may be effects of oil to sea turtles from reduced prey availability. For example, a 1986 oil spill off Panama resulted in the destruction of seagrass and other invertebrates that sea turtles eat (Shigenaka and Milton 2003). Exposure to oil may also damage nostrils and olfactory sensory organs. The sense of smell plays an important role in navigation and orientation of sea turtles. Olfactory masking may not harm a turtle, but impairment of orientation in individuals could have population-level effects depending on the number of impaired individuals because disorientation can lead to things like an increased risk in predation or hampered response to vessels (Shigenaka and Milton 2003).

8.8.1.3 Gulf Sturgeon

With regard to Gulf sturgeon, fish larval development is known to be affected by PAHs (Incardona et al. 2004). The NAS (2022) found that buoyant eggs released by some species of fish and other marine organisms during spawning come into contact with surface oil slicks when eggs rise to the surface. Gulf sturgeon spawn upstream in rivers, so offshore spills are not likely to result in exposure of eggs and early life stage juveniles. We include these species in our analysis because juveniles or adults, or their prey, could be exposed to spilled oil.

To estimate the potential of exposure of Gulf sturgeon to oil spills associated with the Oil and Gas Program, we took a more qualitative approach than for whales and sea turtles. Sturgeon are not expected to be exposed to surface oil, but could be exposed to dispersed oil, weathered oil, oil mixed into the water column by wave action, or oil remaining in the sediments. The risk of sturgeon exposure to an oil spill is dependent on the size, location, and season that a spill occurs in the CPA or EPA.

The Gulf sturgeon is an anadromous fish; adults spawn in freshwater then migrate to feed and grow in estuarine/marine habitats, so the likelihood of exposure to fresher oil is highly dependent on the time of year oil is present. Persistent oil may remain in Gulf sturgeon habitat after a spill and sturgeon may come into contact with this oil upon returning to their winter marine habitat. Based on the life history of this species, adult sturgeon are the most vulnerable to an oil spill during winter months (between October and April) when adults of this species are foraging in estuarine and marine habitats. We do not expect any eggs or young fish to be exposed to oil from spills associated with the Oil and Gas Program because we do not expect oil to reach freshwater areas where these life stages occur.

BOEM estimates a less than 0.5% chance of an offshore oil spill contacting Gulf sturgeon marine habitat for a spill size of ≥ 1,000 bbl (Ji and Schiff 2023). The chances of contact will be greater for a larger spill. Assuming a larger spill occurring east of the Mississippi or closer to shore (e.g., pipeline rupture) could contact Gulf sturgeon marine habitat (Figure 113), we used the approach described below to estimate exposure numbers for adult sturgeon. Figure 114 displays the

satellite-imaged cumulative footprint from DWH and its proximity to the coast, barrier islands and Gulf sturgeon critical habitat used to inform our estimate.

About 2,800 mature Gulf sturgeon are estimated in the Choctawhatchee River population (Alabama-Florida), about 224-376 in each of the Pearl, Pascagoula and Escambia rivers, and Yellow and Apalachicola river populations are estimated at about 1,036 and 1,288 individuals, respectively. Depending on the locations of the affected areas, one or more of these populations could come into contact with mixed or submerged oil. Based on variable environmental conditions, sunken oil is generally expected to scatter in deeper passes and offshore of beaches where sturgeon typically forage in marine habitats. Diluted oil would be available for the duration of the spill, and sunken oil would persist for longer periods of time. It is likely some sturgeon would be exposed to or ingest oil in amounts that could impair the future reproductive success of the animals or have other non-lethal effects.

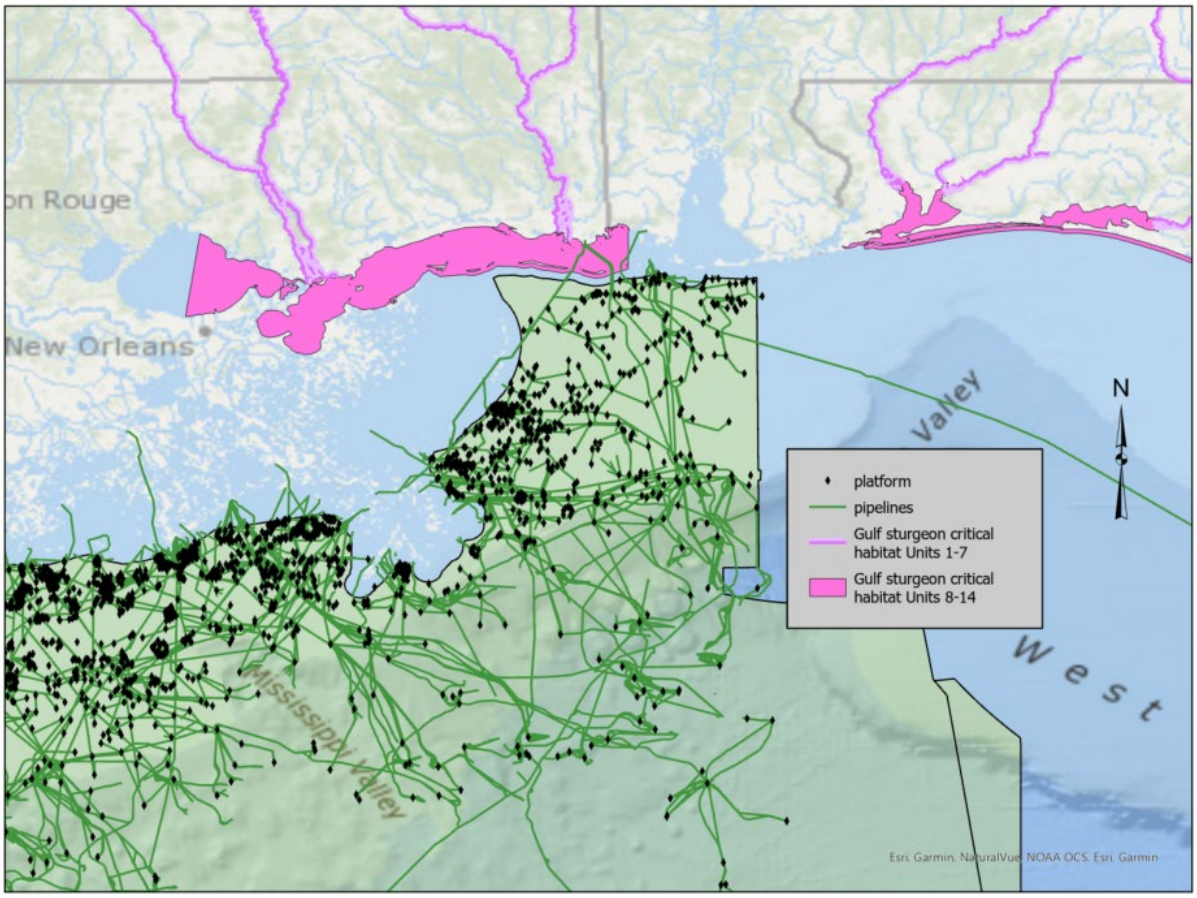


Figure 113. Location of Gulf sturgeon critical habitat (pink areas) in relation to oil and gas platforms (black diamonds) and pipelines (green lines)

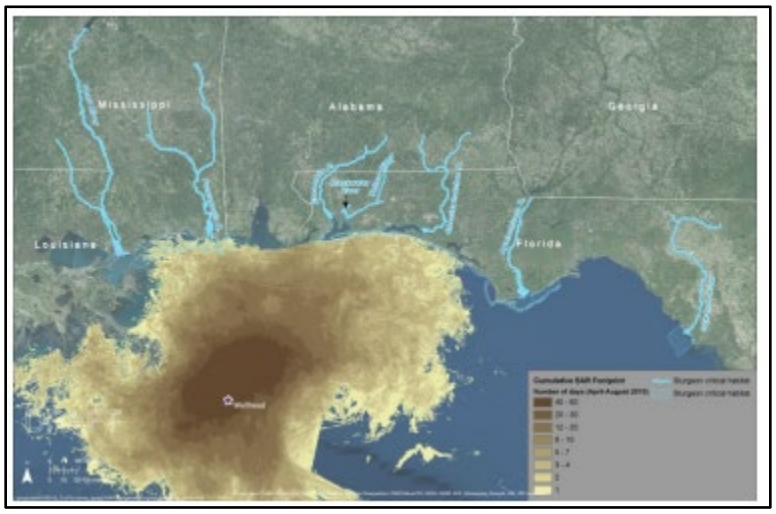


Figure 114. Cumulative satellite imagery footprint from DWH showing proximity to Gulf sturgeon critical habitat

Based on the extent of the oiled area of shallow unvegetated habitats during DWH (Trustees 2016), many animals from river populations in Louisiana, Mississippi, and Alabama were exposed to DWH oil. The DWH damage assessment concluded that approximately 63%, or between 1,100-3,600 Gulf sturgeon from the Pearl, Pascagoula, Escambia, Blackwater, Yellow, and Choctawhatchee river populations were exposed to oil from the DWH spill (FWS 2015; Trustees 2016). The Mississippi Canyon area where DWH occurred is a highly active oil and gas producing region; therefore, we assume another spill could happen in a similar location east of the Mississippi River outlet. Using the DWH damage assessment results of 1,100-3,600 individual sturgeon, we estimate that 33-108 Gulf sturgeon (using the 100,000 bbl spill size, which is 3% of the DWH spill) will be exposed to spilled oil resulting from activities under the Oil and Gas Program over the period considered in this consultation. These individuals could also be exposed to other smaller accidental spills under the Oil and Gas Program in similar locations.

Although sturgeon were not present in the DWH spill area when oil was actively being released, the effects of post-release oil exposure on Gulf sturgeon included genotoxicity (fractured DNA) and imunosuppression, which can lead to malignancies, cell death, susceptibility to disease, infections, and a decreased ability to heal (USFWS 2015). In other fish species, high concentrations of PAH metabolites were documented in bile and liver. Sunlight has been shown to magnify the sensitivity of early life stages of fish and invertebrates to oil exposure (Trustees 2016). Crude oil from the DWH spill was shown to cause developmental abnormalities and heart defects in young bluefin and yellowfin tunas, resulting in early mortality of young present during the active release of oil from DWH (Incardona et al. 2014). Gulf killifish exposed to sediment concentrations of PAHs of about 38 ppm showed DNA damage, decreased heart rates, and decreased hatching success of developing eggs (Pilcher et al. 2014). These studies show that

young fish are more sensitive to oil exposure than adults and widespread impacts on younger life stages can have population-level effects if high number of individuals are affected. Exposure to hydrocarbons has been linked to malformations, genetic damage, mortality, decreased size, inhibited swimming, skin and fin lesions in numerous species of fish (Hargis et al. 1984; Murawski et al. 2014) (Carls et al. 1999; Collier et al. 2013). Adult fish can also be adversely affected by stress associated with the detoxification of PAHs in the body (Crowe et al. 2014).

We do not expect severe oiling and direct mortality of Gulf sturgeon because sturgeon do not occur directly within oil and gas leasing areas. Thus, the up to 108 Gulf sturgeon will be adversely affected primarily through ingestion of contaminated prey or incidental ingestion of oil, followed by physical contact while foraging or resting, and uptake of dissolved oil through the gills, as well as affects to habitat from transport of oil to nearshore locations. Exposure to oil could result in genotoxicity and immunosuppression and a subsequent reduction in fitness of exposed individuals.

Because Gulf sturgeon are found close to shore, exposure to any oil from OCS spills would likely be from transport of days-old oil from an offshore spill. Oil becomes more dispersed over time and the weathering and consolidation of oil with sediments and other materials causes the properties of the oil to change and become less adhesive to body surfaces. Although contact with oil is still possible, we do not expect direct oiling of Gulf sturgeon. However, a spill closer to shore would have the potential to cause heavy oiling and fouling of gills that could kill some individual Gulf sturgeon.

8.8.1.4 Summary of the Effects of Oil Spills

We conclude that oil spills are likely to adversely affect sperm whales, Rice's whales, sea turtles (North Atlantic DPS green, Kemp's ridley, hawksbill, leatherback, and Northwest Atlantic Ocean DPS loggerhead), and Gulf sturgeon. Table 100 summarizes the potential exposure of these species to a very large spill of up to 100,000 bbl, which is reasonably certain to occur over the period of the Oil and Gas Program.

Table 100. Summary of oil spill effects on species for a 100,000 bbl spill

Species	Oil spill exposures based on Downscaled 3% DWH effects
Sperm whale	7.86
Rice's whale	0.75
Kemp's ridley turtle	7,500
Loggerhead turtle	1,794
Green turtle	4,440
Leatherback turtle	0
Hawksbill turtle	257
Hardshell turtle	476

Species	Oil spill exposures based on Downscaled 3% DWH effects
Gulf sturgeon	33

8.8.1.5 Effects of Oil Spill Response Planning

OSRPs are an important planning tool to enable a quick and effective response once oil spills occur. BSEE's preparedness standard operating procedure can be found at https://www.bsee.gov/sites/bsee.gov/files/bsee-sop-approved-2017-edition.pdf. The quantity of oil recovered, chemically dispersed, or burned off during response to a spill varies, but planning for such responses is intended to ensure that adequate equipment and resources are available to be quickly deployed in the event a spill occurs, including a very large spill. In the case of the DWH event, the Oil Budget Calculator Science and Engineering Team of the Federal Interagency Solutions Group (Group 2010), estimated that more than one quarter (29%) of the oil released was naturally or chemically dispersed into Gulf waters. Meanwhile, burning, skimming, and direct recovery from the wellhead removed one quarter (25%) of the oil released. Approximately 17% of the recovered oil was directly recovered from the wellhead and likely had no contact with listed species (Group 2010). Other oil persisted for several days or weeks before being removed with the potential for exposure of animals while it was present in the environment. We do not have other data available on the recovery of oil from deep water blowouts. Removing or dispersing oil as quickly as possible limits the exposure time and could reduce the severity of oiling of some listed species that come into contact with oil, or limit the amount of oil that is transported by wind and currents to locations where species and their habitats are found.

OSRPs could further limit the severity of effects, or avoid oil exposure through wildlife rescue and rehabilitation if adequate planning occurs in advance. As mentioned in section 3.1.5.4, wildlife plans are required of the oil and gas industry and must be approved by BSEE prior to a company conducting any exploration, development, or production on a lease on the OCS.

Our review of OSRPs as part of the 1,100 reviews NMFS conducted as part of the interim procedures (presented in Section 1.1) found wildlife plans associated with individual oil and gas activities consistently do not demonstrate sufficient preparedness to respond to events that require rescue and/or rehabilitation of ESA-listed species. Specifically, during our 1,100 interim procedural reviews of individual Oil and Gas Program activities, we found that OSRPs do not demonstrate adequacy in the following elements:

- Consideration for protecting sea turtles and marine mammals from dispersants, in situ burns, boom deployment, and other response activities;
- Planning with authorized wildlife responders, rehabilitators, and stranding networks;
- Planning for communications with NMFS during a response, specifically regarding impacts to ESA resources;

- Access to local and/or readily available resources to be mobilized during a response to survey for oiled animals, retrieve and transport dead oiled animals, rescue or capture live animals, treat and rehabilitate protected species, and medically sample and complete diagnostics on oiled animals;
- Planning for staging areas to treat animals prior to transport to long-term care facilities; and
- Planning for rapid training and increasing the number of authorized wildlife responders during large spills.

The capability and capacity to locate, capture, and rehabilitate oiled animals, and the ability to immediately access the necessary resources directly influences the health and survival outcome of oiled animals. During the early stages of the DWH response, it quickly became apparent that the sea turtle and marine mammal wildlife response requirements in the applicable OSRP were insufficient given the size of the spill. NMFS worked with agency partners and through the incident command structure to mobilize the necessary resources to conduct turtle rescues, transport of animals, rehabilitation, and release of sea turtles. Of the approximately 456 visibly oiled and 80 not visibly oiled live sea turtles rescued during DWH, nearly 90% were successfully rehabilitated and released, but delays in securing personnel and equipment likely resulted in a number of animals not being recovered.

Because we do not expect the current approach to wildlife plans in OSRPs in the Gulf of America to have sufficient, predictable beneficial outcomes to reduce the impacts to listed species resulting from oil spills, our effects analysis did not reduce anticipated impacts based on the use of OSRP wildlife plans.

9 EFFECTS OF THE ACTION ON CRITICAL HABITAT

In this section, we analyze the effects of the proposed action on the identified PBFs of designated critical habitat for Gulf sturgeon and proposed critical habitat for Rice's whale. Table 101 provides a "roadmap" of our effects determinations for each stressor from an Oil and Gas Program activity and designated and proposed critical habitat for these species for which we determined a stressor may affect the critical habitat.

For each PBF of critical habitat, we assess the likelihood of exposure to and potential impact of stressors, including marine debris and oil and oil dispersants because of the Oil and Gas Program. Releases of trash and debris and oil spills are not part of the Oil and Gas Program because they are not lawful actions. However, we include an analysis of the effects of marine debris and oil spills because we cannot discount the risk that releases of marine debris (Section8.7) and a major spill will occur (Section 8.8) over the period covered in this opinion. We analyze the effects of marine debris and oil spills on proposed critical habitat for Rice's whale.

Table 101. Summary of effects determinations for each activity and critical habitat evaluated

Activity	Gulf Sturgeon	Proposed Rice's Whale	Proposed North Atlantic DPS Green Sea Turtle
HRG, AUV (e.g. other G&G activities producing sound)	--	NLAA	NLAA
Vessel sound and operation	NLAA	LAA	NLAA
NPDES water discharges	NLAA	NLAA	NLAA
Discharge of marine debris	NLAA	NLAA	NLAA
Seismic surveys: airguns, boomers, sparkers	NLAA	LAA	NLAA
Oil spill > 1,000 bbl	NLAA	NLAA	NLAA
Oil spill ≥ 10,000 bbl	LAA	LAA	LAA

9.1 Gulf Sturgeon Critical Habitat

The action area encompasses all seven of the marine and estuarine units of Gulf sturgeon designated critical habitat. For this analysis, we consider the effects on the following PBFs found in the marine and estuarine units of Gulf sturgeon designated critical habitat:

- Abundant food items;
- Water quality necessary for normal behavior, growth, and viability of all life stages;
- Sediment quality necessary for normal behavior, growth, and viability of all life stages; and

Safe and unobstructed migratory pathways necessary for passage within and between riverine, estuarine, and marine habitats.

9.1.1 Effects of Vessel Sound and Operation

While Gulf sturgeon critical habitat units are outside of BOEM's jurisdiction for geophysical activities, vessels associated with the proposed action may briefly transit through Gulf sturgeon critical habitat. The operation of vessels transiting through areas containing Gulf sturgeon critical habitat will not significantly alter water quality, sediment quality or the availability of Gulf sturgeon prey because the vessels will be moving quickly and any effects to critical habitat will be localized and temporary. It is possible that vessel activity may briefly delay sturgeon migration by causing a temporary obstruction to migratory pathways; this effect will be unmeasurable. We believe any effects of vessel activity on Gulf sturgeon designated critical habitat as part of the action are insignificant.

9.1.2 Effects of Seismic Surveys

PBFs of Gulf sturgeon critical habitat that could be affected by seismic sound include abundant food items and unobstructed migratory pathways. The use of seismic airguns may cause significant mortality of zooplankton, including copepods (McCauley et al. 2017), and could include Gulf sturgeon prey. The sound from seismic surveys could create a disturbance that affects the PBFs of migratory pathways.

Seismic surveys conducted under the proposed action will not overlap spatially with Gulf sturgeon critical habitat. The OCS off Mississippi and Alabama begins 5.6 km offshore, and 16.7 km offshore of Florida, meaning surveys will not occur closer than this. The Gulf sturgeon critical habitat in Florida is adjacent to the EPA, where seismic activity from the Oil and Gas Program is largely absent (89 FR 31488). Because of this, we do not expect effects to Gulf sturgeon critical habitat in Florida. Depending on different factors (e.g., size of the source array, water depth), sound fields from the seismic survey can extend far distances (e.g., several kilometers or more). Therefore, although the seismic surveys will not occur in areas overlapping with Gulf sturgeon critical habitat, under certain scenarios, the resulting sound field could extend into the critical habitat off Mississippi and Alabama in particular. As described for loggerhead nearshore critical habitat (Section 6.1.3), there will be large array, 3-D seismic activity in Zone 2. These arrays are typically used to survey the deeper waters (>200 m) in that zone, and thus would occur further from shore. Therefore, we expect any temporary noise from the survey will diminish before reaching the Gulf sturgeon critical habitat to the point any effects from sound on the PBFs of migratory pathways are so small as to not be meaningfully measured, and, thus, insignificant. Similarly, as described for loggerhead critical habitat, because of the short-term impacts and high turnover rate of zooplankton, the effects from seismic survey sound on food resources of Gulf sturgeon critical habitat are so small as to not be meaningfully measured, and, thus, insignificant.

9.1.3 Effects of Water Discharges

Water discharges resulting from the proposed action could affect Gulf sturgeon PBFs of abundant food items, water quality, and sediment quality. Fuel and oil leaks, as well as the discharge of gray water and wastewater (containing pollutants) from the vessels associated with the Oil and Gas Program can degrade habitat for marine life. Hydrocarbons also affect prey populations and, therefore, may affect the PBFs of Gulf sturgeon critical habitat.

Gulf sturgeon critical habitat includes rivers, bays, and marine areas close to shore and outside the action area. Water discharges from action-associated vessels transiting through the critical habitat are possible but will be ephemeral. Water discharges originating from locations or activities occurring offshore are less likely to enter Gulf sturgeon critical habitat given the distance and expected dilution of the discharges.

All NPDES-regulated discharges must meet requirements for acceptable toxicity levels and other restrictions set forth in the permit, which are intended to protect all aquatic life. Such treated

discharges will quickly dilute and disperse in the vast receiving waters. Regulated discharges require limitations on the type, amount and toxicity of pollutants in waste streams. Because of the adherence to the standard procedures, applicable laws, and permit requirements, the large size of the action area, the distance to critical habitat offshore water discharges, the dilution of discharges, and oceanographic conditions that promote mixing, the PBFs of Gulf sturgeon critical habitat are not likely to be exposed to concentrations of discharges that could lead to measurable responses. We find the risks from this stressor to be immeasurably small on Gulf sturgeon critical habitat, and, thus, insignificant.

9.1.4 Effects of Marine Debris

Gulf sturgeon critical habitat includes rivers, bays, and marine areas close to shore and outside the action area. Most oil and gas-related debris is expected to sink or be transported into current convergence zones and remain in deeper water, and due to the presence of barrier islands on the seaward side of several marine and estuarine areas of critical habitat serve to prevent the transport of marine debris from Oil and Gas Program-related activities to areas containing the PBFs of Gulf sturgeon critical habitat. Therefore, it is extremely unlikely and, thus, discountable marine debris from the Oil and Gas Program will reach coastal areas containing the PBFs of Gulf sturgeon critical habitat.

9.1.5 Effects of Oil Spills

In addition to the effects of oil exposure on individual Gulf sturgeon (see Section 8.8.1.3), oil spills may affect Gulf sturgeon critical habitat within the action area.

BOEM oil and gas leasing areas do not overlap directly with Gulf sturgeon critical habitat. For critical habitat to be affected by an oil spill, oil from OCS sources would have to be transported to nearshore waters by wind and currents. Because of the distance, smaller offshore spills (i.e., < 1,000 bbl) are not expected to reach to the nearshore areas containing Gulf sturgeon critical habitat. However, this does not necessarily apply to larger spills, and we discuss the possible effects of exposure to oil from a larger spill below.

BOEM estimates a less than 0.5% percent chance, depending on location, of an offshore oil spill contacting areas with designated Gulf sturgeon marine habitat within 10 and 30 days based on a spill size greater than 1,000 bbl (Ji and Schiff 2023). Larger spills (i.e., > 10,000 bbl) have a higher risk of impacting coastal waters, depending on many factors such as the buoyancy of the spilled fluid, distance from the spill, currents, and duration of the spill. Almost all types of nearshore ecosystem habitats in the northern Gulf of America were oiled and impacted because of the DWH oil spill, including shallow unvegetated habitats utilized by Gulf sturgeon. Oil was observed on more than 1,300 mi (2,113 km) of shoreline from Texas to Florida (Trustees 2016). Based on the DWH damage assessment and BOEM's estimate, it is possible Gulf sturgeon critical habitat would be exposed to an oil spill resulting from Oil and Gas Program activities, particularly if the spill is at least 10,000 bbl.

PBFs of Gulf sturgeon critical habitat, including abundant benthic prey and sediment quality and water quality, could be exposed to oil from a larger oil spill originating offshore. Dissolved oil in the water column, sunken oil, and oil that remains in sediments could all negatively affect Gulf sturgeon critical habitat. Diluted oil would be available for the duration of the spill, whereas sunken oil would persist for longer periods. Some proportion of buoyant oil typically reaches sediments after a spill, leading to exposure and contamination of zooplankton, benthic invertebrates, and benthic fish (Teal and Howarth 1984). Because oil can persist in sediments for some time after a spill has occurred, prey can be exposed to oil through exposure to contaminated sediment. Oil contamination often results in decreased abundance and diversity of benthic communities. Many benthic animals ingest sediment routinely as part of their normal feeding behavior and as part of burrowing into and reworking sediments, a process known as bioturbation. Unusually low tidal events, increased wave energy, and the use of oil dispersants can increase the risk of impact to bottom-feeding and/or bottom-dwelling fauna (NMFS 2007).

Because oil can persist in sediments for some time after a spill has occurred, prey can be exposed to oil through exposure to contaminated sediment although offshore spills, in general, are expected to have a smaller impact on Gulf sturgeon critical habitat because much of the critical habitat is protected by barrier islands, shoals, shorelines, and currents (NMFS 2007). Oil that does reach nearshore environments occupied by Gulf sturgeon will be diluted and in lower concentrations compared to thicker, more concentrated oil in offshore areas closer to the spill source. Damage assessment studies conducted after the DWH oil spill found that exposure of the vast majority of soft-bottom benthos along the continental shelf to spill-related constituents appeared to be relatively low (Trustees 2016). In addition, oil disperses more with time, and the weathering and consolidation of oil with sediments and other materials causes the properties of the oil to change, thus reducing the potential adverse effects to benthic organisms.

Based on BOEM's estimate of a less than 0.5% percent chance of an offshore oil spill contacting portions of designated Gulf sturgeon marine habitat for a spill size greater than 1,000 bbl (Ji and Schiff 2023) and, given that non-blowout-related spills have occurred in the action that are larger than 10,000 bbl (Table 89), we believe there is a possibility of oil spills associated with Oil and Gas Program activities adversely affecting the PBFs of Gulf sturgeon critical habitat.

In the event of a nearshore subsea pipeline rupture and spill, there would be a higher likelihood of Gulf sturgeon critical habitat being affected by more toxic (less weathered) oil. The Pearl and Pascagoula river areas in critical habitat unit 8 are the most likely to be affected based on the areas where pipelines make landfall. Should a pipeline rupture occur because of the Oil and Gas Program, it is likely to require a response and that response is a federal action for which an ESA section 7 consultation with NMFS will be conducted.

9.1.6 Summary of Effects on Designated Critical Habitat for Gulf Sturgeon

We examined the effects of vessel sound and operation, seismic surveys, water discharges, marine debris, and oil spills and spill response on the designated critical habitat for Gulf sturgeon

for each of the PBFs: abundant food items, and migratory pathways. For the stressors of vessel sound and operation, seismic surveys, and water discharges, we found that these effects will be insignificant on PBFs of the designated critical habitat. For the stressor of marine debris, we found that the effects will be discountable on PBFs of Gulf sturgeon critical habitat. Therefore, the effects of the Oil and Gas Program are not likely to adversely affect designated Gulf sturgeon critical habitat.

In our analysis of the effects of oil spills, we found this stressor will result in adverse effects to the PBFs of abundant food resources, sediment quality, and water quality. Any spill that occurs because of the Oil and Gas Program is likely to require a Federal response and that response is a Federal action for which an ESA section 7 consultation with NMFS will be conducted.

9.2 Proposed Rice's Whale Critical Habitat

NMFS proposed the designation of critical habitat for the Rice's whale on July 24, 2023. Rice's whale proposed critical habitat encompasses the area ranging from the 100 to 400 m isobaths in U.S. waters in the Gulf of America. Based on the best scientific information available, NMFS identified the following feature as being essential to the conservation of the Rice's whale: Gulf of America continental shelf and slope associated waters between the 100 and 400 m isobaths that support individual growth, reproduction, and development, social behavior, and overall population growth. The following attributes of this feature support Rice's whales' ability to forage, develop, communicate, reproduce, rear calves, and migrate throughout the Gulf of America continental shelf and slope waters and may be affected by stressors from Oil and Gas Program activities:

- Sufficient density, quality, abundance, and accessibility of small demersal and vertically migrating prey species, including scombriformes, stomiiformes, myctophiformes, and myopsida;
- Marine water with (i) elevated productivity, (ii) bottom temperatures of 10-19°C (50 to 66°F), and (iii) levels of pollutants that do not preclude or inhibit any demographic function; and
- Marine soundscape that supports occupancy and use (e.g., intraspecific communications, navigation, and detection of prey and predators) over biologically relevant time periods (e.g., hours to days).

9.2.1 Effects of Vessel Sound and Operation

We consider the effects of the Oil and Gas Program-related vessel sound and operation on the PBF of the Rice's whale marine soundscape.

Because Rice's whales vocalize at frequencies between 60 and 160 Hz, elevation of ambient noise in the low frequency range (between 10 and 1,000 Hz) is likely to adversely affect Rice's whales' acoustic soundscape and use of their habitat. Noises that impair the marine soundscape that supports use and occupancy of the habitat are those that inhibit Rice's whales' ability to

receive and interpret sound for the purposes of navigation, communication, foraging, and detection of predators, and other threats over biologically relevant periods (e.g., hours to days).

Of particular concern are anthropogenic noise sources that are of long duration, chronic, recurrent, and/or persistent, and cumulatively inhibit and/or mask an animal's ability to receive and interpret sound (e.g., opportunities to forage or reproduce). The range over which conspecifics can detect one another—communication space—can be impacted by anthropogenic noise from vessel activity, especially if anthropogenic noise exceeds the ambient sound of the environment. One study in New Zealand showed that routine vessel transit and the accompanying noise reduced communication space for Bryde's whales by up to 87.4% (Putland et al. 2018). Sounds emitted by large vessels are low frequency, continuous, or tonal, and sound pressure levels at a source will vary according to speed, burden, capacity, and length (Kipple and Gabriele 2007; McKenna et al. 2012; Richardson et al. 1995a).

In order to significantly degrade the marine soundscape PBF, anthropogenic noise would need to, either alone or combined with other noises, significantly raise sound levels over a significant portion of an area (in terms of size and use by the whales) on a prolonged basis (e.g., months to years).

Based on the AIS data used in our vessel strike analysis (Section 8.4), the mean percentage of oil and gas vessel traffic was 46% of all vessel traffic from 2015-2023 (ranging from 41-49% each year over that time period). Vessels associated with oil and gas activities comprising this traffic include service vessels, barges, tankers and G&G survey vessels. This vessel activity amounts to thousands of transits annually in and through the proposed critical habitat for Rice's whale over the next 45 years. Vessel noise is common within the proposed critical habitat for Rice's whale (Soldevilla et al. 2022a). As such, the effects to the PBF from vessel sound and operation associated with the Oil and Gas Program are characterized as long lasting, chronic, recurrent, and persistent.

Chronic noise has been shown to cause elevated stress levels in North Atlantic right whales (Rolland et al. 2012), and noise from shipping noise can be region-wide, likely degrading the acoustic environment for whales (Redfern et al. 2017). Because the vessel noise will be long lasting, chronic, and persistent, and the sound levels are such that they may prevent intraspecific communications, it is possible occupancy use of the proposed critical habitat will be affected. Therefore, we determine the elevated noise levels from vessel activity associated with the Oil and Gas Program is likely to adversely affect the proposed Rice's whale critical habitat.

9.2.2 Effects of Sound from HRG Surveys

As discussed previously, the action includes HRG surveys that may use other sound sources, such as sub-bottom profilers (at 2.5-7 kHz), echosounders (single-beam at 12-240 kHz; multibeam at 50-400 kHz), CHIRP sub-bottom profiler (at 4-24 kHz), pingers (at 2 kHz), and side-scan sonars (16-1,500 kHz). These devices are "deep-towed" just above the seafloor, and attached to cables that can be up to 7 km long. Similar sound sources are also present on AUVs.

Surveys and AUV activity using these sound sources will operate within the proposed critical habitat for Rice's whale. In our analysis, we examine the effects of these sound sources on the PBFs of (1) sufficient density, quality, abundance, and accessibility of small demersal and vertically migrating prey species, and (2) marine soundscape that supports occupancy and use. We do not expect HRG sounds to have any effect on the marine water temperature, productivity, or pollutant PBF.

9.2.2.1 Effects to Prey Species

While HRG sound sources could disperse Rice's whale prey species, the impact is anticipated to be extremely localized, temporary, and of short duration (only occurring during ensonification or activity duration, with a return to normal conditions after the activity has ceased in an area) and of negligible magnitude (in terms of area size and proportion of available forage). It is highly unlikely that mortality or injury will occur from the activity's active acoustic sources because most of the active acoustic sources used during the proposed action are outside of the hearing range of Rice's whale prey species.

Cephalopods (like myopsida squid) are thought to possess low-frequency hearing, showing sensitivities to sounds between 1 and 100 Hz (Packard et al. 1990). The vast majority of fish species studied cannot hear sounds above 0.5 to 1.5 kHz (BOEM 2014a). Direct injury from active acoustics is highly unlikely because injury is not documented in fish exposed to these sound sources based on several studies(Halvorsen et al. 2013; Halvorsen et al. 2012c; Popper et al. 2007). We are not aware of any studies documenting direct injury from HRG sound sources for squid species. The HRG sound sources are outside the functional hearing range of fishes and squids. Therefore, fishes and squids that are prey species for Rice's whale are not expected to detect or respond to sounds emitted by sources used in the Oil and Gas Program. Due to this, we believe it is unlikely that the density, quality, abundance, and accessibility of prey species would be measurably affected. Any impacts would be brief, lasting as long as the HRG sound source is in the immediate vicinity, and would not measurably alter the density, quality, abundance, or accessibility of prey. Thus, any HRG sounds that do occur will have insignificant effects on the PBF of prey species.

9.2.2.2 Effects to Marine Soundscape

As discussed previously (Section 8.2.1), HRG sound sources, including sub-bottom profilers, single-beam echosounders, CHIRP sub-bottom profilers, pingers, and side-scan sonars, are within the Rice's whale hearing range. Rice's whales vocalize at frequencies between 60 and 160 Hz. Elevation of ambient noise in the low frequency range (between 10 and 1,000 Hz) is likely to adversely affect Rice's whales' acoustic soundscape and use of their habitat.

HRG sound sources are be towed close to the seafloor, and are a mobile sound source. The location of the sound source near the ocean bottom, while Rice's whale predominantly use the water column, likely limits the amount of overlap between the Rice's whale habitat use and the HRG sound. Any ensonification of the habitat will be brief and result in temporary avoidance of

the area with underwater noise louder than the behavioral harassment threshold, which is a reaction that is considered to be of low severity and with no lasting biological consequences (Southall et al. 2007). We do not expect that a brief exposure of the PBF of marine soundscape would significantly alter the functionality of the proposed habitat. Any impacts would last only as long as the HRG sound source was in the immediate vicinity of proposed critical habitat and the effects are expected to be too small to be meaningfully measured. Therefore, HRG sounds will have insignificant effects on the PBF of marine soundscape conditions that support occupancy and use.

9.2.3 Effects of Seismic Surveys

Here, we evaluate how seismic surveys using airguns, boomers, and sparkers, can affect the PBFs of (1) density, quality, abundance, and accessibility of small demersal and vertically migrating prey species, and (2) marine soundscape that supports occupancy and use.

Airguns, boomers, and sparkers are the seismic sources used in the Oil and Gas Program, and these surveys will occur within the proposed critical habitat for Rice's whale. As we discussed earlier, because they use a higher source level and create a larger sound field, we consider airguns to pose a greater potential impact to the PBFs of the proposed critical habitat. In addition, because airguns are commonly used, there is more information available on the effects of airguns on the environment. In the absence of more specific information on boomers and sparkers, we assume that, because of the sound source characteristics, the degree of effects will be smaller in magnitude than for airguns. There are relatively few survey days projected for surveys using boomer or shallow hazards (2-3 days annually) as part of the Oil and Gas Program, so our analysis focuses on seismic airgun surveys.

9.2.3.1 Effects to Prey Species

Seismic surveys may have effects on the proposed Rice's whale critical habitat by affecting the PBF of prey species through lethal or sub-lethal damage, stress responses, or alterations in their behavior or distribution in response to exposure to sounds from the surveys. Small demersal and vertically migrating prey species for Rice's whale include fishes (scombriformes, stomiiformes, and myctophiformes), and squid (myopsida).

In a review, Carroll et al. (2017) summarized the available information on the impact seismic surveys have on fishes and invertebrates. In many cases, species-specific information on the prey of Rice's whales is not available. Until more information specific to Rice's whale prey is available, we assume the prey of Rice's whales respond to sound from airgun operation in a similar manner to the fishes and invertebrates described in this opinion.

It is possible that seismic surveys can cause physical and physiological responses, including direct mortality, in fishes and invertebrates. In fishes, such responses appear to be highly variable, and depend on the nature of the exposure to seismic survey activities, as well as the species in question. Current data indicate that possible physical and physiological responses include hearing threshold shifts, barotraumatic ruptures, stress responses, organ damage, and/or

mortality. For invertebrates, research is more limited, but the available data suggest that exposure to sound from airguns used in seismic survey activities can result in anatomical damage and mortality in some cases.

Some evidence exists showing fish mortality resulting from exposure to airguns, indicating it is limited to close-range exposure to high amplitudes. Lethal effects, if any, are expected within a few meters of the airgun array(Buchanan et al. 2004; Dalen and Knutsen 1986a). We expect that, if fish detect the sound and perceive it as a threat or some other signal that induces them to leave the area, they are capable of moving away from the sound source (e.g., airgun array) if it causes them discomfort. We also expect they will return to the area after the sound source is gone and be available as prey.

There are reports showing sublethal effects to some fish species from airgun arrays, such as injury, especially at close distances (Booman et al. 1996; McCauley et al. 2003), and hearing loss with recovery within one day (Hastings and Popper 2005b). Exposure to airguns at close range were found to produce balance issues in exposed fry (Dalen and Knutsen 1986b). Exposure of monkfish (*Lophius* spp.) and capelin (*Mallotus villosus*) eggs at close range to airguns did not produce differences in mortality compared to control groups (Payne 2009). Salmonid swim bladders were reportedly damaged by received sound levels of approximately 230 dB re: 1 µPa (Falk and Lawrence 1973). McCauley et al. (2000a; 2000b) found small fish show startle responses at lower exposure levels than larger fish in a variety of fish species, and generally observed responses at received sound levels of 156 to 161 dB re: 1 µPa (rms), although responses tended to decrease over time suggesting habituation.

Squid responses to operating airguns have been studied, although to a lesser extent than fishes. In response to airgun exposure, squid exhibited both startle and avoidance responses at received sound levels of 174 dB re: 1 µPa (rms) by first ejecting ink and then moving rapidly away from the area (Fewtrell 2013; McCauley et al. 2000b; McCauley et al. 2000c). Mohl (1983) observed lethal effects in squid (*Loligo vulgaris*) at levels of 246 to 252 dB after three to 11 minutes. Guerra et al. (2004) suggested that giant squid mortalities were assocpiated with seismic surveys based upon coincidence of carcasses with the seismic surveys in time and space, as well as pathological information from the carcasses.

The overall behavioral response of fishes and squid to exposure to airgun noise is to exhibit startle responses and undergo vertical and horizontal movements away from the sound field. While lethal effects for fishes and squid have been observed, those effects are at close range. We expect fishes and squid to move away from the seismic sound source, but, given the large ensonified area created by the airguns, and the hundreds of expected survey days in the action area overlapping with the proposed critical habitat, moving away to avoid the sound may not be possible. Because the sound from seismic surveys may cause detrimental effects to the density, quality, abundance, and accessibility of small demersal and vertically migrating prey species, we determine that this stressor is likely to adversely affect Rice’s whale proposed critical habitat.

9.2.3.2 Effects to Marine Soundscape

Rice's whales vocalize at frequencies between 60 and 160 Hz, and hear between 7 Hz and 35 kHz, and seismic airguns are a low frequency sound that overlaps with these ranges (15-60 Hz). Annually, over the duration of the LOA, hundreds of seismic survey days are projected in Zones 2, 5, and 6, overlapping with the proposed critical habitat (Table 1; 89 FR 31488). Noise sources that are long duration, chronic, recurrent, and/or persistent may cumulatively inhibit and/or mask the animals' ability to receive and interpret sound (e.g., opportunities to forage or reproduce). As such, the effects to the PBF from seismic surveys is characterized as recurrent and persistent. Because this sound occurs in the low frequency range, and given the amount and duration of seismic activity, this will likely have detrimental effects to Rice's whale intraspecific communications, navigation, and detection of prey and predators over biologically relevant periods (e.g., hours to days). We determine that this stressor is likely to adversely affect Rice's whale proposed critical habitat.

9.2.4 Effects of Water Discharges

Water discharges could have effects on the prey resources PBF by impacting the density, quality, abundance, and accessibility of small demersal and vertically migrating prey species. Water discharges could also affect the other PBF of the proposed critical habitat by changing the productivity, bottom temperatures, or levels of pollutants. Water discharges will not affect the soundscape PBF.

The proposed critical habitat within the 100-400m isobath overlaps with oil and gas platforms and structures that discharge water. The proposed critical habitat will be regularly transited by vessels associated with the action that will also be a source for water discharges. Discharges are regulated, as discussed previously, and are expected to quickly dilute and disperse in the vast receiving waters of the action area. Any changes to water temperature caused by the water discharge will quickly dissipate as in the large receiving water area, so bottom temperature will not be affected. We expect dilution to be such that the effects of pollutants/discharges in the Rice's whale proposed critical habitat will be so small as to be unmeasurable and, therefore, insignificant. Depending on the contents of the water discharge, there could be components that affect nitrogen or phosphorous in the water, thus affecting productivity. However, we expect such discharges would be so diluted that they would only cause an immeasurably small effect, and, therefore, be insignificant.

9.2.5 Effects of Marine Debris

We do not expect releases of marine debris to lead to effects to marine water temperature, productivity, or the soundscape.

As part of the breakdown process for plastic and other marine debris, chemicals could leach into the environment, affecting the PBF associated with pollutant levels. There could also be adverse effects to prey if fishes and squid consume the microplastics from the degradation of materials in the marine debris. Nearly all of microplastic ingestion occurs through trophic transfer, but the

effects of exposure are largely unknown. There are some concerns that the ingestion of microplastics may reduce the energetic quality of the prey (Kahane-Rapport et al. 2022), but this has not been studied extensively or quantified. Research has shown that fish and squid consume microplastics, which were found in the stomach of Atlantic chub mackerel (*Scomber colias*) and the stomach, gills, and ink sac of three pelagic squid species. Average concentrations of phthalate esters were also found in specimens' tissue (Sambolino et al. 2023).

While it is possible there could be effects to the prey resources PBF from the stressor of marine debris through microplastic ingestion, we do not believe it would affect the density, quality, abundance, and accessibility of the prey species. Any effects, if present, would be too small to be measured, and, thus, insignificant on the PBF of sufficient density, quality, abundance, and accessibility of small demersal and vertically migrating prey species.

9.2.6 Effects of Oil Spills

Oil spills may affect Rice's whale proposed critical habitat within the action area. For this analysis, we consider the effects of oil spills on the PBF of marine waters with levels of pollutants that do not preclude or inhibit any demographic function. An oil spill causes elevated levels of pollutants. It is thought the DWH oil spill caused a decline of up to 22% of the Rice's whale population due, at least in part, to benthic communities and prey species being affected by oil and oil dispersant mixtures used in spill response (Trustees 2016).

As such, oil spills resulting from the Oil and Gas Program would have detrimental effects on the ability of the PBF to support demographic functions such as reproduction, feeding, and survival. We determine that oil spills associated with the Oil and Gas Program will likely adversely affect the marine waters PBF of proposed critical habitat for Rice's whale.

9.2.7 Summary of Effects on Proposed Critical Habitat for Rice's Whale

We examined the effects of vessel sound and operation, sounds from HRG surveys, seismic surveys, water discharges, marine debris, and oil spills on the proposed critical habitat for Rice's whale for each of the PBFs: sufficient density, quality, abundance and accessibility of prey species, marine water conditions, and marine soundscape conditions that support occupancy and use.

For the stressors from HRG surveys, marine debris, and water discharges, we found the effects of these stressors will be insignificant to the PBFs of the proposed Rice's whale critical habitat. In our analysis of the effects of vessel sound, we found this stressor will have adverse effects to the PBF of the marine soundscape conditions that support occupancy and use. In our analysis of the effects of seismic surveys, we found this stressor will have adverse effects to the PBFs of sufficient density, quality, abundance and accessibility of prey species and marine soundscape conditions that support occupancy and use. Therefore, the effects of the Oil and Gas Program are likely to adversely affect proposed critical habitat for Rice's whale.

In our analysis of the effects of oil spills, we found that this stressor will result in adverse effects to the PBF of marine water conditions with levels of pollutants that do not preclude or inhibit any demographic function. Any spill that occurs because of the Oil and Gas Program and requires a Federal response is a Federal action for which an ESA section 7 consultation with NMFS will be conducted.

9.3 Proposed North Atlantic DPS Green Sea Turtle Critical Habitat

North Atlantic DPS of green turtle proposed critical habitat includes the following PBFs essential to the conservation of the DPS that may be affected by stressors from the Oil and Gas Program:

- Reproductive: From the mean high water line to 20 m depth, sufficiently dark and unobstructed nearshore waters adjacent to nesting beaches designated as critical habitat by USFWS, to allow for the transit, mating, and internesting of reproductive individuals and the transit of post-hatchlings.
- Migratory: From the mean high water line to 20 m depth, sufficiently unobstructed waters that allow for unrestricted transit of reproductive individuals between benthic foraging/resting and reproductive areas.
- Benthic foraging/resting: From the mean high water line to 20 m depth, underwater refugia and food resources (i.e., seagrasses, macroalgae, and/or invertebrates) of sufficient condition, distribution, diversity, abundance, and density necessary to support survival, development, growth, and/or reproduction.
- Surface-pelagic foraging/resting ("*Sargassum*"): Convergence zones, frontal zones, surface-water down-welling areas, the margins of major boundary currents, and other areas that result in concentrated components of the Sargassum-dominated drift community, as well as the currents which carry turtles to Sargassum-dominated drift communities, which provide sufficient food resources and refugia to support the survival, growth, and development of post-hatchlings and surface-pelagic juveniles, and which are located in sufficient water depth (at least 10 m) to ensure offshore transport via ocean currents to areas which meet forage and refugia requirements (NMFS 2023b).

9.3.1 Effects of Vessel Sound and Operation

The proposed green turtle critical habitat migratory, reproductive, and benthic units are outside BOEM's jurisdiction for leasing and geophysical activities, although vessels associated with the Oil and Gas Program may transit through these areas. Vessel sound and operation will not affect benthic food resources or underwater refugia because the vessels travel at the water's surface and do not impact the benthos, and any transit is temporary in duration. The vessel operation, transit, and associated sound may present temporary obstructions in the migratory and reproductive units, but any potential effects to the proposed critical habitat features will localized with no

lasting or measurable effects over extended periods. Therefore, any effects of vessel activity on green turtle migratory, reproductive, and benthic proposed critical habitat units associated with the Oil and Gas Program will be insignificant.

Vessel activity as part of the Oil and Gas Program could overlap with the proposed green turtle surface-pelagic foraging/resting ("*Sargassum*") unit. As discussed elsewhere in this opinion, we anticipate vessel operators will actively avoid *Sargassum* patches within the action area to minimize detrimental impacts on vessel operation from *Sargassum*. Some vessels may still come in direct contact with *Sargassum,* temporarily disturbing the biotic community (including available food resources and refugia for oceanic juveniles and post-hatchlings). However, such disturbances are likely to be very short, cover a relatively small area, and result in no lasting measurable detrimental effect on the affected *Sargassum* community. Therefore, any effects of vessel activity on the green turtle *Sargassum* proposed critical habitat unit associated with the Oil and Gas Program are insignificant.

9.3.2 Effects of Sounds from HRG Surveys

As discussed previously, the Oil and Gas Program activities include HRG surveys and AUVs that use sound-producing devices like sub-bottom profilers, single-beam and multibeam echosounders, side-scan sonar, and pingers. The proposed green sea turtle North Atlantic DPS critical habitat migratory, reproductive, and benthic units are outside BOEM's jurisdiction for leasing and geophysical activities, so these areas will not be affected by sounds from HRG surveys, including those using AUVs. HRG surveys using these sound sources may operate in or near *Sargassum* patches, potentially affecting the PBF of prey abundance. However, as discussed previously, invertebrate prey species exposed to the high frequency surveying devices are expected to be unaffected. In addition, the location of operation of these sound sources and their orientation limits the possible exposure of prey within the *Sargassum* patches at the ocean's surface to these high-frequency sound sources. Because of the low likelihood of exposure to the sound sources used during high-resolution geophysical surveys and the expected low likelihood of measurable effects to prey species in *Sargassum* should they be exposed to these sounds, we find the effects to the PBF of prey abundance in *Sargassum* patches to be insignificant.

9.3.3 Effects of Seismic Surveys

Seismic surveys conducted as part of the Oil and Gas Program activities will not overlap spatially with North Atlantic DPS green sea turtle migratory, reproductive, or benthic proposed critical habitat units. Seismic surveys will take place within the proposed *Sargassum* critical habitat for green turtles. Specifically, the food resources (i.e., invertebrate prey) PBF of this unit may be affected. Green turtles consume a variety of marine invertebrates when in *Sargassum* patches, including hydroids, gastropods, and polychaetes (Witherington et al. 2012). Because the consumption of zooplankton and prey resources in *Sargassum* part of the PBFs for Northwest Atlantic DPS loggerhead sea turtle, the effects analysis for seismic survey sound in Section 6.1.3 also applies to the PBFs proposed for North Atlantic DPS green sea turtle critical habitat. We

adopt that analysis here and find that sound from seismic surveys may affect but is not likely to adversely affect North Atlantic DPS of green turtle proposed critical habitat.

9.3.4 Effects of Water Discharges

Migratory, reproductive, and benthic proposed critical habitat units for North Atlantic DPS green sea turtle do not overlap with areas that could be affected by offshore water discharges. Discharges from offshore oil and gas structures are expected to treated or diluted to such levels as to dissipate and be immeasurably small if and when they reach nearshore waters where these units are located (i.e., up to 20 m deep). Therefore, we determine the effects of water discharges to migratory, reproductive, and benthic proposed critical habitat for green sea turtle are insignificant.

Water discharges could occur offshore within *Sargassum* habitat but treated discharges are expected to quickly dilute and disperse in the vast receiving waters. There have been no reported measurable adverse environmental impacts resulting from the discharges from oil or gas platforms that are part of the Oil and Gas Program within the action area, and no reported adverse effects to NMFS' protected resources. While it is possible that North Atlantic DPS green sea turtles proposed *Sargassum* critical habitat could overlap areas where there are discharges, we expect dilution to be such that discharges reaching *Sargassum* patches will be so small as to be unmeasurable and, therefore, insignificant.

9.3.5 Effects of Marine Debris

We believe it is extremely unlikely marine debris lost offshore as part of Oil and Gas Program activities will be transported to nearshore coastal areas where the migratory, reproductive, and benthic proposed critical habitat areas for North Atlantic DPS green sea turtle are located. Therefore, the effects of marine debris on the migratory, reproductive, and benthic proposed critical habitat areas for green turtle are discountable.

It is possible that floating marine debris (e.g., plastic and wood) from oil and gas operations could be entangled in *Sargassum*. However, any effects of marine debris on the PBFs of proposed *Sargassum* critical habitat, including available green sea turtle prey, given the size of the available proposed *Sargassum* critical habitat in the action, are expected to be so minimal as to be unmeasurable, and, thus, insignificant.

9.3.6 Effects of Oil Spills

Oil spills may affect the proposed critical habitat for North Atlantic DPS green sea turtles. Post-hatchlings and surface-pelagic juvenile green turtles congregate around *Sargassum* patches, caused by convergence zones and other oceanographic features, for food and shelter. Oil, tar, and dispersants accumulate in these same convergence zones, meaning that oil spills can severely degrade these areas, causing zooplankton die-offs and *Sargassum* mats to sink (Fisher et al. 2016). Oil spills reaching the coastal environment (e.g., within 15 km of the coast) can negatively impact the abundance and species composition of planktonic communities for up to a

year (Murawski et al. 2016), potentially affecting the prey available to green sea turtles that are part of food resources associated with the benthic area unit of proposed critical habitat.

Offshore oil spills from activities associated with the Oil and Gas Program could affect the nearshore environment (i.e., mean high water line to 20 m deep), where the proposed reproductive, migratory, and benthic units of critical habitat for North Atlantic DPS green sea turtle are present based on the analysis by Ji and Schiff (2023). The analysis concluded there is a less than 0.5% percent chance of an offshore oil spill contacting areas containing Gulf sturgeon marine habitat, which overlap with some of the proposed North Atlantic DPS green sea turtle critical habitat, based on a spill size of greater than 1,000 bbl. Oil spills smaller than this range are not a concern for these proposed critical habitat units because the offshore activities likely to cause spills do not overlap with these units and oil from these spills usually dilutes over the course of a day. A larger oil spill of sufficient volume and duration could reach these proposed critical habitat units. The PBFs of the proposed reproductive and migratory habitat units could be affected by the oil itself, presenting an obstruction restricting transit through the migratory corridor and access to nesting beaches, although we expect these effects to be temporary.

The DWH oil spill caused reductions to planktonic communities along the coast for up to a year (Murawski et al. 2016). As described in Section 9.1.5 for Gulf sturgeon critical habitat PBFs, oil spills can affect the benthic community, which would affect the prey PBF of proposed North Atlantic DPS green sea turtle critical habitat. We determine that effects from oil spills are likely to adversely affect proposed benthic, reproductive, and migratory critical habitat units for North Atlantic DPS of green sea turtle.

Oil spills could overlap with the proposed surface-pelagic foraging/resting critical habitat unit in the Gulf of America from 10 m deep to the boundary of the U.S. EEZ, or roughly 707,832 km^2. The surface-pelagic foraging/resting PBF includes convergence zones and other oceanographic conditions that result in "concentrated components of the *Sargassum*-dominated drift community…which provide sufficient food resources and refugia to support the survival, growth, and development of post-hatchlings and surface-pelagic juveniles…" Because this proposed critical habitat unit shares the characteristics of the Northwest Atlantic DPS loggerhead sea turtle designated critical habitat, the analysis of effects of oil spills described in Section 6.1.3 applies to the proposed surface-pelagic foraging/resting critical habitat unit. We anticipate the ephemeral nature and annual cycle of rapid growth, movement, and subsequent die-off will allow *Sargassum* to repopulate quickly if patches are exposed to oil from the anticipated numerous offshore oil spills during the Oil and Gas Program. Because of this, and because catastrophic spills are not reasonably certain to occur, we believe effects to the proposed surface-pelagic foraging/resting critical habitat unit, including the PBF of prey, will be temporary in any patches exposed to oil and too small to measure on the scale of this unit in the Gulf. Therefore, the effects to the surface-pelagic foraging/resting proposed critical habitat unit of North Atlantic DPS green sea turtle of oil spills of the size likely to occur over the period of the Oil and Gas Program considered in this opinion are insignificant.

In summary, we determined that North Atlantic DPS green sea turtle proposed critical habitat is likely to be adversely affected by the Oil and Gas Program because of the potential for adverse effects of oil spills to the benthic, reproductive, and migratory critical habitat units.

9.3.7 Summary of Effects on Proposed Critical Habitat for North Atlantic DPS of Green Sea Turtle

We examined the effects of vessel sound and operation, HRG surveys, seismic surveys, water discharges, marine debris, and oil spills on the proposed critical habitat for North Atlantic DPS green turtle for the PBFs in the following units: reproductive, migratory, benthic foraging/resting, and surface-pelagic foraging/resting (*Sargassum*). For the stressors of vessel sound and operation, seismic surveys, and water discharges, we found the effects will be insignificant for all PBFs of the proposed critical habitat. For the stressor of marine debris, we found that the effects will be discountable on the proposed migratory, reproductive, and benthic critical habitat units, and insignificant on the proposed *Sargassum* unit. For the stressor of sound from HRG surveys, we found that the effects will be discountable on the proposed *Sargassum* unit. Therefore, the effects of the Oil and Gas Program are not likely to adversely affect proposed North Atlantic DPS green sea turtle critical habitat.

In our analysis of the effects of oil spills, we found this stressor will result in adverse effects to the PBFs of the proposed reproductive, migratory, and benthic foraging/resting critical habitat units. Any spill that occurs because of the Oil and Gas Program and requires a Federal response, which is a Federal action, will require an ESA section 7 consultation be conducted with NMFS.

10 CUMULATIVE EFFECTS

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

During this consultation, we searched for information on future state, tribal, local, or private (non-federal) actions reasonably certain to occur in the action area. We did not find any information about non-federal actions other than actions already described in the Environmental Baseline (Section 7), which we expect will continue in the future. Non-federal activities anticipated to continue into the future include commercial and recreational fishing, vessel traffic, oil and gas activities, scientific research, ocean sound, and pollution. An increase in these activities could similarly increase their effect on ESA-listed resources and for some, an increase in the future is considered reasonably certain to occur. Given current trends in global population growth, threats associated with changing environmental conditions, pollution, fisheries, bycatch, aquaculture, vessel strikes and approaches, and sound 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. In contrast, more historic threats such as whaling and

sea turtle harvest are likely to remain low or potentially decrease. For the remaining activities and associated threats identified in the *Environmental Baseline*, and other unforeseen threats, the magnitude of increase and the significance of any anticipated effects remain unknown. The best scientific and commercial data available provide little specific information on any long-term effects of these potential sources of disturbance on ESA-listed species. Thus, this consultation assumed effects in the future would be similar to those in the past and, therefore, are reflected in the anticipated trends described in the Status of Species and Critical Habitat and Environmental Baseline sections 6.2 and 7, respectively.

11 INTEGRATION AND SYNTHESIS

In this section, we add the effects of the action (Section 8 and Section 9) to the environmental baseline (Section 7) and the cumulative effects (Section 10), taking into account the status of the species, critical habitat, and recovery planning (Section 6), to formulate the agency's biological opinion as to whether BOEM and BSEE can insure their Oil and Gas Program is not likely to: 1) reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or 2) appreciably diminish the value of designated or proposed critical habitat as a whole for the conservation of the species (16 U.S.C. §1532(15)). This opinion includes a jeopardy analysis for the ESA-listed threatened and endangered species and a destruction or adverse modification analysis for designated and proposed critical habitat that are likely to be adversely affected by the action.

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). *Recovery*, used in that definition, means "improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in section 4(a)(1) of the Act" (50 CFR §402.02).

Destruction or adverse modification means "a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species" (50 CFR §402.02). *Conservation*, used in that definition, means "to use and the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary" (16 U.S.C. §1532(3)).

Some ESA-listed species and designated and proposed critical habitat in the action area are not expected to be affected by the action or the effects of the action on these ESA resources were determined to be insignificant or discountable. Some stressors evaluated individually were determined to have insignificant or discountable effects and thus to be not likely to adversely affect some ESA-listed species and designated and proposed critical habitat (Sections 6.1 and 8.1).

The following discussions separately summarize the probable risks the action poses to sperm whale, Rice's whale, North Atlantic DPS green sea turtle, Northwest Atlantic Ocean DPS loggerhead sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, hawksbill sea turtle, and Gulf sturgeon; and designated critical habitat for Gulf sturgeon, and proposed critical habitat for Rice's whale and North Atlantic DPS green sea turtle. These summaries integrate the exposure and response analyses for each of the activities or stressors considered further in this opinion; specifically, G&G surveys, decommissioning using explosives and site clearance, pile driving, moon pools, vessel transit and operation, and entanglement in lines. In addition, we considered marine debris in this consultation because, while intentional releases are unlawful activities, accidental releases of trash and debris are reasonably certain to occur and would not occur but for the Oil and Gas Program over the period considered. We also considered oil spills in this opinion because we determined oil spills are reasonably certain to occur and would not occur but for the Oil and Gas Program over the period considered in this consultation. Based on the best available information, including the estimate from BOEM that 1.5 oil spills >10,000 bbl may occur over the duration of the Oil and Gas Program and the 50-year return period from Ji et al. (2014) for at least one spill resulting in a release of up to 100,000 bbl because of a blowout in deep water, we conducted exposure and response analyses for listed species and designated and proposed critical habitat for a 100,000 bbl oil spill. NMFS determined that this volume would be most reasonable after considering the best available science and the 2012 drilling rule and subsequent safety measures.

11.1 Jeopardy Analysis

The jeopardy analysis assesses the Oil and Gas Program's effects to ESA-listed species' survival and recovery.

The following sections summarize the probable risks that Oil and Gas Program activities pose to ESA-listed species that are likely to be exposed over the 45-year period considered in this consultation.

In making our jeopardy determinations, we considered both survival and recovery in tandem as is our practice under the section 7 implementing regulations. We note that while conducting this tandem analysis, the continued existence of the species is the key to the jeopardy standard, placing an emphasis on injury to a species survival (51 Fed. Reg. 19934). This practice makes sense in part because the concepts of survival and recovery are intertwined and it may not be possible to draw distinctions between the two concepts in any given effects analysis. In performing our analysis here, we consulted recovery plans where they exist, and the interim guidance provided by the Rice's whale recovery outline. Consideration of these plans does not change the outcome of our jeopardy analysis. Nor, to the extent that recovery is distinguishable from survival in any context in this opinion, does recovery separate and apart from survival affect the outcome of our jeopardy analysis for any listed species. As we have noted, the significant impairment of recovery efforts which then rise to the level of jeopardy might be the

basis for a jeopardy opinion, but in many cases, there is virtually no difference between injury to survival and recovery (51 Fed. Reg. 19934). We do not discern any such difference here.

We also note that our discussion of environmental trends including warming and its effects to listed species and their environment, made throughout this opinion and addressed with particularity in section 7.1, were considered as part of the species status and environmental baseline, as well as other portions of this opinion, and are therefore incorporated as appropriate into our following jeopardy conclusions. We also considered the significant body of scientific information regarding climate change in the administrative record. We have incorporated the possible, though uncertain, impacts of climate change to the best of our ability into this jeopardy analysis. We do not discern any instance, however, in which credible potential impacts of climate change on one of the listed species considered here alters our ultimate conclusions on jeopardy.

11.1.1 Rice's Whale

We believe there is the potential for lethal and non-lethal take of Rice's whale from vessel strike and non-lethal take from sound sources, including G&G surveys and vessel noise, and exposure to marine debris and a large oil spill (defined as 100,000 bbl) that may occur once over the 45 year period considered in this consultation.

The current best available abundance estimate for the Rice's whale is 51 animals, with a confidence interval of 20 to 130 whales (Garrison et al. 2020b) and a minimum population estimate of 34 (Hayes et al. 2023; NMFS 2021). We note here that, acknowledging the court's finding on this subject in *Sierra Club v. NMFS*, this best available abundance estimate incorporates data post-Deepwater Horizon. Given the very small population size, available information is insufficient to effectively monitor trends in Rice's whale abundance over time. Nearly one-half of the Rice's whale population was exposed to the DWH oil spill, resulting in increased estimated rates of mortality (17%) and failed pregnancies (22%) (DWH-MMIQT 2015). The most significant ongoing anthropogenic threats to the species are sound, vessel strike, and oil and gas activities (Rosel 2016).

Sound from Oil and Gas Program-related activities is expected to adversely affect Rice's whales. Whereas most large whales (including those considered in this opinion) exhibit migratory movement patterns, Rice's whales are considered a resident species in the Gulf. The exposure potential for resident species is year-round and the risk of repeated impacts on individuals is likely similar within the population as animals move throughout their range (Keen et al. 2021).

BOEM calculated an annual average of 12 exposures of Rice's whale to sound from G&G surveys that could cause PTS over a five year period (equivalent to the MMPA authorization). This does not necessarily equate to exposure of 12 individuals because repeat exposure of a single individual could occur. However, based on the best available information on baleen whale reactions to seismic sound, we believe Rice's whales would avoid exposure to injurious sound levels (Ellison et al. 2012; Gordon et al. 2003; Southall et al. 2007; Stone and Tasker 2006). In

addition, the lack of G&G activities within the RWA in the northeastern Gulf mean exposure of individuals to injurious sound levels from seismic surveys is less likely and, if exposures do occur, it would be to sound levels that would cause auditory injury of minor severity that would not render animals unable to find prey, avoid predators, or locate conspecifics to socialize and reproduce. Therefore, we do not anticipate that any exposure to sound at levels that could cause minor auditory injury will result in a reduction in numbers or reproduction or affect the distribution of Rice's whale in the action area over the period of the Oil and Gas Program considered in this opinion.

Sound from G&G survey activities will also result in TTS and behavioral harassment of Rice's whales. Rice's whales may be exposed an annual average of 452 times to sound levels at TTS and behavioral harassment levels from G&G surveys (again, this does not necessarily equate to a number of individuals because repeat exposure of particular individuals could occur). As a capital breeder, Rice's whales may be less sensitive to short-term foraging losses resulting from TTS or a significant behavioral response leading to temporary abandonment of foraging, particularly during the lactation period, because they rely on energy that has already been stored (Pirotta et al. 2019). In addition, few seismic surveys are planned for areas that overlap with RWA in the northeastern Gulf. Due to the limited amount of G&G activities conducted in the Gulf of America that are expected to result in harassment of this species, and that both the G&G seismic vessel and the animal would be moving, we do not anticipate long duration exposures or exposures to individual Rice's whales that recur on subsequent days. Therefore, we do not anticipate that any exposure to sound at levels that could cause TTS or behavioral harassment will result in a reduction in numbers or reproduction or affect the distribution of Rice's whale in the action area over the period of the Oil and Gas Program considered in this opinion.

Vessel sound produced during activities associated with the Oil and Gas Program is likely to result in chronic stress and masking for Rice's whales because Rice's whale hearing and communication largely overlap with the low frequency sounds produced by vessels. Because the area currently under Presidential Withdrawal until 2032 was removed from the Oil and Gas Program, these effects will largely be located outside the area with the greatest density of Rice's whale. The RWA where the greatest density of these animals occurs is not within the busiest vessel traffic regions of the action area. It is possible for vessel sound to interfere with an individual's ability to locate a mate or disrupt mother-calf communication, if individuals are in areas with vessel noise for extended periods. Rice's whales may adjust their communication to cope with changes in ambient sound, as has been suggested for North Atlantic right whales (Parks et al. 2007; Parks et al. 2011; Tennessen and Parks 2016) given that Rice's whales are a full-time resident of the Gulf where vessel traffic is frequent. We do not expect exposure to vessel noise associated with the Oil and Gas Program to result in a reduction in numbers or reproduction of Rice's whale or a change in their distribution.

Exposure to marine debris may result in one non-lethal take of a Rice's whale in a given year because most activities that may generate trash and debris are located outside the area of the Gulf

where Rice's whales are common and best management practices and control measures will minimize the chance for measurable quantities of debris to be present in the water. Similarly, our analysis of the potential effect of a very large oil spill (up to 100,000 bbl) occurring once over the 45-year period considered in this consultation indicated that up to one Rice's whale could be impacted by a spill with the most likely response being sub-lethal or minor because most oil and gas activities that could result in a blowout and subsequent very large spill are located outside the area where Rice's whales are common in the Gulf. In addition, the Bureaus are mandated under OCSLA and OPA to ensure protection of the environment while facilitating the federal government's leasing of its offshore mineral resources and energy resources, and have conducted rulemakings to that effect. For example, BSEE amended their Drilling Safety Rule in 2016 to strengthen oil spill prevention requirements. In 2019, BSEE revised their Well Control Rule, which was revised again in 2023 to clarify blowout preventer (BOP) system requirements and to modify certain specific BOP equipment capability requirements. These rules along with others detailed in Section 3.1.5 and listed in Section 8.3 are in place to increase safety and to reduce the likelihood of spill occurrence. NMFS acknowledges that the Bureaus are the entities tasked by statute with determining the best measures to implement for oil spill prevention, and, after independently reviewing such measures, NMFS finds that the existing regulatory regime for oil spill prevention is sufficient. NMFS concludes that marine debris and oil spills from the Oil and Gas Program will not result in changes in the number, distribution, or reproductive potential of Rice's whales in the Gulf of America.

Rice's whales are expected to experience lethal and sublethal physical injury or impairment from vessel strike in waters of the Gulf of America where vessel traffic from Oil and Gas Program activities overlap with proposed critical habitat for Rice's whale because these are the areas the species is expected to be present. Based on the quantitative analysis, 9 instances of lethal or serious injury, and 3 instances of sublethal physical injury or impairment from oil and gas vessels are reasonably certain to occur over the course of the duration of the action (45 years). This means that, while we do not anticipate a change in distribution, there will be a decline in numbers because of mortality of a few individuals and a loss of reproduction. Given the population size and status of Rice's whale, any effects that may reduce the fitness of individuals or result in mortality will affect the population. The death of one female, assuming a 1:1 sex ratio, would affect vital rates because calf production would decline, and would constitute the loss of approximately 4% of the breeding population (Rosel 2016). Thus, the effects of vessel strike to Rice's whales are likely to reduce appreciably the survival of Rice's whale in the wild.

The Rice's Whale Recovery Outline identifies the primary threats to Rice's whale as energy exploration and development, exposure to oil spills and spill response, vessel collisions, anthropogenic noise during seismic surveys, small population effects, genetics, low productivity rate, fishing gear interactions, difficulty finding mates, noise from shipping traffic and other vessels, and unpredictable and catastrophic events. The initial focus of the interim recovery program is on two main strategies: 1) controlling threats to the species in its known range, and 2) gathering additional information through research and monitoring of the species. The interim

recovery plan identifies the following management activities that are relevant to the Oil and Gas Program and the stressors and activities associated with the program that are likely to adversely affect Rice's whale:

- Identify appropriate mitigation/conservation measures for activities to protect Rice's whales and their habitat;
- Protect important habitat from threats associated with energy development (including anthropogenic noise during seismic surveys), oil spills, and oil spill response; and
- Reduce primary threat of vessel strikes, and marine debris to prevent further declines in the species' abundance and stabilize the population.

The low growth rate, relatively late age at maturity (estimated as 9 years for females), long gestation period, single offspring, and potentially biennial or longer reproductive periodicity, affect the species' ability to recover from threats that impact its abundance and productivity. The loss of individuals from lethal vessel strikes and the probability of sub-lethal effects to other individuals from vessel strikes associated with the Oil and Gas Program will impede the interim recovery goals for Rice's whale, thereby appreciably reducing the recovery of Rice's whale in the wild.

In summary, we determined the effects of exposure to sound from G&G survey activities and vessel noise, marine debris, and one large (100,000 bbl) oil spill over the 45-year period of the Oil and Gas Program considered in this opinion, are not likely to appreciably reduce the survival and recovery of Rice's whale in the wild. However, we find the lethal and sub-lethal effects of vessel strike, are likely to appreciably reduce survival and recovery of this species in the wild and, thus, the Oil and Gas Program is likely to jeopardize the continued existence of the Rice's whale.

11.1.2 Sperm Whale

We believe there is the potential for lethal and non-lethal take of sperm whale from vessel strike, marine debris, and a large (100,000 bbl) oil spill, and non-lethal take from exposure to sound sources, including G&G surveys and pile driving.

The current global sperm whale estimate is about 850,000 whales (Whitehead and Shin 2022). There are no reliable estimates for sperm whale abundance across the entire North Atlantic Ocean. The best abundance estimate for the northern Gulf stock is 1,180 (Garrison et al. 2020b; Hayes et al. 2021). Garrison et al. (2020b) found no significant differences in abundance estimates across multiple survey years (i.e., 2003-2004, 2009, and 2017-2018), suggesting a stable sperm whale population trend in U.S. Gulf of America waters over this time period. However, the statistical power to detect a trend in abundance for this stock is poor due to the relatively imprecise abundance estimates and long intervals between surveys (Hayes et al. 2021). Frasier et al. (2024a) documented a 31% density decline for sperm whales in the northeastern Gulf of America in the decade after the DWH oil spill.

Sound from Oil and Gas Program-related activities is expected to adversely affect sperm whales. Sperm whales are expected to experience TTS or behavioral harassment from exposure to sound from G&G activities and pile driving throughout the waters of the Gulf. BOEM calculated an annual average of 31,738 exposures of sperm whales to sound from G&G surveys and a 45-year total of two exposures of sperm whales to sound from pile driving that could cause TTS or behavioral harassment. As for Rice's whale, the numbers of exposures do not necessarily equate to a number of individuals. We estimate the average number of days an individual sperm whale will be harassed by G&G survey noise is 27 days annually. Given the low number of exposures anticipated for pile driving activities, we did not estimate an average number of days an individual sperm whale will be harassed by pile driving noise. We anticipate that, because of the size of the action area and the spatial distribution of pile driving activities, one sperm whale could be harassed in a particular year. We anticipate responses to exposure will be minor and ephemeral, including temporary avoidance, discomfort, discontinuance of foraging, masking, alteration of vocalizations, and physiological stress, with individuals returning to normal shortly after the exposure has ended. While masking of echolocation clicks could result in sperm whales being temporarily less efficient at locating prey, we expect that the lost foraging opportunities would be short-term with the animals returning to normal feeding efficiency once the sound source is gone. For this reason, we do not anticipate that instances of TTS or behavioral harassment from exposure to sound from G&G activities and pile driving will result in changes in the number, distribution, or reproductive potential of sperm whales in the Gulf of America, or throughout their range.

Exposure to marine debris may result in one lethal and three non-lethal takes of a sperm whale, although best management practices and control measures will minimize the chance for measurable quantities of debris to be present in the water. Our analysis of the potential effect of a large oil spill (100,000 bbl) occurring once over the 45-year period considered in this consultation indicated that up to three sperm whales could suffer mortality and five others could suffer sub-lethal effects if exposed to oil from a blowout and subsequent very large spill from Oil and Gas Program activities in the Gulf. As indicated in the Rice's whale section above, the Bureaus are mandated under OCSLA and OPA to ensure protection of the environment while facilitating the federal government's leasing of its offshore mineral resources and energy resources, and have conducted rulemakings to that effect. NMFS finds that the existing regulatory regime for oil spill prevention is sufficient. NMFS concludes that marine debris and oil spills from the Oil and Gas Program will not result in appreciable changes in the number or reproductive potential of sperm whales, or their distribution, in the Gulf of America, or throughout their range.

Sperm whales are expected to experience lethal and sublethal physical injury or impairment from vessel strike throughout the waters in the Gulf of America from vessels associated with the Oil and Gas Program. Based on the quantitative analysis, 12 instances of lethal strikes and four instances of sublethal physical injury or impairment from oil and gas vessels are reasonably certain to occur over the 45-year period considered in this opinion.

The best available information suggests the sperm whale population in the Gulf of America action area is 1,180 animals. Assuming a balanced sex ratio, this means there are about 590 females in the Gulf of America population. A reasonably predictable outcome is that six of the 12 lethal or mortal injury strikes, and two of the four non-lethal injurious strikes of sperm whales by Oil and Gas Program vessels over the 45 years considered in this opinion would be females of early reproductive age. This means that, while we do not expect a change in distribution of the species, there will be a small change in numbers and reproductive potential. However, given the size and apparent stability of the Gulf stock of sperm whales, as well as the estimated several hundred thousand whales range-wide, there would not be an appreciable reduction in the numbers and reproduction of the sperm whales in the Gulf or range-wide. Therefore, we conclude the effects of the Oil and Gas Program will not appreciably reduce the survival of sperm whales in the wild.

The 2010 sperm whale recovery plan (NMFS 2010a) defines three recovery populations by ocean basin (the Atlantic Ocean/Mediterranean Sea, Pacific Ocean, and Indian Ocean) and sets criteria for the downlisting and delisting of this species. Both downlisting and delisting requirements include abatement of threats associated with fisheries, changes in environmental conditions, direct harvest, oil spills, anthropogenic noise, and vessel strike. Of these, anthropogenic noise, vessel strike, and oil spills, are relevant to Oil and Gas Program activities. Downlisting criteria for sperm whales include the maintenance of 1,500 mature, reproductive individuals with at least 250 mature females and 250 mature males in each recovery population. As discussed above, we do not anticipate that the effects to sperm whales from exposure to sound from G&G activities and pile driving, marine debris, a large oil spill occurring once over the 45-year period considered in this opinion, or vessel strikes will impede the recovery objectives for sperm whales.

In summary, we determined the effects of exposure to the stressors likely to adversely affect sperm whales over the 45-year period of the Oil and Gas Program considered in this opinion are not likely to appreciably reduce the survival and recovery of sperm whale in the wild. Thus, we find the Oil and Gas Program is not likely to jeopardize the continued existence of the sperm whale.

11.1.3 Green Sea Turtle North Atlantic DPS

We believe there is potential for lethal and non-lethal take of North Atlantic DPS green sea turtle from a large oil spill, marine debris, entanglement, use of explosives during structure removal, and vessel strikes, and non-lethal take from exposure to sound sources from G&G surveys and pile driving.

The North Atlantic DPS exhibits the highest nester abundance of all green sea turtle populations with approximately 167,424 females across 73 nesting sites (Seminoff et al. 2015) with Florida nesting sites in the U.S. considered essential for the recovery of the Atlantic green sea turtle population (NMFS and USFWS 1991). Although there are no reliable estimates of population

growth rate for the DPS as a whole, the available data indicate that all major nesting populations demonstrate long-term increases in abundance (Seminoff et al. 2015). The most significant anthropogenic threat to the species is the overexploitation for food and other products. The threats of pollution, habitat loss through coastal development or stabilization, destruction of nesting habitat from storm events, beachfront lighting, environmental change, fisheries interactions, natural predation, disease, and fisheries bycatch continue as well.

BOEM did not conduct an exposure and response analysis for sea turtles associated with sound from G&G survey activities. NMFS determined sound from G&G activities is expected to adversely affect North Atlantic DPS green sea turtles through exposure to sound levels causing TTS and behavioral harassment that may also lead to physiological stress responses. The calculated numbers of exposure do not necessarily represent numbers of individuals because repeat exposure of a single individual could occur. The majority of effects from G&G surveys will be to oceanic juveniles. Pile driving and explosive severance may lead to sound exposure levels that cause mortality or injury, including PTS, TTS, and behavioral harassment. We predict 182 instances of lethal and serious injury and 228 instances of sublethal injury or impairment to neritic and oceanic juvenile and 42 adult green sea turtles, and 372 instances of behavioral harassment to oceanic juvenile green sea turtles total over the 45-year duration of the Oil and Gas Program from explosive severance. The quantitative acoustics effects analysis for pile driving predicts 450 instances of sublethal physical injury or impairment (PTS), and 12,060 instances of behavioral harassment or physiological stress to oceanic juveniles from exposure to pile driving sound over the 45-year duration of the Oil and Gas Program. For those individuals that experience TTS, the available data suggest hearing will return to normal within days of the exposure (Moein et al. 1994).

Overall, exposure to sound will affect large numbers of oceanic juveniles because of their densities and presence offshore in areas where Oil and Gas Program activities are concentrated. Population models show that, while small size classes (typically less than 45 cm) are dominant in terms of numbers, oceanic juvenile green sea turtles have a lower survival probability than later life stages (although higher than eggs/hatchlings). The mean annual survival rate is up to 0.64 for pelagic juveniles and up to 0.88 for benthic juveniles (Mazaris et al. 2006; Kameda et al. 2017) versus 0.95 for adults (Mazaris et al. 2006), meaning the loss of animals or temporary impacts to individuals from the oceanic juvenile life stage is not likely to have population-level consequences compared to the loss of reproductive adults, especially females. While there will be some reduction in numbers, particularly related to mortality, injury and sub-lethal effects to adult sea turtles during explosive severance, and a corresponding reduction in reproduction over the 45-year period of the Oil and Gas Program, we do not anticipate that these reductions will be measurable at the level of the DPS. We do not anticipate that any exposure to sound at levels that cause TTS or behavioral harassment will result in a measurable reduction in numbers or reproduction at the level of the DPS. We also do not anticipate any changes in the distribution of the North Atlantic DPS green sea turtle in the action area because of sounds from G&G surveys,

explosive severance, and pile driving associated with the Oil and Gas Program over the 45-year period considered in this opinion.

North Atlantic DPS green sea turtles are expected to experience mortality or serious injury and sublethal physical injury throughout waters in the Gulf of America from Oil and Gas Program vessels. Based on our analysis, we estimated there could be up to 10,170 (226 annually) vessel strikes of adult and juvenile oceanic and 1,170 (26 annually) vessel strikes of neritic green sea turtles over the 45-year duration of the Oil and Gas Program. This means that, while we do not anticipate a change in distribution, there will be a decline in numbers because of the mortality of individuals and a loss of reproduction, particularly if adult females are among those that suffer mortality or sub-lethal effects that lead to a delay in reproduction. However, given the size and apparent stability of the North Atlantic DPS green sea turtle in the action area based on the increase in nesting at beaches in the Gulf, there would not be an appreciable reduction in the numbers and reproduction of the North Atlantic DPS green sea turtle in the Gulf or range-wide or any change in distribution.

North Atlantic DPS green sea turtles are expected to experience lethal or serious injury, and behavioral or physiological stress responses throughout waters in the Gulf of America from entrapment or entanglement in Oil and Gas Program moon pools and trawl nets used for site clearance. The effects analysis predicts five instances of lethal or serious injury, and 495 instances of behavioral harassment of adult and neritic juveniles to occur over 45-year duration the duration of the Oil and Gas Program. We do not anticipate that entrapment or entanglement, which will largely result in measurable behavioral responses, will result in a measurable reduction in numbers or reproduction at the level of the DPS. We also do not anticipate any changes in the distribution of the North Atlantic DPS green sea turtle in the action area because of entanglement or entrapment associated with the Oil and Gas Program over the 45-year period considered in this opinion.

Exposure to marine debris may result in lethal and non-lethal takes of North Atlantic DPS green sea turtle oceanic juveniles and adults, although best management practices and control measures will minimize the chance for measurable quantities of debris to be present in the water. Our analysis of the potential effect of a very large oil spill (up to 100,000 bbl) occurring once over the 45-year period considered in this consultation indicated that up to 4,400 North Atlantic DPS green sea turtles could be exposed to oil from a blowout and subsequent very large spill from Oil and Gas Program activities in the Gulf and, of these, 1,653 would die from oiling. As indicated in the previous sections above, the Bureaus are mandated under OCSLA and OPA to ensure protection of the environment while facilitating the federal government's leasing of its offshore mineral resources and energy resources, and have conducted rulemakings to that effect. NMFS finds that the existing regulatory regime for oil spill prevention is sufficient. NMFS concludes that marine debris and oil spills from the Oil and Gas Program will not result in appreciable changes in the number or reproductive potential of North Atlantic DPS green sea turtles, or their distribution, in the Gulf of America, or throughout their range.

The best available information suggested there are an estimated 167,424 adult nesting females in the population with increases across all major nesting locations. A reasonable assumption is that approximately half of any of the adult sea turtles that suffer mortality or sublethal effects from explosive severance, vessel strike or exposure to marine debris or a large oil spill would be female. This means that, while we do not expect a change in distribution, there will be a reduction in numbers and reproduction. We do not consider this to be an appreciable reduction in the numbers of female North Atlantic DPS green sea turtles or the reproductive rate of the population, either on an annual basis or continuing into the reasonably foreseeable future considering the anticipated size of the population. Because we do not expect this level of mortality to result in an appreciable reduction in the numbers or reproductive rate of the North Atlantic DPS green sea turtle, we do not expect this level of mortality to impact the survival or recovery of this population. In addition, the loss of reproductive potential resulting from mortality will not affect the current geographic range of this population, and no reduction in the distribution of this DPS is expected as a result of the action. Therefore, we conclude lethal and sub-lethal take and behavioral harassment resulting from exposure to sound, vessel strike, entanglement and entrapment, marine debris, and oil spills from activities associated with the Oil and Gas Program will not appreciably reduce the survival of the North Atlantic DPS green sea turtle in the wild.

The Recovery Plan for the U.S. Population of Atlantic Green Turtle NMFS and USFWS (1991) identified the major actions needed to recover the U.S. Atlantic population of green sea turtles and set criteria for delisting the species. Recovery criteria include: 1) the level of nesting in Florida has increased to an average of 5,000 nests per year for at least six years; 2) at least 25% (105 km) of all available nesting beaches (420 km) is in public ownership and encompasses greater than 50% of the nesting activity; and 3) a reduction in stage class mortality is reflected in higher counts of individuals on foraging grounds. The plan identified the following major population limiting factors in the marine environment relevant to the Oil and Gas Program: oil and gas exploration, development, and transportation; seagrass bed degradation; boat collisions; underwater explosions; offshore artificial lighting; entanglement; and ingestion of marine debris. While we do anticipate North Atlantic DPS green sea turtle mortalities and injuries from vessel strike, entanglement and entrapment, explosive severance, oil spills, and marine debris, as discussed above, we do not anticipate the effects to North Atlantic DPS green sea turtle over the 45-year period considered in this opinion will impede the recovery objectives for the species in the wild.

In summary, we determined the effects of exposure to sound from G&G survey activities, pile driving and explosive severance, entanglement and entrapment, vessel strikes, marine debris, and one large (100,000 bbl) oil spill over the 45-year period of the Oil and Gas Program considered in this opinion, are not likely to appreciably reduce the survival and recovery of North Atlantic DPS green sea turtles in the wild. Thus, we find the Oil and Gas Program is not likely to jeopardize the continued existence of the North Atlantic DPS green sea turtle.

11.1.4 Loggerhead Sea Turtle Northwest Atlantic DPS

We believe there is potential for lethal and non-lethal take of Northwest Atlantic Ocean DPS loggerhead sea turtle from a large oil spill, marine debris, vessel strike, exposure to sound from explosive severance and pile driving, and entanglement or entrapment, and non-lethal take from exposure to sound from G&G survey activities.

While an overall estimate of nesting females for the Northwest Atlantic Ocean DPS is not available, based on available nest count data from Texas through Virginia and Quintana Roo, Mexico, the DPS hosts more than 110,000 nests annually (NMFS and USFWS 2023). Ceriani et al. (2019) estimated the total number of adult females nesting in Florida to be 51,319, based on nest count data from 2014-2018. There is no significant trend in the annual number of nesting females in either the Peninsular Florida (1989-2018) or Northern Gulf (1997-2018) units over the last several decades (NMFS and USFWS 2023). Overall, the latest 5-year status review concluded that the DPS as a whole demonstrates a stable (neither increasing nor decreasing) population trend (NMFS and USFWS 2023). A preliminary regional abundance survey of loggerheads within the northwestern Atlantic continental shelf estimated about 588,000 loggerheads (interquartile range of 382,000 to 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 to 1,111,000) (NEFSC 2011). The most significant anthropogenic threats to the species are fisheries bycatch, interactions with dredge equipment, vessel strikes, and coastal and marine development and associated pollution.

BOEM did not conduct an exposure and response analysis for sea turtles associated with sound from G&G survey activities. NMFS determined sound from G&G survey activities is expected to adversely affect Northwest Atlantic DPS loggerhead sea turtles through exposure to sound levels causing sublethal physical injury or impairment (including TTS), and behavioral harassment throughout waters in the Gulf of America. The calculated numbers of exposure do not necessarily represent individuals because repeat exposure of a single individual could occur. The acoustic effects analysis predicts the majority of exposures will result in behavioral harassment followed by TTS in both juveniles and adults over the 45-year duration of the Oil and Gas Program considered in this opinion. Pile driving and explosive severance may lead to sound exposure levels that cause mortality or injury, including PTS, TTS, and behavioral harassment. We predict 11 instances of PTS, 16 instances of sublethal physical injury or impairment (including TTS), and 323 instances of behavioral harassment per year to adult loggerheads and 5 instances of PTS, 465 instances of sublethal physical injury or impairment (including TTS), and 142 instances of behavioral harassment per year to oceanic juveniles from exposure to sound from pile driving activity. We predict 663 instances of lethal and serious injury and 870 instances of sublethal injury or impairment to adult loggerhead sea turtles, and 99 instances of of lethal and serious injury, 131 instances of sublethal injury or impairment, and 263 instances of behavioral harassment to oveanic juvenile loggerhead sea turtles total over the 45-year duration of the Oil and Gas Program from explosive severance. In terms of PTS, individuals would have to be

within 176 m of the pile driving sound source and within 80 m of the explosive sound source in order to experience auditory injury. Given the use of PSOs and the likelihood that animals will move away from disturbance, we anticipate few individuals will be exposed to sound levels that result in more than minor hearing impairment. For those individuals that experience TTS, the available data suggest hearing will return to normal within days of the exposure (Moein et al. 1994).

Overall, because loggerheads are one of the most common species of sea turtle in the Gulf, it is one of the species that will be exposed to sound from Oil and Gas Program-related activities more frequently because individuals are more likely to overlap with activities. An injury can impact an individual sea turtle's fitness, causing a reduction in foraging success, reproduction, or increased susceptibility to predators. Depending on the type of injury and other relevant factors (e.g., animal life stage, size, condition prior to exposure), a reduction in fitness from non-auditory injury could be temporary with recoverable impacts, or result in long-term fitness consequences for some individuals. However, we do not anticipate individual effects will result in a measurable reduction in numbers or reproduction of the species in the action area. We also do not anticipate any changes in the distribution of the Northwest Atlantic DPS loggerhead sea turtle because of the exposure to sound from G&G survey activities, explosive severance and pile driving associated with the Oil and Gas Program over the 45-year period considered in this opinion.

Northwest Atlantic DPS loggerhead sea turtles are expected to experience mortality or serious injury and sublethal physical injury throughout waters of the Gulf of America from Oil and Gas Program vessels. Based on our analysis, we estimated there would be 3,420 vessel strikes of adult (76 annually) and 14 (rounded up from 13.5) juvenile (less than 30 cm diameter) loggerhead sea turtles over the 45-year duration of the Oil and Gas Program. This means that, while we do not anticipate a change in distribution, there will be a decline in numbers because of the mortality of individuals and a loss of reproduction, particularly if adult females are among those that suffer mortality or sub-lethal effects that lead to a delay in reproduction. However, given the size and apparent stability of the Northwest Atlantic DPS loggerhead sea turtle in the action area based on the nesting at index beaches in the Gulf, there would not be an appreciable reduction in the numbers and reproduction of the Northwest Atlantic DPS loggerhead sea turtle in the Gulf or range-wide or any change in distribution.

North Atlantic DPS green sea turtles are expected to experience lethal or serious injury, and behavioral or physiological stress responses throughout waters in the Gulf of America from entrapment or entanglement in Oil and Gas Program moon pools and trawl nets used for site clearance. The effects analysis predicts 1,260 instances of capture of adults or juveniles in trawl nets used during site clearing, which are anticipated to be non-lethal because of conservation measures to limit trawl times and handle and release any captured animals over the 45-year period of the Oil and Gas Program considered in this opinion. The effects analysis also predicts one instance of a loggerhead being entrapped in a moon pool in a given year over 45-year

duration the duration of the Oil and Gas Program. We do not anticipate that entrapment or entanglement, which will largely be non-lethal because of measures to release any entangled or entrapped animals unharmed, will result in a measurable reduction in numbers or reproduction at the level of the DPS. We also do not anticipate any changes in the distribution of the Northwest Atlantic DPS loggerhead sea turtle in the action area because of entanglement or entrapment associated with the Oil and Gas Program over the 45-year period considered in this opinion.

Exposure to marine debris may result in lethal and non-lethal takes of Northwest Atlantic DPS loggerhead sea turtle oceanic juveniles and adults, although best management practices and control measures will minimize the chance for measurable quantities of debris to be present in the water. Our analysis of the potential effect of a very large oil spill (up to 100,000 bbl) occurring once over the 45-year period considered in this consultation indicated that up to 1,794 Northwest Atlantic DPS loggerhead sea turtles could be exposed to oil from a blowout and subsequent very large spill from Oil and Gas Program activities in the Gulf and, of these, 420 would die from oiling. As indicated in the previous sections, the Bureaus have conducted rulemakings to ensure protection of the environment; thus, NMFS finds that the existing regulatory regime for oil spill prevention is sufficient. NMFS concludes that marine debris and oil spills from the Oil and Gas Program will not result in appreciable reductions in the number or reproductive potential of Northwest Atlantic DPS loggerhead sea turtles, or their distribution, in the Gulf of America, or throughout their range.

The best available information suggests the estimated size of the Northwest Atlantic DPS loggerhead sea turtle may be over 800,000 animals, and the estimated number of nesting females in Florida is 51,319 where a number of index nesting beaches are located (Ceriani et al. 2019; NMFS and USFWS 2008b). A reasonable assumption is that approximately half of any of the adult sea turtles that suffer mortality or sublethal effects from explosive severance, sound from pile driving, vessel strike or exposure to marine debris or a large oil spill would be female. This means that, while we do not expect a change in distribution, there will be a reduction in numbers and reproduction. We do not consider this to be an appreciable reduction in the numbers of female Northwest Atlantic DPS loggerhead sea turtles or the reproductive rate of the population, either on an annual basis or continuing into the reasonably foreseeable future considering the anticipated size of the population. Because we do not expect this level of mortality to result in an appreciable reduction in the numbers or reproductive rate of the Northwest Atlantic DPS loggerhead sea turtle, we do not expect this level of mortality to impact the survival or recovery of this population. In addition, the loss of reproductive potential resulting from mortality will not affect the current geographic range of this population, and no reduction in the distribution of this DPS is expected as a result of the action. Therefore, we conclude lethal and sub-lethal take and behavioral harassment resulting from exposure to sound, vessel strike, entanglement and entrapment, marine debris, and oil spills from activities associated with the Oil and Gas Program will not appreciably reduce the survival of the Northwest Atlantic DPS loggerhead sea turtle in the wild.

The 2009 Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle (NMFS and USFWS 2008b) identified the major actions needed to recover this DPS. Relevant to the proposed action, these include: minimize vessel strike mortality and ensure the in-water abundance of juveniles in both neritic and oceanic habitats is increasing at a greater rate than strandings of similar age classes. Demographic recovery criteria include the following: statistically significant minimum levels of increase in the annual number of loggerhead nests over 50 years, including for the recovery units in the action area (Peninsular Florida Recovery Unit, Dry Tortugas Recovery Unit, and Northern Gulf Recovery Unit). The plan identified the following major population limiting factors in the marine environment relevant to the Oil and Gas Program: vessel strikes, marine debris ingestion, and oil pollution. While we do anticipate Northwest Atlantic DPS loggerhead sea turtle mortality, injury and behavioral harassment from vessel strike, explosive severance, pile driving, G&G surveys, entanglement and entrapment, oil spills and marine debris, as discussed above, we do not anticipate the effects to Northwest Atlantic DPS loggerhead sea turtle over the 45-year period considered in this opinion will impede the recovery objectives for the species in the wild.

In summary, we determined the effects of exposure to sound from G&G survey activities, pile driving and explosive severance, entanglement and entrapment, vessel strikes, marine debris, and one large (100,000 bbl) oil spill over the 45-year period of the Oil and Gas Program considered in this opinion, are not likely to appreciably reduce the survival and recovery of Northwest Atlantic DPS loggerhead sea turtle in the wild. Thus, we find the Oil and Gas Program is not likely to jeopardize the continued existence of the Northwest Atlantic DPS loggerhead sea turtle.

11.1.5 Kemp's Ridley Sea Turtle

We believe there is potential for lethal and non-lethal take of Kemp's ridley sea turtle from a large oil spill, marine debris, vessel strike, entanglement in lines, and exposure to sound from explosive severance and pile driving, and non-lethal take from exposure to sound from G&G activities.

The Kemp's ridley sea turtle has declined to the lowest population level of all sea turtle species in the world. Nesting aggregations at a single location (Rancho Nuevo, Mexico) declined to an estimated 300 females by the mid-1980s. From 1980 through 2003, largely due to conservation efforts, the number of nests at three primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) in Mexico increased 15% annually (Heppell et al. 2005). By 2014, there were an estimated 10,987 nests and 519,000 hatchlings released from these three primary nesting beaches. Because females lay approximately 2.5 nests each season they nest, 10,987 nests represents 4,395 females nesting in a season at these primary nesting sites, and increases in nest counts have been documented over the past two decades at nesting beaches in Texas (NMFS 2015b).

NMFS determined sound from G&G survey activities is expected to adversely affect Kemp's ridley sea turtles through exposure to sound levels causing sublethal physical injury or

impairment (including TTS), and behavioral harassment throughout waters in the Gulf of America. The calculated numbers of exposure do not necessarily represent individuals because repeat exposure of a single individual could occur. The acoustic effects analysis predicts the majority of exposures will result in behavioral harassment followed by TTS in both juveniles and adults over the 45-year duration of the Oil and Gas Program considered in this opinion. Kemp's ridley sea turtles are expected to experience mortality (including serious injury), sublethal physical injury, and behavioral harassment or physiological stress throughout waters in the Gulf of America from Oil and Gas Program from explosive severances used for structure removal. Kemp's ridley sea turtles are expected to experience sublethal physical injury or impairment (including PTS and TTS), and behavioral or physiological stress responses throughout waters in the Gulf of America from Oil and Gas Program-related pile driving. The quantitative acoustics effects analysis predicts 360 instances of sublethal physical injury or impairment (including PTS and TTS and 10,575 instances of behavioral harassment over the 450-year duration of the Oil and Gas Program considered in this opinion. We predict 409 instances of lethal and serious injury, 490 instances of sublethal injury or impairment to adult and juvenile Kemp's ridley sea turtles, and 317 instances of behavioral harassment to oceanic juvenile Kemp's ridley sea turtles because of exposure to pile driving sound. In terms of PTS, individuals would have to within 176 m of the pile driving sound source and within 80 m of the explosive sound source in order to experience auditory injury. Given the use of PSOs and the likelihood that animals will move away from disturbance, we anticipate few individuals will be exposed to sound levels that result in more than minor hearing impairment. For those individuals that experience TTS, the available data suggest hearing will return to normal within days of the exposure (Moein et al. 1994).

Overall, because Kemp's ridley are one of the most common species of sea turtle in the Gulf, it is one of the species that will be exposed to sound from Oil and Gas Program-related activities more frequently because individuals are more likely to overlap with activities. An injury can impact an individual sea turtle's fitness, causing a reduction in foraging success, reproduction, or increased susceptibility to predators. Depending on the type of injury and other relevant factors (e.g., animal life stage, size, condition prior to exposure), a reduction in fitness from non-auditory injury could be temporary with recoverable impacts, or result in long-term fitness consequences for some individuals. However, we do not anticipate individual effects will result in a measurable reduction in numbers or reproduction of the species in the action area. We also do not anticipate any changes in the distribution of the Kemp's ridley sea turtle because of the exposure to sound from G&G survey activities, explosive severance and pile driving associated with the Oil and Gas Program over the 45-year period considered in this opinion.

Kemp's ridley sea turtles are expected to experience mortality or serious injury and sublethal physical injury throughout waters in the Gulf of America from Oil and Gas Program vessels. Based on our analysis, we estimated there would be 77 vessel strikes of adult Kemp's ridley sea turtles annually, 61% of which are likely to be females. We also expect 18 interactions leading to entanglement of Kemp's ridley and likely mortality per year. This means that, while we do not anticipate a change in distribution, there will be a decline in numbers because of the mortality of

individuals and a loss of reproduction, particularly if adult females are among those that suffer mortality or sub-lethal effects that lead to a delay in reproduction. Given the apparent improvement in population stability of Kemp's ridley based on the ongoing increase in nesting since the severe decline in the mid-1980s, we believe there would not be an appreciable reduction in the numbers and reproduction of the Kemp's ridley sea turtle in the Gulf or any change in distribution.

Exposure to marine debris may result in lethal and non-lethal takes of Kemp's ridley sea turtle oceanic juveniles and adults, although best management practices and control measures will minimize the chance for interactions. Our analysis of the potential effect of a very large oil spill (up to 100,000 bbl) occurring once over the 45-year period considered in this consultation indicated that up to 7,500 Kemp's ridley sea turtles could be exposed to oil from a blowout and subsequent very large spill from Oil and Gas Program activities in the Gulf and, of these, 2,781 would die from oiling. As indicated in the previous sections, the Bureaus have conducted rulemakings to ensure protection of the environment; thus, NMFS finds that the existing regulatory regime for oil spill prevention is sufficient. NMFS concludes that marine debris and oil spills from the Oil and Gas Program will not result in appreciable reductions in the number or reproductive potential of Northwest Atlantic DPS loggerhead sea turtles, or their distribution, in the Gulf of America, or throughout their range.

The best available information suggests Kemp's ridley underwest a drastic population decline in the mid-1980s but nesting steadily increased in the 1990s and accelerated in the 2000s, indicating the species may be recovering. In addition to increases at index beaches in Mexico to over 10,000 nests beginning around 2006, representing 4,395 females nesting in a season at these primary nesting sites, and nesting along the Texas coast has also increased (NMFS 2015b). In the Gulf of America, there is a mean annual abundance of large (adult) Kemp's ridley of 133,371 (Table 30). Approximately 61% of any of the adult sea turtles that suffer mortality or sublethal effects from explosive severance, entanglement, sound from pile driving, vessel strike or exposure to marine debris or a large oil spill would be female. This means that, while we do not expect a change in distribution, there will be a reduction in numbers and reproduction. We do not consider this to be an appreciable reduction in the numbers of female Kemp's ridley sea turtles or the reproductive rate of the population, either on an annual basis or continuing into the reasonably foreseeable future considering the anticipated size and apparent increasing trend of the population. Because we do not expect this level of mortality to result in an appreciable reduction in the numbers or reproductive rate of the Kemp's ridley sea turtle, we do not expect this level of mortality to impact the survival or recovery of this population. In addition, the loss of reproductive potential resulting from mortality will not affect the current geographic range of this population, and no reduction in the distribution of this species is expected as a result of the action. Therefore, we conclude lethal and sub-lethal take and behavioral harassment resulting from exposure to sound, vessel strike, entanglement, marine debris, and oil spills from activities associated with the Oil and Gas Program will not appreciably reduce the survival of the Kemp's ridley sea turtle in the wild.

The 2011 Bi-National Recovery Plan for the Kemp's Ridley Sea Turtle identified the major actions needed to recover this species (NMFS et al. 2011a). Relevant to the proposed action, these include minimizing vessel strike mortality and ensuring the in-water abundance of juveniles in both neritic and oceanic habitats is increasing at a greater rate than strandings of similar age classes. Demographic recovery criteria for downlisting the species include the following: 1) 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; and 2) recruitment of at least 300,000 hatchlings to the marine environment per season at the three primary nesting beaches. The recovery plan identified the following major population limiting factors in the marine environment relevant to the Oil and Gas Program: vessel strikes; oil, gas, and liquid natural gas exploration, development, and removal; marine debris ingestion and entanglement; oil, fuel, tar, and chemical pollution; low frequency noise pollution. While we do anticipate Kemp's ridley sea turtle mortality, injury and behavioral harassment from vessel strike, entanglement, explosive severance, pile driving, G&G survey activities, oil spills and marine debris, as discussed above, we do not anticipate the effects to Kemp's ridley sea turtle over the 45-year period considered in this opinion will impede the recovery objectives for the species in the wild.

In summary, we determined the effects of exposure to sound from G&G survey activities, pile driving and explosive severance, entanglement, vessel strikes, marine debris, and one large (100,000 bbl) oil spill over the 45-year period of the Oil and Gas Program considered in this opinion are not likely to appreciably reduce the survival and recovery of Kemp's ridley sea turtles in the wild. Thus, we find the Oil and Gas Program is not likely to jeopardize the continued existence of the Kemp's ridley sea turtle.

11.1.6 Hawksbill Sea Turtle

We believe there is potential for lethal and non-lethal take of hawksbill sea turtle from sound exposure from explosive severance, a large oil spill and vessel strike.

The number of hawksbill sea turtle nests in the Gulf has increased in most of their known nesting sites in Mexico since 1990. There is also nesting in Florida, but there are no reliable estimates of population abundance and trends for non-nesting hawksbill sea turtles other than indications that the population in the Altantic, although smaller than that in the Pacific, appears to be more stable.

Hawksbill sea turtles are expected to experience mortality or serious injury, sublethal physical injury or impairment, and behavioral harassment from explosive severances used for structure removal. The quantitative analysis estimated up to 4 instances of lethal and serious injury, 5 instances sublethal injury or impairment, and 11 instances of behavioral harassment to oceanic juvenile hawksbill sea turtles, and up to 42 instances of lethal and serious injury to adults over the 45-year period of the Oil and Gas Program considered in this opinion. This means that, while we do not anticipate a change in distribution, there will be a small decline in numbers,

particularly if adult females are among those that suffer mortality or sub-lethal effects that delay reproduction. However, given the likely size and apparent stability of the Atlantic portion of the hawksbill sea turtle population, there would not be an appreciable reduction in the numbers and reproduction of this species in the Gulf or range-wide, or any change in distribution because of the action.

Our analysis of the potential effect of a very large oil spill (up to 100,000 bbl) occurring once over the 45-year period considered in this consultation indicated that up to 257 hawksbill sea turtles could be exposed to oil from a blowout and subsequent very large spill from Oil and Gas Program activities in the Gulf and, of these, 90 would die from oiling. As indicated in the previous sections, the Bureaus conducted rulemakings to ensure protection of the environment; thus, NMFS finds that the existing regulatory regime for oil spill prevention is sufficient. NMFS concludes that oil spills from the Oil and Gas Program will not result in appreciable reductions in the number or reproductive potential of hawksbill sea turtles, or their distribution, in the Gulf of America, or throughout their range.

NMFS and USFWS (1993) identified the major actions needed to recover the U.S. Atlantic population of hawksbill sea turtles. Relevant to the proposed action, these include ensuring long-term protection of important foraging habitats. Criteria for delisting the U.S. hawksbill population include: 25-year increasing trends in the adult female nester population on five index beaches, and adult, subadult, and juvenile abundance in key foraging areas within Puerto Rico, USVI, and Florida. The plan identified the following major population limiting factors in the marine environmentl relevant to the Oil and Gas Program: entanglement; ingestion of marine debris; watercraft collisions; and oil and gas exploration, development, transportation, and storage. While we do anticipate hawksbill sea turtle mortality, injury and behavioral harassment from explosive severance, vessel strikes, and a large oil spill, as discussed above, we do not anticipate the effects to hawksbill sea turtles over the 45-year period considered in this opinion will impede the recovery objectives for the species in the wild.

In summary, we determined the effects of exposure to sound from explosive severance, vessel strikes, and one large (100,000 bbl) oil spill over the 45-year period of the Oil and Gas Program considered in this opinion, are not likely to appreciably reduce the survival and recovery of hawksbill sea turtle in the wild. Thus, we find the Oil and Gas Program is not likely to jeopardize the continued existence of the hawksbill sea turtle.

11.1.7 Leatherback Sea Turtle

We believe there is potential from lethal and non-lethal take of leatherback sea turtle from vessel strike, sound from G&G survey activities, explosive severance and pile driving, entanglement during site clearing trawls, entrapment in moon pools, and marine debris.

Based on the best available data, the total index of nesting female abundance for the leatherback Northwest Atlantic population is 20,659 females (NMFS and USFWS 2020). Using nesting females as a proxy for population, the TEWG (2007) determined that the Southern

Caribbean/Guianas stock, which is the largest known Atlantic leatherback nesting aggregation, demonstrated a long-term, positive population growth rate. Florida nesting beaches, largely along the east coast, similarly seem to demonstrate an increasing trend in nesting. The overall status of the Atlantic leatherback is less clear than the Pacific population but appears to be stable or increasing compared to the Pacific population, which has been declining based on data from nesting sites.

NMFS determined sound from G&G survey activities is expected to adversely affect leatherback sea turtles through exposure to sound levels causing sublethal physical injury or impairment (including TTS) and behavioral harassment throughout waters in the Gulf of America from Oil and Gas Program air guns. The quantitative acoustic effects analysis predicts 6,496 instances of behavioral harassment and 902 instances of sublethal physical injury or impairment (including TTS) annually for adult leatherback sea turtles. The calculated numbers of exposure do not necessarily represent individuals because repeat exposure of a single individual could occur. Pile driving and explosive severance may lead to sound exposure levels that cause mortality or injury, including PTS, TTS, and behavioral harassment. We predict 42 instances of lethal and serious injury and 42 instances of sublethal injury or impairment to adult leatherback sea turtles over the 45-year period of the Oil and Gas Program considered in this opinion. We predict 45 instances of sublethal physical injury or PTS, and 360 instances of impairment of adult leatherback sea turtles over the 45-year duration of the Oil and Gas Program considered in this opinion. In terms of PTS, individuals would have to within 176 m of the pile driving sound source and within 80 m of the explosive sound source in order to experience auditory injury. Given the use of PSOs and the likelihood that animals will move away from disturbance, we anticipate few individuals will be exposed to sound levels that result in more than minor hearing impairment. For those individuals that experience TTS, the available data suggest hearing will return to normal within days of the exposure (Moein et al. 1994).

Leatherback sea turtles are expected to experience sublethal physical injury or impairment and behavioral harassment from entanglement in trawl nets used during site clearance during commissioning and entrapment in moon pools. The effects analysis predicts 23 instances of entrapment in moon pools and 90 non-lethal captures of adult or juvenile leatherback sea turtles over the 45-year duration of the Oil and Gas Program considered in this opinion. Leatherback sea turtles are also expected to experience mortality or serious injury and sublethal physical injury throughout waters in the Gulf of America from encounters with Oil and Gas Program vessels. Based on our analysis, we estimated there would be three vessel strikes of adult and neritic juvenile leatherback sea turtles annually. Exposure to marine debris is also expected to result in lethal and non-lethal takes of adult leatherback sea turtle, although best management practices and control measures will minimize the chance for measurable quantities of debris to be present in the water. This means that, while we do not anticipate a change in distribution, there will be a decline in numbers because of the mortality of individuals and a loss of reproduction, particularly if adult females are among those that suffer mortality or sub-lethal effects that lead to a delay in reproduction. However, given the size and apparent stability of the Atlantic

leatherback sea turtle population, there would not be an appreciable reduction in the numbers and reproduction of the leatherback sea turtle in the Gulf or range-wide, or any change in distribution.

The best available information from index nesting sites in Mexico indicate the nesting female abundance for the leatherback Northwest Atlantic population is 20,659 females. A reasonable assumption is that approximately half of any of the adult sea turtles that suffer mortality of sublethal effects from explosive severance, sound from pile driving, entanglement or entrapment, vessel strike, or exposure to marine debris would be female. This means that, while we do not expect a change in distribution, there will be a reduction in numbers and reproduction. We do not consider this to be an appreciable reduction in the numbers of female leatherback sea turtles or the reproductive rate of the population, either on an annual basis or continuing into the reasonably foreseeable future considering the anticipated size of the population. Because we do not expect this level of mortality to result in an appreciable reduction in the numbers or reproductive rate of the leatherback sea turtle, we do not expect this level of mortality to impact the survival or recovery of this population. In addition, the relatively small loss of reproductive potential will not affect the current geographic range of this population, and no reduction in the distribution of this species is expected as a result of the action. Therefore, we conclude lethal and sub-lethal take and behavioral harassment resulting from exposure to sound, vessel strike, entanglement and entrapment, and marine debris from activities associated with the Oil and Gas Program will not appreciably reduce the survival of the leatherback sea turtle in the wild.

NMFS and USFWS (1992) identified the major actions needed to recover the U.S. Atlantic population of leatherback sea turtles. Relevant to the proposed action, these include protecting and managing turtles and habitat in the marine environment. Criteria for delisting the U.S. Atlantic leatherback population include a 25-year increasing trend in the adult female nester population, based on nesting trend data from Puerto Rico, USVI, and the east coast of Florida. The plan identified the following major population limiting factors in the marine environment relevant to the Oil and Gas Program: entanglement at sea; ingestion of marine debris; boat collisions; oil and gas exploration, development, transportation and storage, and pollution. While we do anticipate leatherback sea turtle mortality, injury and behavioral harassment from vessel strike, explosive severance, pile driving, G&G surveys, entanglement and entrapment, and marine debris, as discussed above, we do not anticipate the effects to leatherback sea turtle over the 45-year period considered in this opinion will impeded the recovery objectives for this species.

In summary, we determined the effects of exposure to sound from G&G survey activities, pile driving and explosive severance, entanglement and entrapment, vessel strikes, and marine debris over the 45-year period considered in this opinion, are not likely to appreciably reduce the survival and recovery of leatherback sea turtles in the wild. Thus, we find the Oil and Gas Program is not likely to jeopardize the continued existence of the leatherback sea turtle.

11.1.8 Gulf Sturgeon

We believe there is potential for lethal and non-lethal take of Gulf sturgeon from vessel strike and a large (100,000 bbl) oil spill.

Currently, seven rivers are known to support reproducing populations of Gulf sturgeon, including the Yellow, Choctawhatchee, and Apalachicola rivers, and juveniles and adults use estuarine and marine waters during the non-spawning season. The impacts of the Oil and Gas Program are expected to occur in Gulf sturgeon winter feeding grounds in the Gulf of America, meaning any of the seven river populations could be affected.

Gulf sturgeon population abundance estimates (USFWS and NMFS 2022) are 9,743 in the Suwannee River, 1,288 in the Apalachicola River, 1,036 in the Yellow and Blackwater system, and 377 in the Escambia. Only a minimum population abundance estimate of 2,000 using post-DWH analysis is available for the Choctawhatchee, and therefore we use this estimate in making our jeopardy determination. As described in our Status of the Species, post-DWH data for the Pearl and Pascagoula rivers are not available; we instead refer to our analysis of the available data on the Pearl and Pascagoula made in the Status of the Species chapter, including the recent data on positive population growth for those river systems. Given that the populations in the Pearl and Pascagoula are only a small percentage of the overall abundance of Gulf sturgeon (likely less than 5% of the total abundance), then even if the abundance of these two western populations was greatly reduced from the most recent available information, this estimated reduction would not significantly impact our jeopardy determination. In sum, Gulf sturgeon populations in the eastern portion of their range within the Gulf of America appear to be stable or slightly increasing, while populations in the western portion are associated with lower abundances and higher uncertainty, though the most recent data suggests a positive population growth in the Pearl and Pascagoula rivers.

Information is not available to partition the estimated impacts from Oil and Gas Program activities on Gulf sturgeon into river subpopulations. Gulf sturgeon are susceptible to vessel strikes, particularly in coastal areas. We estimated that one nonlethal and five lethal vessel strikes associated with Oil and Gas Program activities will occur over the 45-year period considered in this opinion. While we do anticipate a small number of Gulf sturgeon mortalities and injuries (some with fitness consequences) from vessel strike, the mortality and injury levels predicted will not result in an appreciable reduction in the numbers or reproductive rate of Gulf sturgeon. Our analysis of the potential effect of a very large oil spill (up to 100,000 bbl) occurring once over the 45-year period considered in this consultation indicated that up to 33 Gulf sturgeon could be exposed to oil from a blowout and subsequent very large spill from Oil and Gas Program activities in the Gulf, although this exposure is likely to be sublethal. As indicated in the previous sections, NMFS finds that the existing regulatory regime for oil spill prevention is sufficient. Because Gulf sturgeon are a long-lived species, adults can reproduce more than once, and no juveniles or spawning habitats are likely to be affected by Oil and Gas Program activities. NMFS concludes that vessel strikes and oil spills from the Oil and Gas Program will not result in

appreciable reductions in the number or reproductive potential of Gulf sturgeon, or a change in their distribution, in the Gulf of America. The best available information on population size indicates that the numbers of individuals that may be affected by Oil and Gas Program activities will be minimal in the context of the overall population of Gulf sturgeon and, if mortality or sub-lethal effects impact adult females, the reduction in number and reproduction would be minor. Therefore, we conclude lethal and sub-lethal take will not appreciably reduce the survival of Gulf sturgeon in the wild.

The 1995 Gulf Sturgeon Recovery Plan (NMFS and USFWS 1995a) identified the major actions needed to recover this species. Major population limiting factors include barriers (dams) to historical spawning habitats, loss of habitat, poor water quality, and overfishing. The short-term recovery objective is to prevent further reduction of existing wild populations and the long-term recovery objective is to establish population levels that would allow delisting Gulf sturgeon in distinct management units. While we do anticipate Gulf sturgeon mortality and injury from vessel strike and exposure to a large oil spill, as discussed above, we do not anticipate the effects to Gulf sturgeon over the 45-year period considered in this opinion will impede the recovery objectives for the species.

In summary, we determined the effects of vessel strikes and one large (100,000 bbl) oil spill over the 45-year period of the Oil and Gas Program considered in this opinion, are not likely to appreciably reduce the likelihood of survival and recovery of Gulf sturgeon in the wild. Thus, we find the Oil and Gas Program is not likely to jeopardize the continued existence of the Gulf sturgeon.

11.2 Critical Habitat Destruction/Adverse Modification Analysis

When determining the potential impacts to critical habitat for this opinion, NMFS relies on the regulatory definition of "destruction or adverse modification" of critical habitat from the revised regulations issued by NMFS and USFWS (84 FR 45016) on August 27, 2019. Under the revised regulations, destruction or adverse modification means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.

Ultimately, we seek to determine if, with the implementation of the action, critical habitat would remain functional (or retain the current ability for the PBF to become functional) to serve the intended conservation role for the species. This analysis takes into account the geographic and temporal scope of the action, recognizing that "functionality" of critical habitat necessarily means that it must now and must continue in the future to support the conservation of the species and progress toward recovery. The analysis must take into account any changes in amount, distribution, or characters of the critical habitat that will be required over time to support the successful recovery of the species. Because critical habitat for Rice's whale is proposed, the opinion expressed here for this critical habitat represents a conference opinion only. Should this

habitat be designated, additional steps will be required to determine whether it may be adopted as NMFS' biological opinion (See 50 C.F.R. §402.10).

The destruction and adverse modification analysis assesses the Oil and Gas program's effects to Gulf sturgeon designated critical habitat and proposed North Atlantic DPS green sea turtle and Rice's whale critical habitat. The following sections summarize the relevant information in this opinion about how the action is likely to adversely affect the species' critical habitat and PBFs.

We note, in regards to oil spills, oil spill response is a Federal action and requires consultation with NMFS under section 7 of the ESA, including in accordance with the emergency consultation procedures (50 C.F.R. §402.05) for any response activities that may affect ESA-listed species or their designated critical habitat. As part of any ESA section 7 consultation for an emergency response to an oil spill, the Federal action agency and NMFS will coordinate on the development and implementation of measures to insure the response action is not likely to jeopardize the continued existence of ESA-listed species or result in the destruction or adverse modification of their designated critical habitat.

Discharge of marine debris during oil and gas program activities is subject to a number of laws and treaties, including the Marine Debris Research, Prevention, and Reduction Act; the Marine Plastic Pollution Research and Control Act; and the International Convention for the Prevention of Pollution from Ships (MARPOL) Annex V treaty. These laws are enforced by the EPA, NOAA, and the U.S. Coast Guard. The measures and protocols contained in BSEE Appendix A2, *Marine Debris*, which BOEM also applies, are intended to reduce the oil and gas activities' marine debris. We expect that lessees will abide by these measures and all other regulations related to waste management. Based on our analysis (Section 9, Critical Habitat Effects Analysis), we found that the stressor of marine debris was not likely to adversely affect designated or proposed critical habitat.

11.2.1 Gulf Sturgeon Critical Habitat

Gulf sturgeon designated critical habitat units in estuarine and marine habitats under NMFS jurisdiction encompass a total of 6,042 km^2 of estuarine and marine habitats (Figure 48). BOEM oil and gas leasing areas do not overlap directly with Gulf sturgeon critical habitat, although vessel transit from ports servicing these areas does overlap. The key objective for the conservation and recovery of Gulf sturgeon that forms the basis for the critical habitat designation is to establish population levels that would allow delisting of Gulf sturgeon in discrete management units by first preventing further reduction of existing wild populations. Recovery cannot occur without a self-sustaining population, which is one in which the average rate of natural recruitment is at least equal to the average mortality rate in a 12-year period (NMFS and USFWS 1995a). Major population limiting factors include barriers to historical spawning habitat, habitat loss, poor water quality, and overfishing. To this end, our analysis seeks to determine whether or not the action is likely to destroy or adversely modify designated critical habitat in the context of the Status of the proposed critical habitat (Section 6), the

Environmental Baseline (Section 7), the Effects of the Action (Section 8), and Cumulative Effects (Section 9).

The PBFs for Gulf sturgeon critical habitat in estuarine and marine habitats include habitat components that support feeding, including abundant prey items for juvenile, subadult, and adult life stages; water quality, including temperature, salinity, pH, hardness, turbidity, oxygen content, and other chemical characteristics necessary for normal behavior, growth, and viability of all life stages; sediment quality, including texture and other chemical characteristics necessary for normal behavior, growth, and viability of all life stages; and safe and unobstructed migratory pathways within and between riverine, estuarine and marine habitats.

Thus, we need to assess whether the potential loss of prey and decline in water and sediment quality associated with a large oil spill (100,000 bbl) over the 45-year period considered in this opinion rise to the level of adversely modifying or destroying designated Gulf sturgeon critical habitat in the estuarine and marine environment as a whole. Specifically, whether a large oil spill will result in diminished function of the PBFs such that prey availability for juvenile, subadult and adult sturgeon, and normal behavior, growth and viability of all life stages are impaired. We determined the PBF associated with migratory pathways would not be adversely affected by a very large spill (assuming the spill was associated with a blowout at a deep water well). Other stressors resulting from the Oil and Gas Program activities that may affect Gulf sturgeon critical habitat were determined to be either discountable or insignificant (Section 9.1) and are not included in this analysis.

We anticipate that one very large spill (up to 100,000 bbl) is likely over the 45-year period considered in this opinion. BOEM estimated a less than 0.5% chance a spill greater than 1,000 bbl could contact Gulf sturgeon critical habitat (Ji and Schiff 2023), meaning there would be a greater probability for a spill >10,000 bbl, but the probability of oil from a deep water event would still be low. A large oil spill is likely to cause a decline in benthic communities and prey species utilized by Gulf sturgeon, particularly in the marine portions of designated critical habitat, based on information following the DWH event. A large oil spill will have detrimental effects on the PBFs related to the availability of prey and the support of demographic functions by water and sediment quality in the portion of the critical habitat unit or units reached by oil, although the quantity of oil is expected to be small by the time it reaches coastal areas. There are 6,042 km^2 of estuarine and marine areas in Gulf sturgeon critical habitat units along shorelines off the coasts of Louisiana, Mississippi, Alabama, and Florida. The DWH event led to oil being observed on more than 2,113 km of shoreline from Texas to Florida (Trustees 2016). Because the 100,000 bbl spill we evaluated as reasonably certain to occur over the 45-year period of the Oil and Gas Program considered in this opinion is approximately 3% of the size of the DWH event, we calculate up to 64 km of shoreline could be impacted, which would be a very small portion of the estuarine and marine designated critical habitat units. On the other hand, if there were a nearshore subsea pipeline rupture and spill, there would be a temporary loss in the function of the PBFs for prey availability and water quality, in particular, because oil would be

fresher and less would reach the sediment, although that PBF would also be affected. Given the location of pipelines in the action area in relation to Gulf sturgeon critical habitat units, the Pearl and Pascagoula river unit (Unit 8) is the most likely to be affected, as noted in Section 9.1.5. Unit 8 is the largest designated critical habitat unit and, given oil spill response requirements and that containment of spills is easier in the nearshore environment, we do not anticipate a spill from a nearshore pipeline rupture would lead to a permanent loss of the function of the PBFs, although there would be temporary loss of prey and water and sediment quality.

Impacts to designated Gulf sturgeon critical habitat from a large oil spill are expected to be localized and are not expected to result in the loss or degradation of large areas containing the PBFs of prey availability for juvenile, subadult and adult sturgeon, and water and sediment quality supporting normal behavior, growth and viability of all life stages. The PBFs of the critical habitat will not likely be altered or destroyed by the Oil and Gas Program activities to the extent that the survival and recovery of Gulf sturgeon would be appreciably reduced. We base this on current presence of Gulf sturgeon in areas containing the PBFs in the action area that are all outside the Oil and Gas Program Planning Areas. Therefore, we do not expect the effects of the action, in particular the stressor of a large oil spill discussed here that was found to adversely affect designated Gulf sturgeon critical habitat, to appreciably diminish the overall value of the critical habitat for the conservation of Gulf sturgeon in the action area. We conclude the action will not result in the destruction or adverse modification of designated critical habitat for Gulf sturgeon.

11.2.2 Rice's Whale Proposed Critical Habitat

The total area of the proposed critical habitat is 73,220.65 km^2 (Figure 115). The EPA encompasses 46,737 km^2 of the proposed critical habitat, or 63.8%. The majority of the EPA has been withdrawn from leasing, with only small portions of it not under Presidential withdrawal. It is withdrawn from leasing until June 30, 2032. The key objective for the conservation and recovery of Rice's whale that forms the basis for the proposed critical habitat designation is to support foraging opportunities (prey availability) and the animal's ability to receive and interpret sound (e.g., opportunities to forage or reproduce). Recovery cannot occur without protecting the PBFs to support sufficient density, quality, abundance and accessibility of prey species and marine soundscape conditions that support occupancy and use for Rice's whales. Man-made stressors, including oil and gas-related activities, have the greatest impact on habitat quality for Rice's whale. To this end, our analysis seeks to determine whether or not the action is likely to destroy or adversely modify proposed critical habitat in the context of the Status of the proposed critical habitat (Section 6), the Environmental Baseline (Section 7), the Effects of the Action (Section 8), and Cumulative Effects (Section 9).



Figure 115. Map of Action Area with Rice's whale proposed critical habitat and BOEM planning areas

The PBFs for Rice's whale proposed critical habitat include:

- Sufficient density, quality, abundance, and accessibility of small demersal and vertically migrating prey species, including scombriformes, stomiiformes, myctophiformes, and myopsida; and
- Sufficiently quiet conditions for normal use and occupancy, including intraspecific communication, navigation, and detection of prey, predators, and other threats.

Thus, we need to assess whether the potential loss of prey species from mortality caused by sound from seismic airgun surveys or a large oil spill, or temporary shifts in prey and a change in the marine soundscape caused by exposure to sound from seismic airgun surveys of vessel noise over the 45-year period considered in this opinion rise to the level of adversely modifying or destroying the proposed critical habitat when considered as a whole. Specifically, whether these activities will result in dimished function of the PBFs such that foraging, intraspecific communication, navigation, and detection of prey and threats are impaired. Other stressors resulting from the Oil and Gas Program activities that may affect proposed Rice's whale critical habitat were determined to be either discountable or insignificant (Section 9.2) and are not included in this analysis.

Our effects analysis concluded that seismic survey activities are not likely to have permanent effects to the PBFs of prey and the marine soundscape. We do not have information about the specific locations or amount of seismic survey effort that will occur in the proposed critical habitat. From the NMFS MMPA rule authorizing take of marine mammals incidental to geophysical surveys in the action area (89 FR 31488), we know that seismic activity is not evenly distributed throughout the action area and is largely absent from the EPA, which comprises approximately two-thirds of the proposed critical habitat area. In addition, a sizable

proportion of seismic effort annually (roughly one-third) will occur in deep waters outside the proposed critical habitat (Table 1; 89 FR 31488).

Where seismic surveys occur within the proposed critical habitat, the PBF of prey availability could be affected through mortality of fish prey species, if they are within a few meters of the airgun array (Buchanan et al. 2004; Dalen and Knutsen 1986b), or temporary shifts in prey availability as they move away from the sound source. We expect any prey that temporarily move away from seismic survey activities will return and be available as prey for Rice's whale within a short time (hours to days) once survey activities are complete. Similarly, despite disturbance to the PBF of marine soundscape during seismic survey activities, the majority of survey activities will occur outside the areas where Rice's whale densities are highest. Frasier et al. (2024a) documented the most airgun survey activity in areas with active lease blocks and noted deep water sites had the most consistent occurrence of seismic signals because of long-range sound propagation. Given this information, the majority of seismic activity producing sound that could disrupt prey availability and, thus, the ability of Rice's whale to forage or disrupt Rice's whale's ability to communicate by altering the marine soundscape, will occur outside the proposed critical habitat.

Rice's whales may adjust their communication to cope with changes in ambient sound, as has been suggested for North Atlantic right whales (Parks et al. 2007; Parks et al. 2011; Tennessen and Parks 2016) given that Rice's whales are a full-time resident of the Gulf where vessel traffic is frequent, even without oil and gas-related activities. As shown in Section 8.4.1, annual average kilometers of vessel traffic from oil and gas-related vessels are greatest in the Central and Western Planning Areas, with comparatively little traffic in the EPA. Vessel slowdowns result in substantially lower vessel sound source levels, reducing noise duration in the vicinity (Findlay et al. 2023). There are over 1,400 active production platforms in the Gulf of America, with none in the RWA. In addition, two-thirds of the proposed critical habitat is in the EPA, the majority of which is under a Presidential withdrawal on oil and gas activities until 2032. The small number of platforms and the limited oil and gas activity in the area with the highest density of Rice's whale, combined with the required speed reduction through the RWA means alterations to the PBF of the marine soundscape from vessel noise will be minimal in the majority of the proposed critical habitat. Deep water sites (beyond the 400 m isobleth) are where much of the Oil and Gas Program activities are expanding and where the majority of active leases are located, which are outside the proposed critical habitat area. Thus, the majority of activities generating vessel noise for longer periods will take place outside the proposed critical habitat and vessel noise within the boundaries of proposed critical habitat will largely be from vessel transit to and from deep water sites, meaning vessel presence will be transitory and not expected to alter the marine soundscape of the proposed critical habitat to a degree that would impede the function of this PBF as a whole.

We anticipate that one very large spill (up to 100,000 bbl) is likely over the 45-year period considered in this opinion. A very large oil spill is likely to cause a decline in benthic

communities and prey species utilized by Rice's whale, based on information following the DWH event. A very large oil spill will have detrimental effects on the PBF related to demographic functions, including feeding, because of the decline in prey. Based on predictions of oil spill risk by (BOEM 2017c; BOEM 2021b) (Ji and Schiff 2023; Li et al. 2021a), portions of the WPA and CPA and a small portion of the EPA where oil and gas activities occur are most likely to be affected by a larger spill. Using the maximum calculated DWH footprint area (Macdonald et al. 2015) and our very large spill estimate of 100,000 bbl, which is approximately 3% of the volume of the DWH spill, we determined the area affected by oil could be up to 705 km^2. Thus, a large oil spill could affect approximately 1% of the total proposed critical habitat for Rice's whale, specifically the PBF associated with prey availability. The area most likely to be affected is outside the RWA where Rice's whale densities are highest and, by extension, the majority of foraging occurs.

Impacts to the proposed Rice's whale critical habitat from sound from seismic survey activities and oil and gas vessels and a large oil spill are expected to be localized and not are not expected to result in the loss or degradation of large areas containing the PBFs of prey and marine soundscape. The PBFs of the proposed critical habitat will not likely be altered or destroyed by Oil and Gas Program activities to the extent that the survival and recovery of affected species would be appreciably reduced. We base this on current presence of Rice's whales in area containing the PBFs throughout the action area in the Oil and Gas Program Planning Areas and, particularly, in the RWA, which is largely inside the EPA. Therefore, we do not expect the effects of the action, in particular the stressors discussed here that were found to adversely affect proposed Rice's whale critical habitat, to appreciably diminish the overall value of the proposed critical habitat for the conservation of Rice's whale in the action area. We conclude the action will not result in the destruction or adverse modification of proposed critical habitat for Rice's whale.

11.2.3 North Atlantic DPS Green Sea Turtle Proposed Critical Habitat

Nearshore green sea turtle critical habitat units are proposed along the coasts of Texas and Florida, portions of which are in the action area, as well as along the coasts of North Carolina and Puerto Rico with a total area of 96,349 km^2 (Figure 32). *Sargassum* habitat encompassing 1,047,564 km^2 off the coasts of these states and territory is also proposed. This habitat encompasses 707,832 km^2 in the action area. BOEM oil and gas leasing areas do not overlap directly with the majority of the proposed nearshore critical habitat because the depth limit for these units is 20 m, but Oil and Gas Program activities do overlap with the portions of the proposed *Sargassum* critical habitat units in the Gulf. The key objective for the conservation and recovery of Atlantic green sea turtles that forms the basis for the critical habitat designation is to establish population levels that, over a 25-year period, would allow delisting of Atlantic green sea turtles by demonstrating an increase in nesting activity and a reduction in stage class mortality of existing wild populations, as well as the protection of at least 25% of available nesting beaches (NMFS and USFWS 1991). Recovery cannot occur without long-term protection

of important nesting beaches, at least 60% hatch success on major nesting beaches, lighting management on nesting beaches, knowledge of the distribution and seasonal movements for all life stages in the marine environment, minimization of mortality from commercial fisheries, and a reduction of the threat to population and foraging habitat from marine pollution (NMFS and USFWS 1991). Major population limiting factors in the marine environment include oil and gas exploration, development, and transportation, dredging, marina and dock development, seagrass bed degradation, commercial fisheries, boat collisions, power plant entrapment, underwater explosions, offshore artificial lighting, entanglement, and ingestion of marine debris. To this end, our analysis seeks to determine whether or not the action is likely to destroy or adversely modify designated critical habitat in the context of the Status of the proposed critical habitat (Section 6), the Environmental Baseline (Section 7), the Effects of the Action (Section 8), and Cumulative Effects (Section 9).

The PBFs for North Atlantic DPS green sea turtle nearshore marine units include habitat components that allow access to and from nesting beaches and mating, and underwater refugia and food resources to support survival, development, growth and/or reproduction. For the *Sargassum* unit, habitat components include sufficient food resources and refugia to support the survival, growth, and development of post-hatchlings and surface-pelagic juveniles located in at least 10 m water depth to ensure offshore transport via ocean currents to areas that meet forage and refugia requirements. Thus, we need to assess whether the potential loss of prey and decline in food resources and refugia in nearshore habitat associated with a large oil spill (100,000 bbl) over the 45-year period considered in this opinion rise to the level of adversely modifying or destroying proposed North Atlantic DPS green sea turtle critical habitat in the nearshore marine environment as a whole. Specifically, whether a large oil spill will result in diminished function of the PBFs such that prey availability and refugia to support survival, development, growth, and/or reproduction for juvenile, subadult and adult sea turtles are impaired. We determined the PBF associated with *Sargassum* habitat would not be adversely affected by a very large spill given our estimate that a very large spill would affect approximately 705 km^2 while this habitat unit encompasses 707,832 km^2 of ocean in the Gulf, and we anticipate the ephemeral nature and annual cycle of rapid growth, movement, and subsequent die-off will allow *Sargassum* to repopulate quickly if patches are exposed to oil. Other stressors resulting from the Oil and Gas Program activities that may affect Gulf sturgeon critical habitat were determined to be either discountable or insignificant (Section 9.1) and are not included in this analysis.

We anticipate that one very large spill (up to 100,000 bbl) is likely over the 45-year period considered in this opinion. BOEM estimated a less than 0.5% chance a spill ≥ 1,000 bbl could contact Gulf sturgeon critical habitat (Ji and Schiff 2023), which shares some of the same locations and nearshore habitat characteristics as the proposed North Atlantic DPS green sea turtle critical habitat, meaning there would be a greater probability for a spill >10,000 bbl, but the probability of oil from a deep water event would still be low. A large oil spill is likely to cause a decline in benthic communities and prey species utilized by juvenile, subadult and adult green sea turtles in the nearshore marine portions of proposed critical habitat, based on

information following the DWH event. A large oil spill will have detrimental effects on the PBFs related to the availability of prey and the support of demographic functions in the portion of the critical habitat unit or units reached by oil, although the quantity of oil is expected to be small by the time it reaches coastal areas. The DWH event led to oil being observed on more than 2,113 km of shoreline from Texas to Florida (Trustees 2016). Because the 100,000 bbl spill we evaluated as reasonably certain to occur once over the 45-year period of the Oil and Gas Program considered in this opinion is approximately 3% of the size of the DWH event, we calculate up to 64 km of shoreline could be impacted, which would be a very small portion of the proposed nearshore green sea turtle critical habitat units along the coasts of Texas and Florida.

Impacts to proposed North Atlantic DPS green sea turtle critical habitat from a large oil spill are expected to be localized and not are not expected to result in the loss or degradation of large areas containing the PBFs of prey availability and refugia for juvenile, subadult and adult green sea turtles supporting survival, development, growth and/or reproduction. The PBFs of the critical habitat will not likely be altered or destroyed by the Oil and Gas Program activities to the extent that the survival and recovery of North Atlantic DPS green sea turtle would be appreciably reduced. We base this on current presence of green sea turtles in areas containing the PBFs for nearshore critical habitat in the action area that are largely outside the Oil and Gas Program Planning Areas. Therefore, we do not expect the effects of the action, in particular the stressor of a large oil spill discussed here that was found to adversely affect proposed North Atlantic DPS green sea turtle critical habitat, to appreciably diminish the overall value of the critical habitat for the conservation of green sea turtle in the action area. We conclude the action will not result in the destruction or adverse modification of proposed critical habitat for North Atlantic DPS green sea turtle.

12 CONCLUSION

After reviewing the current status of the ESA-listed species, the environmental baseline within the action area, the effects of the proposed action, and cumulative effects, it is NMFS' biological opinion that the proposed action is likely to jeopardize the continued existence of the Rice's whale.

We note here that only the stressor of vessel strike to Rice's whale violates section 7(a)(2) by causing a likelihood of jeopardy to a listed species, and a RPA has been recommended (Section 13). In Section 13, we describe the other stressors determined to adversely affect Rice's whale, noting existing regulatory systems or other factors that reduce their impacts to Rice's whale relevant to our jeopardy analysis. Normally, we would not include further discussion of stressors that are not likely to jeopardize the continued existence of a species in our opinion. However, because these stressors were discussed in the context of the RPA in the *Sierra Club v. NMFS* litigation that precipitated this opinion, we discuss further why an RPA is not appropriate for effects to Rice's whale other than vessel strike.

It is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of sperm whale, Northwest Atlantic loggerhead sea turtle, Kemp's ridley sea turtle, North Atlantic DPS green sea turtle, leatherback sea turtle, hawksbill sea turtle, or Gulf sturgeon. Additionally, it is NMFS' biological opinion that the proposed action is not likely to destroy or adversely modify loggerhead or Gulf sturgeon designated critical habitat, or proposed critical habitat for green sea turtle North Atlantic DPS or Rice's whale.

13 REASONABLE AND PRUDENT ALTERNATIVE

When NMFS concludes that an action is likely to jeopardize an ESA-listed species or is likely to destroy or adversely modify designated and proposed critical habitat, NMFS suggests a reasonable and prudent alternative (RPA) (section 7(b)(3)(A) of the ESA) that would allow the action to proceed in compliance with section 7(a)(2) and implementing regulations at 50 CFR §402.10(c). To this end, NMFS recommends the following RPA to BOEM and BSEE to ensure the Gulf of America oil and gas program operates in accordance with the ESA.

Through this consultation, NMFS finds that the operation of oil and gas vessels in the Gulf of America, in an area where the endangered Rice's whale occurs, is likely to jeopardize the continued existence of the whale due to the risk of vessel strike. The RPA described below reduces or avoids the primary threat to Rice's whales in our analysis, the risk of injurious and lethal vessel strike interaction. The impacts of other stressors that are part of the proposed action are more limited in space and time, diffuse, or not likely to result in adverse effects to Rice's whale. Below, we summarize again the stressors generated by the proposed action and how they are addressed by the RPA. Regarding marine debris, under current regulation, operators are prohibited from deliberately discharging containers and other similar materials (i.e., trash and debris) into the marine environment (30 CFR §250.300(a) and (b)(6)) and are required to make durable identification markings on equipment, tools, containers (especially drums), and other material (30 CFR §250.300(c)) so that they are traceable to the source. In addition, BSEE NTL 2015-G03 "Marine Trash and Debris Awareness and Elimination" provides guidance to prevent intentional and/or accidental introduction of debris into the marine environment. These mitigations include the posting of informational placards and making Marine Trash and Debris Awareness training available to employees working offshore. Marine debris effects are therefore minimized from the program and our analysis of the effects of marine debris resulting in one sublethal take of Rice's whale did not contribute to the likelihood of jeopardy conclusion on the proposed action; therefore, no measures addressing marine debris are included in the RPA.

In terms of chronic sound, vessel noise is not expected to have lethal or injurious effects, but, rather, it may cause chronic behavioral effects. We expect the restrictions in the RWA included in the 2020 BiOp and in the proposed action for this BiOp to reduce the potential for exposure to vessel sound to the degree that behavioral harassment is minimal, or even discountable, where the species is most likely to occur. In addition, the greatest density of Rice's whales is not within the busiest vessel traffic regions of the action area. We believe vessel noise is adequately mitigated by the vessel speed restrictions in the 2020 Rice's Whale Area and also expect

implementation of the Rice's whale vessel strike avoidance technology plan (RW tech plan) described below will result in reduced vessel noise elsewhere in the action area given the ability vessels will have to avoid transiting near Rice's whales; therefore, no measures to address vessel noise are included in the RPA. This additional benefit of the RW tech plan further reduces the impacts of vessel noise to Rice's whales.

Regarding seismic noise, the MMPA regulation governing the authorization of incidental marine mammal take from seismic activity associated with the Oil and Gas Program contains mitigation, monitoring, and reporting requirements relevant to all marine mammals, with particular attention to Rice's whale (86 FR 5322). For example, as reflected in the Letter of Authorization, the scope of BOEM's action excluded the Presidential moratorium area (and thus the RWA in the Eastern Planning Area). We consider these existing requirements and elements of the action, taken together, to be sufficient to reduce impacts that may contribute to adverse effects. We believe Rice's whales would avoid exposure to injurious sound levels based on information from other baleen whales and the lack of G&G activities within the Rice's whale area mean exposure of individuals to injurious sound levels from seismic surveys is less likely. Any exposures that do occur would be at sound levels that would not impede the animal's ability to find prey, avoid predators, or locate conspecifics to socialize and reproduce. Therefore, no measures to address seismic activities are included in the RPA.

Regarding oil spills, BSEE has regulations in place, some of which have been implemented since the 2020 BiOp was issued, to strengthen oil spill prevention and oil spill response measures, improving the overall safety of oil and gas activities. Depending on the location of an oil spill, Rice's whales could be exposed and that exposure could contribute to a reduction in fitness of individual whales. The Bureaus are mandated under OCSLA and OPA to ensure protection of the environment while facilitating the federal government's leasing of its offshore mineral resources and energy resources, and have conducted rulemakings to that effect. For example, BSEE amended their Drilling Safety Rule in 2016 to strengthen oil spill prevention requirements. In 2019, BSEE revised their Well Control Rule, which was revised again in 2023 to clarify blowout preventer (BOP) system requirements and to modify certain specific BOP equipment capability requirements. These rules, along with others detailed in Section 3.1.5.1 are in place to increase safety and to reduce the likelihood of spill occurrence. NMFS acknowledges that the Bureaus are the entities tasked by statute with determining the best measures to implement for oil spill prevention, and, after independently reviewing such measures, NMFS finds that the existing regulatory regime for oil spill prevention substantially reduces the risk of exposure for Rice's whale to oil spills. While our analysis showed that multiple small oil spills may occur over the course of the program, we determined only a single large spill (100,000 bbl) is reasonably certain to occur over the 45-year period considered in this opinion that could lead to exposure of up to one Rice's whale. Thus, no measures addressing oil spills are included in the RPA.

Finally, our analysis of all stressors, considered together, does not lead to a different conclusion from that described for each individual stressor. The impact of threats to the species was

presented in the range-wide status of the species, and the impact of stressors not associated with the action that affect the status of the species in the action area was presented in the environmental baseline. Our effects analysis considered all stressors caused by the Oil and Gas Program, and our jeopardy analysis considered all stressors in the context of the range-wide status of the species, environmental baseline, and effects of the action. We do not foresee a multiplicative impact from combining stressors, but rather, an aggregate one, which we have fully considered by addressing each stressor in turn, while incorporating the range-wide status of the species and environmental baseline, including all existing impacts of the ongoing oil and gas program, in our understanding of the species' current status and trajectory. We do not believe, for instance, that individual exposure to sound from various sound sources contributes to the likelihood of jeopardy from vessel strike for the proposed action. Therefore, associated measures are not included in the RPA.

NMFS's implementing regulations define reasonable and prudent alternatives as alternative actions, identified during formal consultation, that: (1) can be implemented in a manner consistent with the intended purpose of the action; (2) can be implemented consistent with the scope of the action agency's legal authority and jurisdiction; (3) are economically and technologically feasible; and (4) NMFS believes would avoid the likelihood of jeopardizing the continued existence of ESA-listed species or resulting in the destruction or adverse modification of critical habitat (50 CFR §402.02). The overarching requirement is that an RPA be capable of avoiding the likelihood of jeopardizing ESA-listed species and adversely modifying designated and proposed critical habitat – all other elements of the definition must be evaluated within this context. The other three factors are intended to implement the statutory phrase "can be taken by the Federal agency or applicant in implementing the agency action." 16 U.S.C. §1536(b)(3)(A).

13.1 Proposed RPA

We have developed the following RPA to avoid the likelihood of jeopardizing the continued existence of the endangered Rice's whale, which has low population numbers (estimated at less than 100) and is highly vulnerable to vessel strike mortality, effects of sound, and the combination of other stressors from the proposed action. Because vessel strike is the stressor that underlies the conclusion that the proposed action is likely to jeopardize the continued existence of the species, the RPA is focused on this stressor.

If BOEM and BSEE choose to implement the RPA for the programmatic opinion, the RPA will be in effect for the timeframe of the opinion (45 years). BOEM and BSEE would coordinate with NMFS on implementation of the RPA in the first five years and then review the RPA at least every five years to evaluate progress and determine whether and how the RPA may need to be modified to ensure the oil and gas program is not likely to jeopardize the continued existence of the Rice's whale and is consistent with any future MMPA rule. This review would be in addition to or in conjunction with any other review of the RPA or the opinion by the agencies that is appropriate under the reinitiation triggers defined in Section 16 of the opinion.

The RPA requires the following as it relates to vessel activity in the action area, which is identified and defined in Figure 14.

1. **Immediately begin to use technology to enable Rice's whale vessel strike avoidance and monitoring of presence of Rice's whale.**
    - Upon adoption of the RPA, BOEM and BSEE will identify a near real-time platform to help oil and gas related vessels avoid strikes of Rice's whale while the Rice's whale vessel strike avoidance technology plan is under development (see RPA #4). The platform should allow for near real-time reporting of all sightings of large whales (live or dead) that could be Rice's whales within the RWA and the 100 - 400 m isobath outside the RWA (see Figure 27). The platform should be accessible to BOEM, BSEE, and all oil and gas vessel operators (e.g., WhaleAlert, a readily available system) and be structured so that data can be used reliably for Rice's whale avoidance in real time.[43]
    - In addition, BOEM and BSEE, in collaboration with NMFS, must identify and incorporate data from any existing near real-time Rice's whale detection systems (e.g., existing near real-time PAM equipped to detect Rice's whales, visual observations from PSOs) into the identified platform. As additional devices and near real-time Rice's whale detection data systems come online, BOEM and BSEE, in collaboration with NMFS, must work to ensure they are integrated into the near real-time sightings platform to establish an integrated platform for all Rice's whale detections in the Gulf of America (e.g., see WhaleMap for North Atlantic right whales).
    - All oil and gas operators in the specified area must monitor the Rice's whale near real-time detections platform, as crew and vessel safety allows, and take any necessary action to avoid or reduce the likelihood of vessel strike (e.g., by changing trajectory or speed, see Attachment 3, Vessel strike avoidance protocol, for specifics). This includes taking appropriate action in response to detections by the vessel itself as well as in response to any other detections (e.g., from the near real-time platform) that indicate the potential presence of a Rice's whale in the vicinity of the operating vessel. BOEM and BSEE, in collaboration with NMFS, must also monitor this platform for all detections of Rice's whales and ensure oil and gas vessel operators are aware of any detections as soon as practicable but no later than 24 hrs of becoming aware of the detection.

[43] Data in this platform are intended for mariner safety and awareness and should not be used in another context without further validation.

2. **Establish an expert working group to support development and implementation of a Rice's whale vessel strike avoidance technology plan (RW Tech Plan)**
    - Within one month of issuance of the BiOp and adoption of the RPA, BOEM and BSEE must form and chair an expert working group, in collaboration with NMFS, the applicants, and other relevant experts to inform BOEM and BSEE as they develop, test, and implement a RW tech plan The expert working group must include individuals with expertise in oil and gas development activities, marine mammal biology and behavior, vessel types and traffic patterns, and other relevant expertise. The expert working group must be convened at least once every three months, or at some other more frequent cadence, prior to initial implementation of the RW tech plan.
3. **Improve understanding of Rice's whale vessel strike risk associated with the proposed action**
    - Within one year of the issuance of this opinion, BOEM and BSEE, in coordination with NMFS and the expert working group, must complete an advanced assessment of vessel strike risk of Rice's whale in the Gulf of America. This assessment should aim to further our understanding of the uncertainties associated with estimating injurious and lethal vessel strikes from oil and gas program-associated vessel operations, including the potential effects of vessel size, vessel speed, employment of detection technologies, and crew training to avoid vessel strikes. The assessment must rely on the best available scientific and commercial information and methodology.
    - The assessment should make use of recent and future scientific methods to assess vessel strike risk for large whales and consider existing data gaps and recommended improvements for assessing vessel strike risk to Rice's whales (e.g., Blondin et al. 2025, Garrison et al., 2025, Stevens et al. 2024, among others).
    - As new information becomes available, the vessel strike risk assessment must be updated as appropriate to ensure this RPA is still meeting its intended objectives.
4. **Develop a Rice's whale vessel strike avoidance technology plan (RW Tech Plan)**
    - Within 18 months of issuance of this opinion BOEM and BSEE, in coordination with NMFS and the expert working group shall develop a Rice's whale vessel strike avoidance technology plan (i.e., within 6 months of completing an updated vessel strike risk assessment). Such a plan should consider other technology transition plans developed by the U.S. Government (e.g., https://orta.research.noaa.gov/plans/).

- The RW Tech Plan must: be informed by the advanced vessel strike risk assessment (RPA #3); consider information from the near-real time platform and detection systems noted above (RPA #1); lay out clear steps to develop, evaluate, and implement technology to reduce the likelihood of injurious and lethal vessel strikes from oil and gas vessel operations of Rice's whale; and outline how the agencies will engage industry and the private sector to develop, test, and implement the plan. The plan may modify or replace the near real-time platform and detection systems noted above (RPA #1). The plan should harness existing, ongoing, and future technology (e.g., vessel avoidance technology used to prevent vessel interactions with North Atlantic right whales or other large whales), to reduce the likelihood of vessel strikes of Rice's whales. It should also consider pairing technology with real-time/near real-time spatio-temporal protective measures, modifications to vessel operations such as speed and trajectory (in real time) to prevent strikes of oncoming whales, and avoiding areas where Rice's whales are known to be present, etc.
- While the RW Tech Plan must prioritize use of technology where Rice's whales are at heightened vessel strike risk outside of areas where existing speed restrictions are included as part of the proposed action (i.e., the RWA), it should consider application of technologies throughout the full action area, including in the RWA, to further minimize the likelihood of jeopardizing the continued existence of Rice's whales.
- The RW Tech Plan should directly integrate with ongoing efforts by NMFS and other federal agencies to promote the recovery of Rice's whale (e.g., recovery plan) in order to avoid duplication and ensure a cost effective, streamlined approach for meeting the requirements of the MMPA and ESA while reducing the potential for regulatory burden on marine industries.
- In accordance with 50 C.F.R. § 402.02, the RW Tech Plan should be economically and technologically feasible.

5. **Undertake independent peer review**

- To ensure that the vessel strike risk assessment (RPA# 3) and the RW tech plan (RPA #4) are based on the best available scientific and commercial data available, both must undergo a scientific peer review process involving independent experts in large whale biology, vessel strike risk modeling, Gulf of America vessel traffic patterns, and other relevant disciplines, and resulting documents must be made publicly available. The vessel strike risk assessment and RW tech plan must be implemented as appropriate on the timelines outlined below (RPA #6) so as not to cause unreasonable delays and BOEM and BSEE must revise the Tech Plan as needed as a result of the peer review.

6. **Implement Rice's whale vessel strike technology plan**

    - Within 24 months of issuance of this opinion, BOEM and BSEE, in coordination with NMFS and the expert working group must begin implementation of the technology plan, which may consist of whale detection and avoidance technology that is available within this period of time. Implementation must continue to ensure that oil and gas program-associated vessel operation is not likely to jeopardize the continued existence of endangered Rice's whales (see RPA #4).
    - As noted above, at least every 5 years following initial implementation of the RW Tech Plan, BOEM and BSEE, in coordination with NMFS and the expert working group must review the effectiveness of the RW tech plan implementation and modify the Plan as needed such that the application of technologies to reduce vessel strikes, which may evolve over time, continues to ensure that the continued existence of Rice's whale is not likely jeopardized. Such modifications should be documented as amendments to this opinion and made publicly available

7. **Monitor Rice's whales to ensure no likelihood of jeopardy during RPA implementation**

    - Upon acceptance of this RPA and issuance of this opinion, and to ensure the action is not likely to jeopardize the continued existence of endangered Rice's whales while components of this RPA are further developed and implemented, BOEM and BSEE, in coordination with NMFS, must develop and implement plans to monitor each of the following within the action area:
        - Rice's whale population abundance, distribution, and health. Such monitoring serves as a means to ensure the status of the species remains unchanged from its status as evaluated in this opinion and to assess undetected (cryptic) vessel strikes of Rice's whales and the potential population level impacts. This monitoring may make use of various methodologies including vessel surveys, aerial surveys, PAM, biological sampling, telemetry, among others, and may involve external research entities as well as agency activities. A plan for this monitoring must be developed and implementation must begin within 1 year of the finalization of this opinion.
        - All vessel traffic associated with the action. Such monitoring must provide data, to be shared and reported to NMFS, for regular re-assessment of vessel strike risk over the course of implementation of the 45-year timeframe of this opinion utilizing the risk assessment from RPA #1. Vessel monitoring may make use of existing vessel tracking/monitoring technologies and programs such as Automatic Identification System (AIS) vessel traffic monitoring, but must allow for complete monitoring of all

vessel traffic associated with the action. Vessel traffic monitoring and reporting must begin within 6 months of acceptance of this RPA and finalization of this opinion and should be modified as needed to ensure comprehensive monitoring of vessel traffic associated with the proposed action through the timeframe of this opinion.

- All potential vessel strikes of Rice's whales. This should include strikes of any large object that could be a Rice's whale involving any vessel operating in association with the action, as well as any observations of live or dead possible Rice's whales that may have been struck by a vessel. If, through this monitoring, it is determined that a Rice's whale has likely been struck and killed or injured, BOEM and BSEE must immediately coordinate with NMFS to determine if consultation needs to be reinitiated and if modifications to this RPA are necessary. Vessel strike monitoring must begin within 6 months of acceptance of this RPA and finalization of this opinion and should be modified as needed to ensure comprehensive monitoring of vessel strikes through the timeframe of this opinion.

The implementation of this RPA is expected to reduce the risk of vessel strikes from oil and gas program-related vessel operation such that injurious or lethal strikes of Rice's whale are discountable over the full implementation of the RPA and continued operation of the Gulf of America oil and gas program for the full timeframe of the opinion (45 years). Thus, implementation of this RPA is expected to avoid the likelihood of this oil and gas program jeopardizing the continued existence of endangered Rice's whales.

13.2 Compliance with RPA Criteria

Under ESA section 7(a)(2), the proposed action must avoid the likelihood of "jeopardiz[ing] the continued existence of a species in the wild, by appreciably reducing the likelihood of a species' survival and recovery." A RPA to the proposed action is one that avoids the likelihood of jeopardy to the species by ensuring that the action's effects do not appreciably increase the risks to the species' potential for survival or recovery. The RPA must also be: (1) consistent with the intended purpose of the action; (2) within the scope of the federal agency's legal authority and jurisdiction; and (3) economically and technologically feasible.

To evaluate if the RPA is consistent with the intended purpose of the action, we considered the purpose of the program. This RPA is consistent with the purpose of the programmatic action, as it will allow for continuance of the oil and gas program in the Gulf of America while ensuring the program is not likely to jeopardize the continued existence of the Rice's whale. BOEM and BSEE would implement and enforce this RW Tech Plan through whichever means are most efficient, practicable, and reliable, including agreements with industry, programmatic lease stipulations, conditions of approvals on permits and authorizations, NTLs (or comparable guidance), best management practices, and/or other appropriate authorities.

To evaluate if the RPA is within the scope of the action agency's legal authority, we considered the Bureaus' responsibilities and authorities under the OCSLA relevant to this RPA. BOEM is responsible for environmental studies related to its oil and gas leasing program. BSEE is responsible for enforcing safety and environmental regulations, including offshore regulatory programs to develop standards and regulations to enhance operational safety and environmental protection for oil and gas activities on the OCS. Because of these responsibilities, the development and implementation of a RW Tech Plan is within the scope of authority of BOEM and BSEE.

To evaluate if the RPA is technologically and economically feasible, we considered the existing use of whale detection technology and methods by vessels such as those used on seismic survey vessels, and broader adoption of whale alert technology in the oil and gas and maritime industries. Implementation of the RPA may impose additional costs because it requires commitment of resources to set up and enact the RW Tech Plan. However, the RPA is economically and technologically feasible for the action agencies because it does not require the development of technology by the agencies but rather the employment of technology as it becomes available, in a phased approach, and can be implemented through mechanisms routinely used to address other environmental impacts of the oil and gas program, such as BOEM/BSEE lease stipulations or other permits or authorizations (e.g., LOAs under the MMPA).

13.3 RPA Analysis of Effects

The RPA reduces or avoids the risk of injurious and lethal vessel interaction with Rice's whales in conjunction with Oil and Gas Program vessel operations.

Vessel strike risk is elevated in areas where Rice's whales are concentrated and, thus, likely to be more exposed to vessel traffic, both in quantity and speed, as discussed in Section 8.4.2. Therefore, assessing and reducing vessel strike risk through the use of technology to enable implementation of real-time/near real-time spatio-temporal protective measures in areas where Rice's whales are at risk of vessel strike is reasonable and prudent. The RPA, as proposed, prevents the likelihood of jeopardizing the continued existence of Rice's whale by reducing risk of injurious or lethal vessel strike. Specifically, the RPA would:

Avoid or reduce mortalities and serious injuries of Rice's whales by implementing technological solutions to reduce the risk of vessel strikes from oil and gas program-related vessel operation such that injurious or lethal strikes of Rice's whales are discountable.

As summarized in the Effects of Vessel Strikes analysis in Section 8.4.2, an estimated 12 whales are likely to be struck due to BOEM-authorized vessel traffic associated with the oil and gas program in the 45 years over which the program was analyzed for this consultation. Nine of these strikes are expected to result in death or serious injury, and three are expected to result in minor or no injury but are nevertheless still considered "takes" under the ESA. The action includes existing speed restrictions in certain areas, including the RWA (Attachment 4). The RWA contains the highest known density of Rice's whales in the action area, so inclusion of this

measure reduces the likelihood of a lethal or injurious vessel strike. Nonetheless, the speed restrictions in the RWA still do not eliminate possible vessel strike inside the RWA or address possible vessel strike outside that area where our analysis still indicated a high risk of vessel strike. As such, it is necessary to apply further measures to mitigate the likelihood of an injurious or lethal encounter from vessel traffic for Rice's whale. The primary intent of the RW Tech Plan in this RPA is to focus on reducing vessel strike risk in the higher risk areas outside the RWA, though the advancements made through development and implementation of the plan are expected to reduce vessel strike risk wherever such technological tools are employed, and many technologies can and should be considered for application throughout the action area as necessary.

With the speed restrictions that BOEM adopted as part of their action applied in the RWA, our vessel strike analysis in Section 8.4.2 estimated an annual rate of lethal strike for Rice's whale of 0.18. Cumulatively, this amounts to an average of one lethal strike of Rice's whale every 5.6 years. This estimate is based on certain assumptions described in Section 8.4.2, and is likely to be improved with further research and analysis as part of RPA #1. Implementation of the RW Tech Plan will begin within 1.5 years, and we also find that the risk of vessel strike will be substantially reduced by the rapid deployment of the real-time platform described in RPA #1. Considering the low likelihood of vessel strike take of Rice's whales during the development of the plan and the use of the real-time platform to further reduce risk, we conclude that the action is not likely to jeopardize the Rice's whale during the development of the RW Tech Plan.

We note that the monitoring requirements included in the RPA will ensure that, if a strike were to occur, consultation will be reinitiated and the RPA re-evaluated. Within 1.5 years of the finalization of this opinion on May 20, 2025, implementation of the RW Tech Plan will have begun (RPA #3). We expect that implementation will continue from this point forward, likely in phases as new technology becomes available and is shown to be effective at reducing vessel strike risk. During this time, and for the remainder of the timeframe covered by this opinion, there will be an adaptive management plan for re-assessing vessel strike risk (RPA #1) and monitoring potential effects from vessel strikes (RPA #4), which will inform any necessary changes to implementation of the RW Tech Plan (RPA #4) to ensure the Oil and Gas Program is not likely to jeopardize the continued existence of Rice's whale.

Our vessel strike analysis accounted for limitations in the available vessel data, assumptions made regarding the carcass recovery rate, and relied on the best available scientific and commercial data to produce a vessel strike risk estimate to assess exposure. A preliminary examination of vessel strike risk of Rice's whale from oil and gas program related vessels following the recently published methods of Blondin et al. 2025, adds some uncertainty to the number of estimated Rice's whale vessel strikes. This highlights the importance of the first component of the RPA as a critical first step before development and implementation of the other components.

In order to ensure that the first phase of the RW Tech Plan is implemented on schedule, BOEM and BSEE must report to NOAA Fisheries in its annual reporting, on the status of implementation of the RPA. If it is apparent that the action agencies will not be able to achieve the deadlines set forth for each component of the RPA, reinitiation will be required.

NMFS believes that this is a reasonable, pragmatic, and sufficiently reliable approach to avoid the likelihood that the Oil and Gas Program-related vessel operation will jeopardize the continued existence of Rice's whale, and one that satisfies the criteria for a RPA described above, and provided in our regulations at 50 C.F.R. §402.02. The implementation of the RPA will reduce lethal or injurious vessel strikes of Rice's whales to a degree that they will be extremely unlikely to occur and discountable, meaning the effects of vessel strikes are not likely to adversely affect Rice's whale.

13.4 RPA Conclusion

After reviewing the current status of the listed species, the environmental baseline within the action area, the effects of the proposed action, and cumulative effects, it is our biological opinion that the proposed action, as revised by this RPA, is not likely to jeopardize the continued existence of the Rice's whale.

Because this opinion has found the proposed action is likely to jeopardize the continued existence of Rice's whale, BOEM and BSEE are required to notify NMFS of its final decision regarding implementation of the RPA (50 CFR §402.15(b)). If an alternate action is selected rather than the RPA, BOEM and BSEE must ensure that the new action is not likely to jeopardize listed species or destroy or adversely modify critical habitat and consultation with NMFS under section 7(a)(2) should be conducted for the new action.

14 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is defined by regulation (50 CFR §222.102). NMFS has defined the term "harass" in policy (PD 02-110-19) as to create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns that include, but are not limited to, breeding, feeding or sheltering. "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR §402.02). Section 7(b)(4) and section 7(o)(2) of the ESA, as well as in regulation at 50 CFR §402.14(i)(5) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this ITS.

When an action is reasonably certain to result in incidental take of ESA-listed marine mammals, section 7(b)(4) of the ESA requires that such taking be authorized under section 101(a)(5) of the

MMPA before the Secretary can issue an ITS for ESA-listed marine mammals, and the ITS must specify those measures identified as necessary to comply with section 101(a)(5) of the MMPA. The Permits and Conservation Division issued regulations to govern the unintentional taking of marine mammals incidental to geophysical survey activities conducted by oil and gas industry operators in the Gulf of America over the course of five years, pursuant to section 101(a)(5) of the MMPA, effective through April 19, 2026. Accordingly, the terms of this ITS for ESA-listed marine mammals and the associated exemption from Section 9 of the ESA for ESA-listed marine mammals are effective through April 19, 2026. Subsequent MMPA rule-making may require revisions to the ITS for incidental take of ESA-listed marine mammals or opinion, or reinitiation of ESA section 7 consultation, if the scope and subsequent effects of the MMPA rule making change.

The Oil and Gas Program required a Reasonable and Prudent Alternative, or RPA, to comply with section 7(a)(2) of the ESA and NMFS identified an appropriate RPA, consistent with section 7(b)(3). This ITS is specific to incidental take analyzed and evaluated in the RPA. If the Bureaus choose to adopt this RPA, this ITS would exempt the take anticipated to occur incidental to the alternative action.

The Bureaus are not required to adopt the RPA and can instead implement an alternative action they believe is not likely to jeopardize the continued existence of ESA-listed species or adversely modify or destroy designated critical habitat. However, until the Bureaus consult with the Services on that alternative action, they have not satisfied the requirements of section 7(a)(2) to ensure the proposed alternative action is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of critical habitat (16 U.S.C. §5136(a)(2)). Therefore, this ITS, which is specific to the RPA in this opinion, would not apply and provides no exemption for incidental take resulting from any other actions.

14.1 Amount or Extent of Take

Section 7 of the ESA and its implementing regulations require NMFS to specify the impact of any incidental take of endangered or threatened species; that is, the amount or extent of such incidental taking on the species (50 C.F.R. §402.14(i)(1)(i)). The amount of take represents the number of individuals that are expected to be taken by a proposed action while the extent of take specifies the impact, i.e., the amount or extent, of such incidental taking on the species, which may be used if we cannot assign numerical limits for animals that could be incidentally taken during the course of an action (see 80 FR 26832). Where it is not practical to quantify the number of individuals that are expected to be incidentally taken by the action, a surrogate (e.g., similarly affected species or habitat or ecological conditions) may be used to express the amount or extent of anticipated take (50 C.F.R. §402.14(i)(1)(i)). A surrogate may be used when the following three conditions are met and the ITS: 1) describes the causal link between the surrogate and take of the listed species, 2) explains why it is not practical to express the amount or extent of anticipated take or to monitor take-related impacts in terms of individuals of the

listed species, and 3) sets a clear standard for determining when the level of anticipated take has been exceeded.

We anticipate the Oil and Gas Program in the Gulf of America and associated activities are likely to result in the incidental take of ESA-listed sperm and Rice's whales and sea turtles (Kemp's ridley, North Atlantic DPS green, Northwest Atlantic loggerhead, leatherback, and hawksbill) by death, injury, and harassment (Tables 109, 110, and 111). Additional incidental take of Gulf sturgeon from lethal (five) and non-lethal (one) vessel strikes and two sperm whales from pile driving sound are anticipated over the 45-year period considered in this opinion but are not included in the tables below. We also anticipate TTS and behavioral harassment of Rice's whale from vessel noise associated with the Oil and Gas Program but are not able to quantify the amount of incidental take. However, we anticipate the affected individuals will be the same as those exposed to other stressors for which we are able to estimate incidental take.

The estimated amount of incidental take from the activities associated with the Oil and Gas Program are explained in our effects analysis (Section 8). It is important to note that the numbers are numbers of exposures to a stressor and may reflect multiple exposures of the same individuals rather than numbers of individuals exposed. As discussed in our effects analysis, sea turtle take estimates could not be determined to species level for some stressors. In these cases, effects were classified as being to hardshell turtles as a group. Based on the best available data, we expect that the majority of these unidentified hardshell turtles will be loggerhead sea turtles (Northwest Atlantic Ocean DPS), with the remainder representing green (North Atlantic DPS) and Kemp's ridley sea turtles. With respect to Rice's whale and sperm whale, the anticipated amount of incidental take authorized under the final MMPA rule is only for marine mammal take that is incidental to geophysical survey activities and does not include pile-driving, which we determined was likely to result in a very low number of Rice's whales experiencing ESA harassment. As described further below, this ITS uses surrogate measures to monitor levels of incidental take to determine whether these are exceeded for some activities where monitoring of individual animals is not feasible.

At this time, we are unable to quantify the incidental take from some activities described in Section 3.4 for which step-down review will be required, and, potentially, tiered consultation under this programmatic. Tiered consultation, when required, will enable us to determine the amount of incidental take of ESA-listed species for specific activities under the program. The ITS in this opinion is meant to establish the boundaries for take occurring under the Oil and Gas Program. Therefore, if the results of the effects analysis for a tiered consultation reveal an activity will result in additional incidental take, the ITS in this opinion may be amended or consultation reinitiated, as appropriate.

Additionally, while we quantify incidental take of Rice's whale and sperm whale from vessel interaction, and Rice's whale from pile driving sound, incidental take of animals from stressors from these activities cannot be exempted under the ESA until such time as takes are authorized under section 101(a)(5) of the MMPA. The MMPA rule effective through April 20, 2026 does

not include authorization of MMPA Level A or Level B harassment of marine mammals from pile driving noise or interactions with vessels. Likewise, from April 18, 2026 (the end of the existing MMPA rule) through the end of the Oil and Gas Program considered in the opinion, there are no actual and observed takes of ESA-listed marine mammals authorized under the MMPA. In addition, we lack information about where, when, and over what spatial scale specific geophysical surveys may occur for which a new MMPA rule may be promulgated. Therefore, for this ITS, we use the number of incidental takes in the last year of the MMPA rule as a surrogate for the annual amount of take of Rice's whale and sperm whale during geophysical surveys from April 18, 2026 onward.

We also note that NMFS is not exempting a specified amount of incidental take from a large oil spill (100,000 bbl) in this ITS. The ESA and its implementing regulations allow exemptions for "incidental take," which are "takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant" (50 C.F.R. §402.02). Releases of harmful amounts of oil are unlawful under the CWA and the OPA, and, thus, are not a lawful activity for which take may be exempted.

This approach accords with prior agency practice, including our approach in the 2020 and 2007 biological opinions on the Gulf Oil and Gas Program, the November 9, 2022 Biological Opinion on Deepwater Oil Exportation Port Construction, Operation, and Decommissioning, Continental Shelf in Galveston/Freeport Area, Brazoria Counties, Texas[44], and the agency's practice regarding oil and gas activities elsewhere in the country (see, e.g., June 16, 2006 Biological Opinion on Oil and Gas Leasing and Exploration Activities in the U.S. Beaufort and Chukchi Seas, Alaska; June 4, 2015 Biological Opinion on Lease Sale 193 Oil and Gas Exploration Activities, Chukchi Sea, Alaska). NMFS believes this is the appropriate position on this matter, and notes that it is also consistent with the USEPA's approach, which does not permit oil spills under the CWA or OPA. Providing take exemptions under the ESA for activities the USEPA may not permit under the CWA would be both inconsistent in practice and would require making a distinction between the two statutes that is not apparent from any statutory text. We note that reinitiation of consultation would be necessary should oil spills exceed the volume anticipated or effects from oil spills to listed species or critical habitat exceed those analyzed here.

We note that, in the 2020 biological opinion, NMFS did exempt incidental take from marine debris, some of which may be lawfully discharged but some of which we anticipated would be discharged in violation of governing statutes and regulations. Exempting incidental take from the illegal discharge of marine debris was incorrect. In this opinion, we are not exempting take from unlawful discharges of marine debris, consistent with our approach to unlawful discharges of oil.

[44] See https://doi.org/10.25923/gx4d-xz46. Accessed 5/19/2025.

Table 102. Estimated amount of incidental take by harassment of ESA-listed sea turtles over the 45-year duration of the Oil and Gas Program. Note that take associated with sound may represent repeat exposures of the same individuals rather than numbers of individuals.

Stressor	Leatherback Sea Turtle	Loggerhead Sea Turtle	Kemp's Ridley Sea Turtle	Green Sea Turtle	Hawksbill Sea Turtle
G&G Activities					
Impairment (TTS) from Seismic survey sound	40,590	1,828,800	1,167,480	41,175	0
Harassment from seismic survey sound exposure (TTS/Behavioral)	292,320	13,166,055	8,405,055	296,325	0
Lethal entanglement in equipment	0	17	18	4.5	0
Entrapment in moon pools	23	22	0	0	0
Offshore Infrastructure Activities					
Hearing injury (PTS) from pile driving sound exposure	45	720	360	450	0
Disturbance from pile driving sound exposure	360	20,925	10,575	12,060	0
Vessel strike					
Adults and neritic juveniles	135	3,420	3,465	10,170	0
Oceanic juveniles	0	14	225	1,170	0
Site Clearance Activities					
Non-lethal capture in trawl net	90	540	1,485	225	0
Structure Severance Activities					
Impairment from exposure to sound/impact from explosives	42	1,001	490	228	0

Stressor	Leatherback Sea Turtle	Loggerhead Sea Turtle	Kemp's Ridley Sea Turtle	Green Sea Turtle	Hawksbill Sea Turtle
Harassment from exposure to sound/impact from explosives	0	263	317	372	0
Injury/Lethal effects from exposure to sound/impact from explosives	42	762	409	182	0

Table 103. Estimated amount of incidental take by harassment of ESA-listed marine mammals from seismic survey sound exposure under each year of the MMPA rule. Note that take associated with sound may represent repeat exposures of the same individuals rather than number of individuals

Stressor	Rice's Whale	Sperm Whale
G&G Activities		
Harassment from seismic survey sound exposure (TTS/Behavioral) – year 1 of MMPA rule***	27	13,198
Harassment from seismic survey sound exposure (TTS/Behavioral) – year 2 of MMPA rule***	26	11,208
Harassment from seismic survey sound exposure (TTS/Behavioral) – year 3 of MMPA rule***	23	11,063
Harassment from seismic survey sound exposure (TTS/Behavioral) – year 4 of MMPA rule***	25	8,126
Harassment from seismic survey sound exposure (TTS/Behavioral) – year 5 of MMPA rule***	30	10,127
Harassment from seismic survey sound exposure (TTS/Behavioral) – pending MMPA rule****	26	10,744

***Take numbers reflect the Rice's and sperm whale take numbers in the MMPA rule, which vary by year based on expected fluctuations in geophysical survey activity levels. For the years over which the MMPA rule is effective (2021-2026), these numbers are used to compare to actual reported take numbers to confirm take has not been exceeded; reported observations can be used for this, though these can underrepresent actual exposures. Under the MMPA rule, the total instances of take that may be authorized for any given species or stock over the course of the 5 years covered under these regulations must not, and is not expected to, exceed the sum of the 5 years of take

indicated for the 5 years in that rule. Additionally, in any given year, the instances of take of any species must not, and are not expected to, exceed the highest annual take listed in that rule for any of the 5 years for a given species. **** Take numbers reflect predicted annual averages for Rice's and sperm whale. After the MMPA rule is no longer in effect (April 2026), these numbers will be used to estimate future take until a new MMPA authorization is in effect. Package for new MMPA authorization submitted by industry March 24, 2025.

Table 104. Estimated amount of incidental take by vessel strike of ESA-listed marine mammals over the 45-year duration of the Oil and Gas Program

Stressor	Rice's Whale	Sperm Whale
Non-lethal vessel interaction	0	4
Lethal vessel interaction	0	12

Surrogate Measures for Monitoring Incidental Take

The incidental take expected from this action was quantified in terms of numbers of individuals expected to be taken over the 45-year duration of the oil and gas program (Tables 1, 2, and 3). For some of the stressors resulting in incidental take of ESA-listed sea turtles and whales, take can be directly monitored and reported by protected species observers. These include sea turtle take resulting from entanglement in G&G survey equipment and capture in trawl nets during site clearance activities, and sea turtle and sperm whale take from impact pile driving activities. Takes of ESA-listed species from impact pile driving sound will be categorized as either PTS or disturbance based on the estimated distances from the pile to the animal, as recorded by observers. Because pile driving is a stationary sound source, most ESA-listed species are expected to be observable. For structure explosive severance activities, NMFS' PROP will report ESA-listed sea turtle take through direct monitoring using helicopter and onboard observers for each structure removal project. Takes of sea turtles from explosives will be categorized as either injury/lethal take or harassment based on the estimated distances from the detonation to the animal, as recorded by observers.

For other stressors, it is not practicable to directly monitor take in terms of individuals. Feasible monitoring techniques for detecting and calculating actual take at the scale of the oil and gas activities described in this opinion do not exist. As such, we must rely on proxy indicators to determine when anticipated take levels are exceeded. To provide a clear standard for determining when the level of anticipated take is exceeded, we establish surrogate measures for monitoring the predicted take to ensure it does not exceed the authorized take limits in Tables 1, 2, and 3. Note that the identification of surrogates with respect to whales does not, in itself, reflect any exemption of whale take under this ITS.

Geophysical survey activities: At this time, there is no known practicable way to detect and calculate actual take of sea turtle species from G&G activities because we lack information about where, when, and over what spatial scale surveys may occur, and MMPA section 101(a)(5) rule making, IHAs and LOAs do not require reporting of sea turtle take. Similarly, in the absence of MMPA take estimates for Rice's and sperm whales beyond April 19, 2026, we use the annual number of takes authorized in the last year of the existing MMPA rule and monitor for take using the surrogate measure of the location and extent of geophysical survey track lines reported to us under the terms and conditions of this ITS. The location and extent of geophysical survey track lines is causally linked to the take of listed species because we can estimate take using density information for a specific project location. BOEM will provide an annual report summarizing geophysical survey activities in terms of the amounts and locations of geophysical survey track lines as part of the annual program review. For the Eastern and Central Planning Areas, we will use percentage reductions shown in Table 2 of BOEM (2021a) to determine the percentage of activity levels that cannot be exceeded for the zones that include those areas. We use the estimate of the total track line distance in each planning area (as shown in the bottom row of Table 3 of this opinion), and account for the percentage removal of the Presidential withdrawal area (i.e., GOMESA) specified in BOEM (2021a). In addition, because the estimates in Table 3, as provided by BOEM, are 10-year estimates of track line distances, the geographically-adjusted totals are divided by 10 to come up with an annual expected average track line distance for each planning area. We then compare the actual reported track line distances (averaged over 3 years) to this number to gauge whether take exceedance has occurred.

Vessel Strikes: We anticipate take in the form of strikes from oil and gas related vessels for Rice's and sperm whales, Gulf sturgeon, and sea turtles. However, any such take of marine mammals is not exempted until and unless there is authorization for those takes under the MMPA. If adopted and implemented, we anticipate the RPA would reduce the likelihood of strikes from oil and gas related vessels for Rice's whales to the point at which they are considered discountable. There are no feasible techniques for directly monitoring the full extent of vessel strike take (either lethal or nonlethal) of these species given that strikes of many species may go unnoticed and/or unreported. It is, therefore, not practical for every species to use direct monitoring and reporting of such incidents as the sole means of monitoring total takes from vessel strikes because it may under-represent the actual number of incidents. While stranding reports may provide a minimum estimate of animals killed (or injured) from vessel strike, the large majority of animals struck by vessels do not strand. In estimating the number of vessel strikes of sea turtles and sperm whales that are likely to result from the action, we used AIS data on vessel traffic in the Gulf of America (Section 8.4.1). In this analysis, we assumed that these data from past vessel traffic operations in the Gulf are representative of future vessel traffic operations, and as such, monitoring vessel traffic in the same way it was used for our effects analysis serves as an appropriate surrogate for monitoring vessel strike take of ESA-listed species.

For sea turtles and whales, the key factors used in our effects analysis to estimate the number of vessel strikes were: 1) gridded AIS vessel traffic data (Figure 66) and species density data, which we used to derive a metric of co-occurrence or risk (Figure 70); and 2) stranding data, which we used to calculate annual rates of vessel strikes, corrected for undocumented or unobserved vessel strikes. Given this, an appropriate surrogate for monitoring vessel strike takes of sea turtles and whales is one that allows for monitoring of meaningful changes in co-occurrence and/or stranding rates, as these are strong indicators of actual vessel strikes at sea. As such, on an annual basis, we will work with BOEM and BSEE to generate comparable gridded AIS data (cite to supplemental table of gridded data), and in conjunction with the best available information on species density and distribution, assess if there are differences in the co-occurrence of each species and the amount of oil and gas related vessel traffic that indicate vessel strike take associated with the oil and gas program is likely to have been exceeded for sea turtles and sperm whales. For example, in estimating vessel strikes of loggerhead sea turtles, the action-area wide co-occurrence (sea turtles x kilometers of vessel traffic) we evaluated ranged from 20,588,507 to 217,680,682 (note this value does not represent the number of animals, but rather a metric of risk with units kilometer*animals) depending on the year and month of data used. Given this, if in our annual assessment we find that co-occurrence for a given month is higher than 217,680,682, reinitiation may be warranted depending on whether or not it was lower or higher in other months such that, in aggregate, overall risk was higher in that year than we considered in this opinion. To assist with this monitoring, the vessel traffic and species density data used to calculate co-occurrence for this opinion can be found in Appendices C-I.

In addition, and because there are likely additional factors that contribute to the likelihood of vessel strikes of sea turtles and whales beyond co-occurrence that we were not able to account for in our analysis (see Section 8.4), in coordinate with BOEM and BSEE, we will also monitor stranding data to assess whether there is a meaningful difference in the annual rate of vessel strikes of sea turtles and whales based stranded animals with evidence of vessel strikes. Keeping with the same example, if, during an annual review, new data become available that suggest loggerhead sea turtles with evidence of vessel strikes are stranding at rates higher than the rate used in our vessel strike effects section (Section 8.4), reinitiation may be warranted, after consideration of other factors that may cause a change in range not indicative of vessel strike take being excited, such as major increases in non-oil and gas vessel traffic or significant increases in efforts to collect stranding data.

It is important to note that small increases in either co-occurrence or stranding rates may not necessarily indicate vessel strike take associated with the proposed action has been exceeded given the precision and level of certainty of our vessel strike take estimates. Nevertheless, these key factors are the best available data for monitoring whether the amount of vessel strike take associated with the oil and gas program has been exceeded. It is important to note that this approach represents a substantial change from the approach we adopted in the 2020 opinion. It explicitly incorporates a spatio-temporal component of vessel strike risk (co-occurrence) and documented incidents of vessel strikes from stranding data, mirroring our analysis in the effects

section of this opinion and providing a reasonable proxy for vessel strike consistent with the court's findings on this issue in Sierra Club v. NMFS.

We adopt a different approach for Gulf sturgeon. As explained in the Analysis of Effects section (Section 8.4.4), research relating the probability of a sturgeon floating after a strike, the probability of drifting to shore, and the probability of then being found and reported provides a direct link between the number of vessel strikes and the number of stranded individuals. This direct link is different in nature than that expected for whales and sea turtles, and therefore our approach to monitoring take is different, as discussed below.

For Gulf sturgeon we will rely on stranding reports to establish when vessel strikes have exceeded what was anticipated. In the Analysis of Effects (Section 8.4.4) we provide the best available science that estimates the probability of a sturgeon floating after being struck by a vessel, the probability of that floating sturgeon reaching shore, and finally the probability of that stranded sturgeon being found and reported. Not all stranded sturgeon are killed by vessel strike, though the physical damage makes vessel strikes easily identifiable. Further, not all vessel struck sturgeon are killed by vessels associated with this action. Over the 45 years of this action, we anticipate reports of 11 vessel struck sturgeon, of which, 2 will be caused by vessels associated with this action. If more than 11 vessel struck sturgeon are reported during this 45 year period, it may be appropriate to reinitiate consultation.

14.2 Reasonable and Prudent Measures

In implementing the reasonable and prudent measures described below, NMFS anticipates using adaptive management. Adaptive management is a systematic approach for improving resource management by learning from management outcomes. An adaptive approach involves exploring alternative ways to meet management objectives, predicting the outcomes of alternatives based on the current state of knowledge, implementing one or more of these alternatives, monitoring to learn about the impacts of management actions, and then using the results to update knowledge and adjust management actions. Adaptive management promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from actions and other events become better understood (e.g., making minor changes to protocols). As a regular part of the interagency ESA Section 7 consultation, the adaptive management process allows for BOEM, BSEE, and NMFS to collaboratively implement in a reasonable timeframe (e.g., phased implementation) new data source identification and methods of data collection, compilation and reporting.

"Reasonable and prudent measures" are measures that are necessary or appropriate to minimize the impact of incidental take on the species (50 CFR §402.02). These measures "cannot alter the basic design, location, scope, duration, or timing of the action and may involve only minor changes" (50 CFR §402.14(i)(2)). NMFS believes the following RPMs are necessary and appropriate:

1. To reduce the risk of sound from oil and gas-related activities to ESA-listed Rice's whales, sperm whales, North Atlantic DPS green sea turtles, Kemp's ridley sea turtles,

leatherback sea turtles, and Northwest Atlantic DPS loggerhead sea turtles, BOEM and BSEE will require industry use the quietest configuration of equipment necessary to conduct geophysical surveys.

2. BOEM and BSEE will require personnel (i.e., captain and crew) carrying out site clearance trawling activities to have proper PSO training and to record details of each trawl.
3. To reduce the risk of vessel strike from oil and gas-related activities to ESA-listed sperm whales, North Atlantic DPS green sea turtles, Kemp's ridley sea turtles, leatherback sea turtles, and Northwest Atlantic DPS loggerhead sea turtles, BOEM and BSEE shall compile and analyze PSO reports during oil and gas activities where PSOs are required to assess their effectiveness and include this information in their annual program report.
4. BOEM, in conjunction with BSEE, shall compile, summarize, and include in their annual program report information regarding the effectiveness of PDCs and other required measures to control unauthorized releases of trash, debris, or oil associated with the Oil and Gas Program activities to NMFS, including investigation reports or other information, as available.

14.3 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the BOEM, BSEE, and NMFS' Permits and Conservation Division must comply (or must ensure that any applicant complies) with the following terms and conditions. The BOEM, BSEE, and NMFS's Permits and Conservation Division or any applicant have a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR §402.14(i)(3)).

Term and Condition #1

The following terms and conditions implement RPM 1:

A. BOEM, in conjunction with BSEE, shall require that industry consider all configurations of equipment available for the type of survey being conducted without compromising data acquisition. The selected configuration should produce the lowest sound source levels (rms and/or peak to peak) over frequencies audible to the aforementioned ESA-listed species, while still accomplishing the goals of the survey.

Term and Condition #2

The following terms and conditions implement RPM 2:

A. BOEM, in conjunction with BSEE, shall require trawl personnel to complete a NMFS-approved PSO course on identifying, handling, and resuscitating sea turtles.

B. BOEM, in conjunction with BSEE, shall require trawl personnel to record sightings of sea turtles (i.e., species, number of animals, and location observed during transit to and from site and while trawling), the location and start/stop times for each trawl line, and any sea turtles entrapped within the trawl (i.e., species, number of animals, condition, handling, resuscitation and release status and location).

Term and Condition #3

The following terms and conditions implement RPM 3:

A. Details included in the report should include information regarding the hours of observer effort per activity (for those activities requiring PSOs) and the time of year and location of activities, sea state and visibility during active observation hours, and total sighting counts by animal type and activity, as well as an assessment of the effectiveness of PSOs for each activity type and in terms of positivie identification of animals. Information should also be included regarding any measures taken to avoid vessel interactions with ESA-listed species and the effectiveness of these measures.

Term and Condition #4

The following terms and conditions implement RPM 4:

A. Details included in the report should include information regarding the type of release, an estimate of the quantity or volume, date, location, and any PDCs and other measures used to control unauthorized releases and their effectiveness, as well as suggestions for improvements or additions to these measures to minimize the potential for future occurrences. Information should also be included regarding any investigation into the release and any ESA-listed resources (species, age class, and number of animals, as available) observed in the vicinity of the release.

15 CONSERVATION RECOMMENDATIONS

Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on ESA-listed species or critical habitat, to help implement recovery plans or develop information (50 C.F.R. §402.02).

We make the following conservation recommendations, which would provide information for future consultations involving the proposed programmatic action that may affect ESA-listed species as well as reduce injury or harassment related to the authorized activities:

1. We recommend that BOEM and BSEE create a reporting/auditing process for BOEM/BSEE permitting. Consider creation of online reporting system that industry, BOEM/BSEE, NMFS and the public can use simultaneously for closer-to real-time information and ease of annual reporting.
    a. BOEM uses a process to deem an application complete and, part of that process helps BOEM determine whether further review is necessary. To improve and streamline the intake process the following items could be used:
        i. Consideration of NUTs use;
        ii. ESA-listed species and designated critical habitats that could be present and determination of effects to those species;
        iii. Worst Case Discharge scenario associated with the plan does not exceed the WCD outlined in the applicant's (BOEM/BSEE-approved) Regional Oil Spill Response Plan;
        iv. Verification that the Regional Oil Spill Response Plan has been approved by BOEM/BSEE and is up-to-date; and
        v. Sound source information for DP vessels.
    b. We recommend BOEM/BSEE work with NMFS to ensure the checklist that BOEM's receiving department uses for determining plan sufficiency includes information necessary for BOEM/BSEE to verify that implementation of the plans will not result in actions exceeding the types and levels of effects anticipated in this programmatic opinion individually or in aggregate.
2. We recommend that BOEM consider making turtle guards a requirement for all permits involving towed gear. Towed or derelict gear has the potential to entangle or entrap sea turtles. Turtle guards are described in section 8.6.2, and the comprehensive use of turtle guards on towed gear will prevent entanglement or entrapment occurrence. This measure, which many G&G companies appear to already take, further reduces the likelihood of adverse effects to ESA-listed sea turtles and does not appear to affect the quality of seismic data obtained.
3. We recommend that BOEM and the NMFS Permits and Conservation Division work with the G&G companies to coordinate their seismic surveys such that across companies the overall impact of the seismic activity on ESA-listed species is minimized. Based on the available data, the greatest impact is expected to occur if animals are more frequently disturbed and have little time for recovery between disturbances. As such, staggering the permitting of surveys, if allowable given the G&G companies' timelines, may reduce the overall additive impacts associated with the proposed action.

4. We recommend BOEM and BSEE continue to work with the oil and gas industry to minimize the effects of sound resulting from the Oil and Gas Program activities and report any progress during annual activity reviews.
5. We recommend that BOEM, BSEE and the NMFS Permits and Conservation Division work to make the data collected as part of the required monitoring and reporting available to the public and scientific community in an easily accessible online database that can be queried to aggregate data across required reports. Access to such data will not only help us better understand the biology of ESA-listed species (e.g., their range), it will also inform future consultations and authorizations by providing information on the effectiveness of the conservation measures and the impact of Oil and Gas Program activity on ESA-listed species.
6. We recommend BOEM, BSEE, and the NMFS Permits and Conservation Division encourage G&G companies to test and employ technology similar to that described in the RPA in this opinion for the detection of ESA-listed whales, sea turtles, and large fish species in the Gulf of America to determine whether technological solutions exist that could reduce the risk of vessel strike to these animals.
7. We recommend USEPA, BOEM and BSEE conduct research to aid in the further understanding of effluents, as part of their action, and their potential to affect ESA-listed species. BOEM and BSEE are in the best position to understand the full effects of the oil and gas program including the effects regulated under other agencies. This could include improving knowledge on how well each species used for toxicity testing may represent ESA-listed species.
    a. We recommend EPA submit all Gulf of America NPDES general permit oil and gas discharges monitoring data to NMFS ESA section 7 Consulting Biologist.
    b. We recommend USEPA compile, summarize and annually report to NMFS all Oil and Gas Program NPDES general permit non-compliance events that result in enforcement action.
8. We recommend BOEM and BSEE continue to reduce the uncertainty related to the effects of oil and gas emissions and discharges on ESA-listed species and their habitats. This includes working with other federal agencies (e.g., USCG and USEPA) to better understand aggregate effects to ESA-listed species from emissions/discharges and improve standards for prevention of unlawful events or impacts to ESA-listed species and their designated critical habitats. We recommend BOEM continue to model air emissions and use those estimates to feed into an updated atmospheric fate and transport model to estimate concentrations of pollutants, and better evaluate risk to air breathing ESA-listed marine species and their designated critical habitats.
9. We recommend USEPA work with BOEM and BSEE to improve knowledge on effects of air emissions on ESA-listed species, especially offshore.

10. We recommend USEPA aid in the conservation of the imperiled Rice's whale in the RWA of the Gulf of America by implementing non-exceedance of the NAAQS near the area where Rice's whales are primarily found.
11. We recommend BOEM/BSEE consider the recommendations in Murawski (2020b) regarding minimizing risk of spills from ultra-deep wellsite locations. Additionally, we recommend consideration of the recommendations in Frasier (2020) discussing preparation strategies for future spills in at-risk regions based on lessons learned from the DWH event.

In order for us to be kept informed of actions minimizing or avoiding adverse effects on or benefiting ESA-listed species or their critical habitat, BOEM, BSEE, and the NMFS Permits and Conservation Division should notify us of any conservation recommendations they implement in their final action.

16 REINITIATION NOTICE

This concludes formal consultation on the Oil and Gas Program in the Gulf of America with proposed activities from BOEM, BSEE, and NMFS' Permits and Conservation Division. As 50 C.F.R. §402.16 states, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if:

1. The amount or extent of taking specified in the incidental take statement is exceeded.
2. New information reveals effects of the agency action that may affect ESA-listed species or critical habitat in a manner or to an extent not previously considered.
3. The identified action is subsequently modified in a manner that causes an effect to ESA-listed species or designated critical habitat that was not considered in this opinion. This includes creation of new regulations or revisions to existing regulations that modify the proposed action.
4. A new species is listed or critical habitat designated under the ESA that may be affected by the action.

In accordance with the above, reinitiation may be needed if:

1. Leasing and post-lease activities are planned in the Eastern Gulf of America under Presidential withdrawal until June 30, 2032, if it is not renewed or otherwise modified (see *"Memorandum on Withdrawal of Certain Areas of the United States Outer Continental Shelf From Leasing Disposition,"* September 8, 2020).
2. Change or cessation of the MMPA rule and LOA requirements issued by NMFS Permits and Conservation Division that have been adopted for the time period covered under this programmatic biological and conference opinion.
3. Exceedance of any projected programmatic activity level or annual take. If the amount of tracklines, location of tracklines, acoustic characteristics of the airgun arrays, or any other

aspect of the proposed action or action area changes in such a way that the incidental take for ESA-listed species could be greater than estimated in the incidental take statement of this opinion, then (3) above may be met and reinitiation of consultation may be necessary.

4. Identification during step-down reviews of an activity under the Oil and Gas Program that causes a program-level change, may affect ESA-listed species, and determined during review to require re-initiation. This includes if an activity in the Description of the Action is carried out in a manner different than described by an action agency in their respective BA and/or supplemental information then that could change how the action affects an ESA-listed species.

5. New scientific information becomes available about the ESA-listed species considered in this opinion, including information about population trends or distribution, significant changes to the known distribution area, distribution outside the RWA for Rice's whale, or publication of new density models or abundance estimates. This information may be relevant to inform our vessel strike analysis, for example, which involved uncertainty regarding Rice's whales outside the area where they are usually observed.

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