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Outer Continental Shelf

Essential Fish Habitat Assessment for Offshore Wind Lease Issuance, Site Characterization, and Site Assessment in the Gulf of Mexico

U.S. Department of the Interior
Bureau of Ocean Energy Management
New Orleans Office

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List of Abbreviations and Acronyms

Short Form	Long Form
BEBR	Biological Environmental Background Report for the Gulf of Mexico OCS Region
BOEM	Bureau of Ocean Energy Management
BSEE	Bureau of Safety and Environmental Enforcement
CHIRP	compressed high-intensity radar pulse
CFR	Code of Federal Regulations
COA	Conditions of Approval
COP	Construction and Operations Plan
CPT	cone penetration test
CWA	Clean Water Act
dB	decibels
DGPS	Differential Global Positioning System
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
Eh	oxidation-reduction potential
ESA	Endangered Species Act
FGBNMS	Flower Garden Banks National Marine Sanctuary
FMC	Fishery Management Councils
FMP	Fishery Management Plan
FR	Federal Register
GMFMC	Gulf of Mexico Fishery Management Council
GOM	Gulf of Mexico
HAPC	Habitat Area of Particular Concern
HRG	high-resolution geophysical
Hz	hertz
kHz	kilohertz
Met	meteorological
MARPOL	International Convention for the Prevention of Pollution from Ships
MMS	Minerals Management Service
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NCCOS	National Centers for Coastal Ocean Science
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOO	New Orleans Office
NWP	nationwide permit
OCS	Outer Continental Shelf
OSS	offshore substation
pH	potential hydrogen

Short Form	Long Form
PSBF	Potentially Sensitive Biological Features
RHA	Rivers and Harbors Act
ROW	right-of-way
RUE	right-of-use and easement
SAP	Site Assessment Plan
SAV	submerged aquatic vegetation
SOC	Standard Operating Conditions
SPI/PV	sediment profile imaging/profile view
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USDOC	U.S. Department of Commerce
USEPA	U.S. Environmental Protection Agency
WEA	Wind Energy Area

1.0 Introduction

This Essential Fish Habitat (EFH) Assessment analyzes proposed activities (see Section 2: Proposed Action and Geographic Location) in support of offshore wind energy development on the Outer Continental Shelf (OCS) of the Gulf of Mexico (GOM). Pursuant to Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), Federal agencies are required to consult with the National Marine Fisheries Service (NMFS) on any action that may result in adverse effects to EFH. NMFS published the final rule (67 FR[Federal Register] 2376) implementing the EFH provisions of the MSA on January 17, 2002. Certain OCS activities authorized by the Bureau of Ocean Energy Management (BOEM) may result in adverse effects to EFH and require consultation.

Essential Fish Habitat as defined in the MSA includes “those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity.” The final rules promulgated by NMFS in 2002 (50 CFR [Code of Federal Regulations] §§ 600.805 to 600.930) further clarify EFH with the following definitions: “waters” refers to aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; “substrate” refers to sediment, hard bottom, structures underlying the waters, and associated biological communities; and “necessary” refers to the habitat required to support a sustainable fishery and the managed species’ contribution to a healthy ecosystem.

The purpose of this assessment is to evaluate if the Proposed Action would have an “adverse effect” on EFH. The final EFH rules define an adverse effect as “any impact which reduces quality and/or quantity of EFH . . . [and] may include direct or indirect physical, chemical, or biological alterations of the waters or substrate, and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components if such modifications reduce the quality and/or quantity of EFH. Adverse effects to EFH may result from actions occurring within EFH or outside of EFH and may include specific or habitat wide impacts, including individual, cumulative, or synergistic consequences of actions.”

BOEM is the lead federal agency for purposes of this EFH consultation; the other action agency is the Bureau of Safety and Environmental Enforcement (BSEE). As a co-action agency, BSEE coordinates with BOEM on Outer Continental Shelf Lands Act (OCSLA) regulatory oversight and is responsible for promoting safety and conducting environmental-compliance verification, inspections, and enforcement for operations outlined under the proposed action.

2.0 Proposed Action and Geographic Location

The Proposed Action is the issuance of commercial and/or research wind energy lease(s) within the GOM Wind Call Area (Call Area) and granting Rights-of-Use and Easement (RUE) and Rights-of-Way (ROW) in support of offshore wind energy development. For offshore wind energy projects, a RUE grant means an easement issued by BOEM that authorizes the use of a designated portion of the OCS to support activities on a lease, whereas a ROW grant provides authorization for the use of a portion of the OCS for the construction and use of a cable or pipeline for the purpose of gathering, transmitting, distributing, or otherwise transporting electricity produced from wind energy developments, but does not constitute a project easement (see 30 CFR § 585.112 for the full definitions). Issuances of leases and grants would allow only the submittal of plans for BOEM's consideration and approval, which does not constitute an irreversible and irretrievable commitment of resources. Therefore, this EFH assessment focuses on the effects of site characterization and site assessment activities reasonably expected to take place after the issuance of commercial and research wind energy leases. This assessment considers issuance of up to 18 wind energy leases within the Call Area, the potential issuance of RUE and ROW grants on portions of the OCS in federal waters, as well as easements traversing state waters. The RUEs, ROWs, and potential project easements would be located in the OCS areas of the GOM, extending from the Call Area through to state waters and to the onshore energy grid. BOEM expects to issue up to 18 leases over 10 years, varying in size but averaging approximately 80,000 acres each. BOEM expects to issue up to 6–8 leases per sale, the first of which may be held in 2023.

Site assessment activities on leases and site characterization activities on the leases, grants, and potential easements are anticipated. Site characterization and site assessment activities associated with leases would be expected to occur in the Call Area and along potential export cable corridors to shore. It is assumed that up to two export cable corridors would be surveyed for each lease. A lessee would submit a Site Assessment Plan (SAP) to describe site assessment activities for BOEM's review (30 CFR §§ 585.605-613). Site assessment activities include the installation, operation, maintenance, and decommissioning of up to two meteorological (met) buoys per lease and the deployment of oceanographic devices. Site characterization activities may include geophysical, geotechnical, and biological surveys of the lease area and transmission corridors. A lease does not grant the lessee the right to construct any permanent facilities; however, each met buoy would likely remain in place for approximately 7 years.

Site characterization surveys are typically conducted from a vessel and may include High Resolution Geophysical (HRG), shallow hazard, geological, archaeological, and biological surveys. HRG surveys may include multibeam echosounders, magnetometers, side-scan sonars, boomers, sparkers, CHIRP subbottom profilers, or bubble guns. Bottom sampling may employ one or a combination of the following techniques: cone penetration tests, vibracores, deep borings, piston cores, or gravity cores. Biological surveys may include ship-based surveys for benthic habitats, marine mammals, sea turtles, birds and bats, as well as areal-based surveys for marine mammals, birds, and bats. Benthic habitat surveying techniques may include grab samples (e.g., standard Van Veen) and sediment profile imaging/profile view (SPI/PV) technologies. For additional information on HRG, geotechnical (i.e., shallow hazard, geological, and archaeological), and biological surveys and equipment see Tables 1, 2, and 3, respectfully, at the end of this section.

Figure 1 depicts the Call Area and also defines the border of the Project Area, an area that includes the state waters of Texas, Louisiana, Mississippi, and Alabama, where wind energy-related activities (e.g., survey activity and vessel traffic) could occur. The Call Area is intentionally broad to afford flexibility in the decision-making process and represents the area in federal waters where offshore wind leases are expected to occur. The Call Area includes the area located seaward of the GOM's Submerged Lands Act boundary, bounded on the east by the north-south line located at 89.858° W longitude, and bounded on the south by the 400-meter bathymetry contour and the United States-Mexico maritime boundary 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 GOM beyond 200 Nautical Miles. BOEM assumes that future landfalls for export cable corridors that result from leases within the Call Area may occur anywhere along the coasts of Texas and Louisiana and, therefore, surveys in coastal waters of these two states are reasonably foreseeable. No surveys are expected in the coastal waters of Mississippi, Alabama, or Florida. For vessel activity, we assume ports along the coasts of Texas and Louisiana will be used for the majority of vessel-related activities. However, there may be situations in which ports as far east as Mobile, Alabama could be used (e.g., in the case of a natural disaster), which is why the Project Area extends eastward from the Call Area to include Pascagoula and Mobile Bays.

Though state waters are not within the jurisdiction and authority of BOEM, this assessment considers some adjacent state waters because site assessment and site characterization activities may include surveys and vessel trips that cross between federal and state waters, and the potential adverse impacts associated with site assessment and site characterization could affect resources in state waters. The U.S. Army Corps of Engineers (USACE) has jurisdiction over some activities in state and federal waters under Section 10 of the Rivers and Harbors Act (RHA) and Section 404 of the Clean Water Act (CWA). The USACE has established a Nationwide Permit (NWP) (USACE 2022b) to regulate geophysical surveys in state waters. State issued permits may also be required for surveys in state waters. Additionally, a USACE NWP (USACE 2022a) is required for the installation of devices and scientific equipment whose purpose is to record scientific data, which would include the installation of met buoys in the Call Area. Though site characterization activities that extend into state waters are a reasonably foreseeable result of a wind energy lease issued in the GOM Call Area, BOEM is not authorizing any activities in state waters and does not have regulatory authority to apply mitigation measures outside of the OCS.

The timing of lease issuance, as well as weather and sea conditions, would be the primary factors influencing timing of site assessment and site characterization survey activities. Lessees have up to five years to perform site assessment and site characterization activities before they must submit a Construction and Operations Plan (COP) (30 CFR § 585.235(a)(2)) but may be granted an extension. BOEM's New Orleans Office expects to hold its first renewable lease auction for offshore wind developments in 2023, and it is assumed lessees would begin survey activities as soon as possible after receiving a lease and when sea states and weather conditions allow. Therefore, BOEM's New Orleans Office expects site assessment and site characterization activities would likely begin within one year following execution of a lease and continue intermittently for the following five to seven years leading up to the submittal of the COP.

BOEM is preparing an environmental assessment (EA) to determine whether the issuance of leases and grants within the Call Area in the GOM would lead to reasonably foreseeable significant impacts on the environment. The proposed action for the EA is similar to that of this assessment but differs in two distinct ways. First, fishery-related biological surveys (e.g., trawl surveys, gillnet surveys, or fish/crustacean trap surveys) are not included in the proposed action for this assessment. BOEM does not require the lessee to perform fishery surveys to satisfy requirements for the SAP, COP, or General Activities Plan to describe biological resources that could be affected by the activities proposed in the plans, or that could affect the activities proposed in the plans (see 30 CFR § 585.611(a)(3); 30 CFR § 585.626(a)(3); and 30 CFR § 585.645(a)(5)). The Gulf of Mexico is a well-studied basin and there are many existing data sources lessees may use for characterizing the fisheries of a site. If a lessee proposes fishery surveys, additional consultation may be necessary. Second, unlike the EA, this assessment's proposed action does not include a transmission backbone. A transmission backbone is a shared transmission system that runs parallel to shore to connect multiple wind facilities to the onshore grid through a single cable landfall. The transmission backbone would require additional site assessment and site characterization activities. However, at this time, the location and extent of these activities are unknown. Should a lessee or lessees apply for an ROW for a transmission backbone within the Call Area, additional consultation may be necessary.

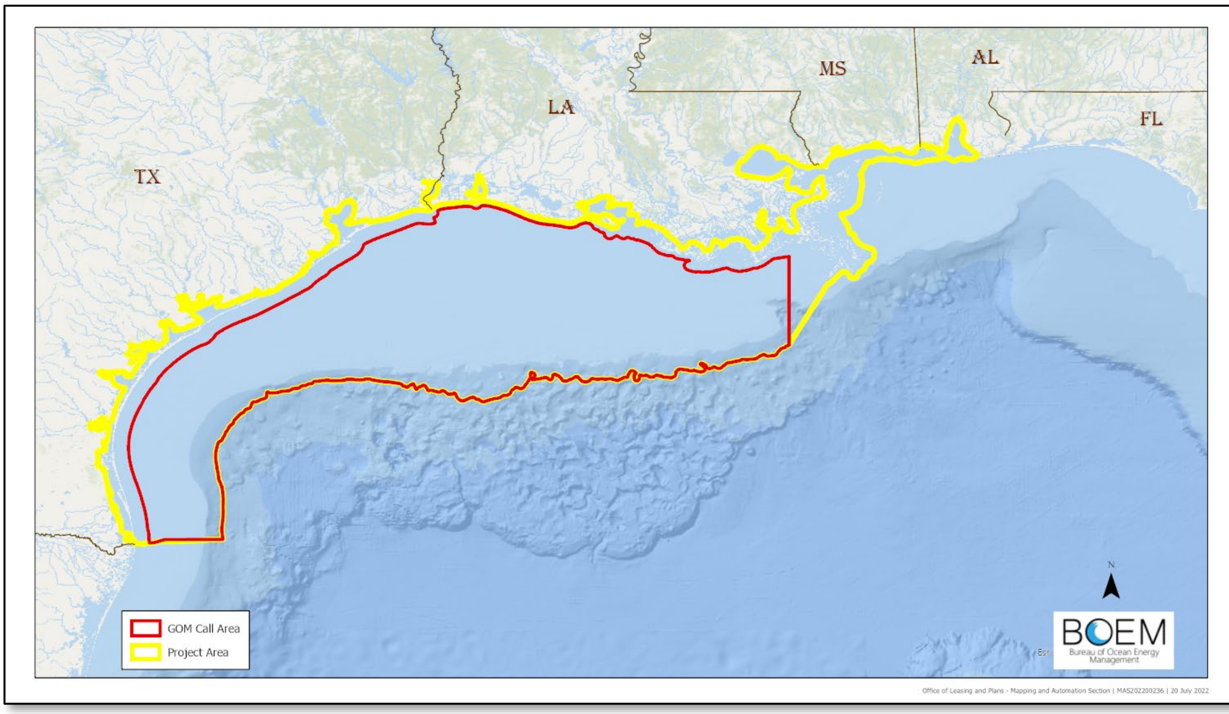

Figure 1. Gulf of Mexico Call and Project Areas

Table 1. High-resolution geophysical survey equipment and methods

Equipment Type	Data Collection and/or Survey Types	Description of the Equipment
Bathymetry and/or depth sounder (multi-beam echosounder)	Bathymetric charting	A depth sounder is a microprocessor-controlled, high-resolution survey-grade system that measures precise water depths in both digital and graphic formats. The system would be used in such a manner as to record with a sweep appropriate to the range of water depths expected in the survey area. This assessment assumes the use of multi-beam bathymetry systems, which may be more appropriate than other tools for characterizing lease areas and export cable corridors containing complex bathymetric features or sensitive benthic habitats, such as hard bottom areas.
Magnetometer	Collection of geophysical data for shallow hazards and archaeological resources assessments	Magnetometer surveys would be used to detect and aid in the identification of ferrous or other objects having a distinct magnetic signature. The magnetometer sensor is typically towed as near as possible to the seafloor and anticipated to be no more than approximately 6m (19.7 ft) above the seafloor.
Side-scan sonar	Collection of geophysical data for shallow hazards, benthic habitat features, and archaeological resources assessments	This survey technique is used to evaluate surface sediments, seafloor morphology, and potential surface obstructions (MMS 2007). A typical side-scan sonar system consists of a top-side processor, tow cable, and towfish with transducers (or “pingers”) located on the sides, which generate and record the returning sound that travels through the water column at a known speed. BOEM assumes that the lessee would use a digital dual-frequency side-scan sonar system with 300–500 kHz frequency ranges or greater (up to 1,500 kHz to detect relatively small objects) to record continuous planimetric images of the seafloor.

Equipment Type	Data Collection and/or Survey Types	Description of the Equipment
Boomers	Collection of geophysical data for shallow hazards and archaeological resources assessments and to characterize subsurface sediments	Modern boomers are towed seismic sources that use an electrical pulse to force a circular plate away from another component of the system to generate a broadband (100 Hz up to a specified bandwidth) pulse focused in a cone of up to 90° (Ruppel et al., in review[1]. The cone geometry depends on the number of boomer plates, which can range from one to three. Boomers do not have an integral receiver and are therefore not classified as sub-bottom profilers. Seismic reflections are detected and recorded by a separately towed streamer with one or more hydrophones. Depending on sediment characteristics and the energy supplied to the boomer, boomers can produce sub-bottom images to depths of more than 100 m (328.1 ft) below the seafloor. They typically have beamwidths less than 90 degrees and operate at source levels near 200 dB re 1 µPa RMS.
Sparkers	Collection of geophysical data for shallow hazards and archaeological resources assessments and to characterize subsurface sediments	A sparker is a seismic source that uses an electrical discharge from a ship-based power supply (100s–10,000 joules) to vaporize saltwater, rapidly creating a bubble that produces a broadband (50 Hz to 4 kHz) omnidirectional pulse of sound. Sparkers are towed behind a ship, usually at a depth of a few meters, and can be mounted on sleds or are sometimes simply bare electrodes at the end of a high-voltage power cable. Sparker signals can penetrate tens of meters to several hundred meters below the seafloor, depending on the power level of the sparker and the nature of the sediments. The higher frequencies of sparkers compared to airguns lead to better vertical resolution in the resulting data. Sparkers do not have an integral receiver and are therefore not classified as sub-bottom profilers. A single hydrophone or multichannel hydrophone streamer is typically towed to detect sound reflected from sub-bottom features. Sparkers can be set to various power levels depending on water depth, and the highest-power sparkers typically have source levels around 200 dB re 1 µPa RMS.

[1] Ruppel CD, Weber TC, Staaterman E, Labak SJ, Hart, PE. [In review].Categorizing active marine acoustic sources based on their potential to affect marine mammals.

Equipment Type	Data Collection and/or Survey Types	Description of the Equipment
CHIRP towed and hull-mounted subbottom profilers	Collection of geophysical data for shallow hazards and archaeological resources assessments and to characterize subsurface sediments	Chirp systems can be hull-mounted, with the transducers acting as both sources and receivers, or towed, with transducers housed in a towfish containing separate source and receiver arrays. Such systems can be towed behind the survey vessel at depths ranging from the water surface to near the ocean bottom. Chirp systems can be referred to as sub-bottom profilers (SBP) because they are complete systems containing source and receiver. Instead of operating at a single frequency, chirp systems are generally single-channel systems that emit a user-defined signal (usually less than 40 ms in duration) that sweeps across a band of frequencies that can range between 400 and 24,000 Hz depending on imaging goals. The received signal is compressed by correlating with the output pulse to produce a high-resolution sub-bottom profile. Because the energy of the source is spread over the sweep duration in a controlled manner, chirp sources are not considered impulsive like boomers, sparkers, and airguns. The transducer configuration of chirp sonars produces a beampattern with the main lobe pointing directly downward. Towed systems generally emit lower-level sounds than hull-mounted systems because the acoustic energy does not need to travel through the water column; the source is towed just a few meters above the seabed.
Bubble guns	Collection of geophysical data for shallow hazards and archaeological resource assessments and to characterize subsurface sediments	Bubble guns are towed seismic sources that generates a low frequency, narrow band impulse by rapidly compressing a fixed volume of air within a flexible plate or pair of plates. The system is designed to produce a repeatable, directed impulse for improved bottom imaging and penetration. Bubble guns do not have an integral receiver and are, therefore, not classified as sub-bottom profilers. Seismic reflections are detected and recorded by a separately towed streamer with one or more hydrophones. Depending on sediment characteristics and the source's configuration, bubble guns can produce sub-bottom images to depths of more than 100 m below the seafloor. Bubble guns are typically used for improved imaging of sediments that are difficult to penetrate with other sources (e.g., coarse sand, gravel tills). Bubble gun sources are not as commonly used as other seismic sources (e.g., airguns, boomers, or sparkers) or sub-bottom profilers (such as towed CHIRP systems). The precise beamwidth of bubble gun sources has not been measured.

CHIRP = compressed high-intensity radar pulse; MMS = Minerals Management Service

Table 2. Geotechnical and/or benthic sampling survey methods and equipment[2]

Survey Method	Use	Description of the Equipment	Survey Details
Bottom-sampling devices	These devices penetrate the seafloor to a depth of a few centimeters to several meters. Seafloor sediment samples may be used to inform facility design.	A piston core or gravity core is often used to obtain samples of soft surficial sediments (not typically used in sandy sediments). A gravity core is essentially a weighted core barrel that is allowed to free-fall through the water column into the sediments. Piston cores have a "piston" mechanism that triggers when the corer hits the seafloor (MMS 2007). Shallow-bottom coring employs a rotary drill that penetrates through several feet of consolidated rock. Drilling produces low intensity, low frequency sound through the drill string (Continental Shelf Associates Inc. 2004; MMS 2007). The above sampling methods do not use high-energy sound sources.	Samples could potentially be taken along the two export cable corridors: at least one sample every 1 km (0.6 mi) along the 1,000 m (3,280.8 ft) wide cable corridor. At least one sample may be taken at each potential turbine and offshore substation location within a lease area. The described sampling methods disturb an area of approximately 1 m^2/sample (10.8 [ft^2]). If anchoring, the estimated maximum bottom disturbance is 10 m^2 (107.6 [ft^2]). It is assumed sample collection would occur on an intermittent basis for five to seven years following a lease.

[2] Note that BOEM's *Guidelines for Providing Geophysical, Geotechnical, and Geohazard Information Pursuant to 30 CFR Part 585* (https://www.boem.gov/sites/default/files/documents/about-boem/GG-Guidelines.pdf) do not recommend the collection of sub-surface seabed samples using all four geotechnical survey methods described in Table 2. An operator may choose to use any of the listed geotechnical tools appropriate for the sediment type present at a sampling station. Further, industry trends may, at times, exceed BOEM guidance, which may result in additional samples collected beyond the minimum number recommended by BOEM. As such, one or more types of geotechnical survey methods may be used, and the total number of samples assumed in this analysis are based on estimates using reasonably foreseeable minimum and maximum sampling scenarios (see Table 4).

Survey Method	Use	Description of the Equipment	Survey Details
Vibracores	Obtaining samples of unconsolidated sediment (typically sandy sediments); may, in some cases, also be used to gather information to inform the archaeological interpretation of features identified through the HRG survey (BOEM 2020). These samples will help inform facility design.	Vibracore samplers typically consist of a core barrel and an oscillating driving mechanism that propels the core barrel into the sub-bottom. Penetration is facilitated by a pneumatic or electric vibrahead, which results in local liquefaction of sediment along the core barrel surface. Once the core barrel is driven to its full length, the core barrel is retracted from the sediment and returned to the deck of the vessel. Typically, cores up to 6 m (19.7 ft) long with 8 cm (3.1 in) diameters are obtained, although some devices have been modified to obtain samples up to 12 m (39.4 ft) long (MMS 2007; USACE 1987). Though the sounds may be considered "continuous" when the vibracore operations are underway, the total operation introduces sound to the water in an intermittent fashion.	Samples could potentially be taken along the two export cable corridors: At least one sample every 1 km (0.6 mi) along the 1,000 m (3,280.8 ft) wide cable corridor. At least one sample may be taken at each potential turbine and offshore substation location within a lease area. The estimated maximum disturbance area is 3 m^2/sample (32.3 [ft^2]). If anchoring, the estimated maximum bottom disturbance is 10 m^2 (107.6 [ft^2]). It is assumed sample collection would occur on an intermittent basis for five to seven years following a lease.

Survey Method	Use	Description of the Equipment	Survey Details
Deep borings	Sampling and characterizing the geological properties of sediments at the maximum expected depths of the structure foundations (MMS 2007). These samples help inform facility design.	A drill rig used to obtain deep borings may be mounted on a jack-up rig and/or lift boat (supported by "spuds" that are lowered to the seafloor), anchored vessel, or dynamically positioned vessel. Geologic borings can generally reach depths of 30–61 m (98.4–200.1 ft) within a few days (based on weather conditions). The acoustic levels from deep borings can be expected to be in the low frequency bands and below the 160 dB threshold established by NMFS to protect marine mammals (Erbe and McPherson 2017).	Samples could potentially be taken along the two export cable corridors: At least one sample every 1 km (0.6 mi) along the 1,000 m (3,280.8 ft) wide cable corridor. At least one sample may be taken at each potential turbine and offshore substation location within a lease area. The average, individual bottom disturbance area for a deep boring sample is approximately 1 m^2/sample (10.8 [ft^2]). If anchoring, the estimated maximum area of bottom disturbance is 10 m^2 (107.6 [ft^2]). If a jack-up rig/lift boat is used, the maximum estimated bottom disturbance area would depend on the diameter of the "spuds" (maximum using a 4-legged drill rig with 1.8 m (5.9 ft) diameter spuds = 10.18 m^2 (109.6 [ft^1]). It is assumed sample collection would occur on an intermittent basis for five to seven years following a lease.

Survey Method	Use	Description of the Equipment	Survey Details
Cone penetration test	Supplement or use in place of deep borings (BOEM 2020)	A CPT is a pointed steel pipe that is forced into the seafloor to determine near-seafloor stratigraphic profile. A CPT rig could be mounted on a jack-up rig/lift boat similar to that used for the deep borings, although an anchored or dynamically positioned vessel could also be used. In waters less than 30 m (98.4 ft), floating or jack-up rig/lift boats would be used; in deeper water (>30 m [98.4 ft] the CPT can be placed on seafloor. These rigs can sometimes be remotely controlled. The top of a CPT drill probe is typically up to 8 cm (3 in) in diameter, with connecting rods less than 15 cm (6 in) in diameter. Penetration is achieved through a hydraulic jacking mechanism that pushes the cone into the seafloor, with maximum penetration of about 100 m (328.1 ft). A variety of additional instruments can be added to a CPT to enhance the sediment properties being examined. A study on sound produced by a mini-CPT showed that the use of a mini-CPT did not significantly increase underwater sound levels beyond contributions from the associated DP-vessel's thrusters (Chorney et al. 2011).	Samples could potentially be taken along the two export cable corridors: At least one sample every 1 km (0.6 mi) along the 1,000 m (3,280.8 ft) wide cable corridor. At least one sample may be taken at each potential turbine and offshore substation location within a lease area. The estimated maximum disturbance area is 4 m^2/sample (43.1 [ft^2]). If anchoring, the estimated maximum area of bottom disturbance is 10 m^2 (107.6 [ft^2]). If a drill rig is used, the maximum estimated bottom disturbance area would depend on the diameter of the "spuds" (maximum using a 4-legged drill rig with 1.8 m (5.9 ft) diameter spuds = 10.18 m^2 (109.6 [ft^1]). It is assumed sample collection would occur on an intermittent basis for five to seven years following a lease.

CPT = cone penetration test; dB = decibels; HRG = high-resolution geophysical; MMS = Minerals Management Service

Table 3. Biological survey methods and equipment

Biological Survey Type	Use	Description of Equipment	Survey Details (single lease)
Benthic habitat	Seafloor surveys performed to characterize baseline existing conditions, as well as support siting decisions that will avoid or minimize potential impacts to sensitive biological communities.	Bottom and sub-surface sediment and/or fauna sampling using benthic grabs (e.g., standard Van Veen grab, Hamon grab, or box corer) and sediment profile imaging/ profile view (SPI/PV). Box cores, Van Veen, and Hamon grabs are used to collect seafloor sediment using a trap method; the trap is lowered to the seafloor where it closes around a section of mud and is brought to the surface for sampling.	BOEM assumes at least three samples of each benthic habitat equipment (i.e., benthic grab and SPI/PV) will be taken along the two potential export cable corridors: every 1 km along the 1,000 m wide cable corridor. BOEM assumes that at least three samples of each benthic habitat equipment (i.e., benthic grab and SPI/PV) will be taken at each potential turbine, offshore substation, and met buoy location within a lease area. The estimated area of bottom disturbance for a single standard Van Veen or Hamon grab sample is 0.1 m^2/sample (1.1 [ft^2]), and 4 m^2/sample (43.1 [ft^2]) for the underwater imagery/sediment profile imaging. Box cores would also disturb an area of approximately 4 m^2/sample (43.1 [ft^2]) Sampling is generally concurrent with the geophysical and geotechnical surveys and do not constitute additional effort. However, there may be occasions where directed benthic surveys are needed to supplement what was collected during the geophysical survey campaign.
Avian	Avian surveys are used to inform design and mitigation strategies by characterizing abundance and distribution of avian species within a leased area.	Visual surveys from a boat or plane-based aerial surveys. May be concurrent with other biological surveys but would not be concurrent with any geophysical or geotechnical survey work.	Visual surveys: 10 OCS blocks per day (Thaxter and Burton 2009); monthly for two years Aerial surveys: two days per month for two years

Biological Survey Type	Use	Description of Equipment	Survey Details (single lease)
Bats	Bat surveys are used to inform design and mitigation strategies by characterizing bat occurrence within a leased area	Ultrasonic detectors installed on survey vessels being used for other biological surveys	Monthly for three months per year
Marine mammals and sea turtles	Marine mammal and sea turtle surveys are used to inform design and mitigation strategies by characterizing occurrence within a leased area	Plane-based and/or vessel-based surveys; may be concurrent with other biological surveys but would not be concurrent with any geophysical or geotechnical survey work.	Monthly for three years of survey to cover spatial, temporal, and inter-annual variance in the area of potential effect

met = meteorological

3.0 Essential Fish Habitat Presence within the Call and Project Areas

In this section, fish and invertebrate resources expected to occur within the Call and Project Areas (Figure 1) are characterized using broad ecological and/or habitat categories: soft bottom, hard bottom, and pelagic. These habitat categories are described and further characterized for offshore, nearshore, and inshore areas when possible. Within each category, the composition and distribution of key resources (i.e., managed species with designated EFH) as well as important species are described.

Much of the Call and Project Areas has been identified as EFH. Managed fish and invertebrates with designated EFH in the area include penaeid shrimps (4 species), red drum, reef fish (32 species), spiny lobster, stone crab, corals (multiple taxa), coastal migratory pelagics (3 species), and highly migratory species (48 species). For the full list of GOM managed EFH species see Table 6 in Appendix A. Relevant Fishery Management Plans (FMP) published by the Gulf of Mexico Fishery Management Council (GMFMC) for the Call and Project Areas include the Shrimp FMP, Red Drum FMP, Reef Fish FMP, Coral and Coral Reef FMP, and the Coastal Migratory Pelagic FMP. The NMFS lists the species, EFH categories and designations, and HAPCs in their *Essential Fish Habitat: A Marine Fish Habitat Conservation Mandate for Federal Agencies; Gulf of Mexico Region* (NMFS 2010). More information can be found in the GMFMC's *Final Environmental Impact Statement; Generic Essential Fish Habitat Amendment to the Following Fishery Management Plans of the Gulf of Mexico: Shrimp Fishery of the Gulf of Mexico, Red Drum Fishery of the Gulf of Mexico, Reef Fish Fishery of the Gulf of Mexico, Stone Crab Fishery of the Gulf of Mexico, Coral and Coral Reefs of the Gulf of Mexico, Spiny Lobster in the Gulf of Mexico and South Atlantic, Coastal Migratory Pelagic Resources of the Gulf of Mexico and South Atlantic* (Gulf of Mexico Fishery Mangement Council 2004), and the *Final Amendment 10 to the 2006 Consolidated Atlantic Highly Migratory Species Fishery Management Plan, Essential Fish Habitat* (82 FR 42329).

For information on associated EFH by life stage of managed species that occur within the Call and Project Areas, refer to Appendix A Tables 7 through 12. Though both the Caribbean spiny lobster (*Panulirus argus*) and stone crabs (*Menippe mercenaria* and *Menippe nodifrons*) can be found throughout the GOM, they primarily occur and are commercially targeted in the southeastern region of the GOM off the west coast of Florida and throughout the Florida Straits. As such, they are not considered further in this assessment and are not included in the aforementioned tables describing EFH by life stage for managed species. Managed coral species are too numerous to describe the associated EFH for each species life stage in detail. A general description of life history characteristics and associated EFH is provided below, and more detailed descriptions of EFH (i.e., Habitat Areas of Particular Concern (HAPCs)) can be found in Section 3.4.

Corals reproduce both asexually (through localized cloning of existing colonies) or sexually (through broadcast spawning of larvae or male gametes in the case of brooding), enabling long-distance dispersion that creates genetic links between regions (NOAA 2016; Veron 2013). The primary locations of the roughly 100 species of shallow-water zooxanthellate corals in the GOM are the East and West Flower Garden Banks, Florida Middle Grounds, and the Dry Tortugas. Seven of these species (i.e., elkhorn coral, staghorn coral, Caribbean boulder star coral, lobed star coral, mountainous star coral, pillar coral, and rough cactus coral) are currently listed as threatened under the ESA (79 FR 53851). Deepwater heterotrophic (non-photosynthetic) corals occur on isolated hard substrates throughout the GOM in over 164 ft (50 m) water depth and include over 250 species that generally grow very slowly. Deep-sea species include stony branching corals, octocorals, cup corals, and black corals, and they provide shelter and foraging opportunities for a variety of species (e.g., shrimps, crabs, fish, brittle stars, and demersal fish).

3.1 Soft Bottom Benthic Habitats

3.1.1 Call area

Soft bottom habitat is the most prevalent type of benthic habitat in the GOM, accounting for approximately 90 percent of the OCS; up to 50 percent of the GOM is mud bottom while 40 percent is a mixture of sand with some gravel and shell (Briones 2004). In the region of the Call Area (i.e., offshore Louisiana and Texas), the bottom sediments on the continental shelf are predominantly mud and primarily derived from the Mississippi River and Atchafalaya River outflows (Balsam and Beeson 2003; Love et al. 2013). Their associated communities contain a variety of invertebrates and demersal fishes. Common and abundant invertebrate phyla include asteroids, gastropods, polychaete worms, pericaridean and decapod crustaceans, echinoderms, mollusks, nematodes, and hydroids. Dominant demersal fish families include Sciaenidae (croakers and drums), Sparidae (porgies), and Trichiuridae (cutlassfish) (Chittenden and McEachran 1976). Mud bottom habitats within the Call Area serve as EFH for adult penaeid shrimp species, including brown (*Farfantepenaeus aztecus*), white (*Litopenaeus setiferus*), and royal red (*Pleoticus robustus*).

Sand shoals are found throughout the continental shelf of the Gulf of Mexico, with notable formations in the Call Area occurring near Louisiana (Ship Shoal) and Texas (Sabine Bank, Heald Bank, Freeport Rocks) (Byrnes et al. 2017; Rutecki et al. 2015). They are elevated sand deposits, often surrounded by hypoxia-prone mud deposits, that can serve as oxygen-rich refuge for organisms and create diversity "hotspots" (Dubois et al. 2009; Gelpi Jr. 2012; Grippo et al. 2009). Sediment compositions of shoals largely determine their associated macrofaunal species assemblages; diversity and abundance increase with decreasing sediment grain size and increasing bottom water dissolved oxygen (Dubois et al. 2009; Gelpi 2012). Though the macrobenthic community of Ship Shoal undergoes seasonal changes in diversity, abundance, and biomass, polychaetes and crustaceans have been highlighted as important contributors to abundance and diversity (Dubois et al. 2009). Sand shoals, such as the Ship, Trinity, and Tiger Shoal Complex offshore of Louisiana, may be important spawning grounds for blue crabs, *Callinectes sapidus* (Gelpi 2012). Sand shoal habitats within the Call Area also serve as EFH for adult pink shrimp (*Farfantepenaeus duorarum*).

3.1.2 Export cable corridor

BOEM expects up to two proposed transmission cable route corridors to shore will be surveyed for each lease. Routes would cross soft bottom habitats and are expected to avoid hard bottoms and other sensitive seafloor resources. Site characterization activities, such as sub-bottom sampling and benthic surveys would occur along these corridors. As such, vegetated EFH that occurs over soft bottom habitats, such as wetlands, mangrove swamps, and submerged aquatic vegetation (SAV) are included and described in this section.

Wetlands occur throughout GOM coastal areas; both Louisiana and Texas contain large areas of salt marsh (Love et al. 2013). Coastal wetlands are complex systems that provide many essential functions including defense against storm surge and buffer against sea-level rise. High organic productivity and efficient nutrient recycling are characteristic of coastal wetlands. Wetland corridors provide sheltered feeding grounds and refuge from predators for a large and diverse group of resident plants, invertebrates, fish, reptiles, birds, and mammals. Salt marsh environments are EFH for many economically important fish and shellfish (e.g., red drum and penaeid shrimps). As "living filters," wetlands improve water quality by removing pollutants and nutrients, as well as trapping sediments.

Intertidal and subtidal flats occur in coastal areas of Texas and Louisiana, along a gradient of inundation and physical exposure to wind and wave energy (Byrnes et al. 2017; Georgiou et al. 2005; Onuf 2006). Flats typically have little or no slope and are composed of fine sediments and organic materials, with varying amounts of sand and mud composition depending on the amount of wave and wind energy they are exposed to. Due to poor water exchange, fine-sediment (e.g., mud) flats favor the growth of dense microbial assemblages and can contain oxygen-depleted or anaerobic sediment below the first several centimeters (Byrnes et al. 2017). In Texas, wind-tidal flats become the dominant feature of the tidal zone from Corpus Christi Bay south through the Laguna Madre (Onuf 2006). It has been estimated that wind tidal algal flats cover over 40% of the Laguna Madre (Huang et al. 2020). These tidal flats are flooded by hypersaline waters after heavy rains and high tides and allow for proliferation of dense microfloral mats that support many species of invertebrates, birds, and fishes (Judd et al. 1977; Onuf 2006).

Mangrove swamp habitat, a type of coastal wetland, can be found from Texas to Florida. In the north central and western GOM (i.e., adjacent to the Call Area), black mangroves (*Avicennia germinans*) are patchily distributed along the Louisiana (primarily southeast Louisiana) and Texas (Port Aransas, Port O'Connor, and South Padre) coastlines and are not as predominant as salt marsh habitats; however, mangroves have been increasing in abundance (Armitage et al. 2015; Giri et al. 2011). Mangroves serve as EFH for a variety of commercial and recreationally valuable fish and invertebrates (e.g., snapper and groupers), and also as storm buffers, stabilizing shorelines by functioning as wind breaks and through prop root baffling of wave action. Mangroves also trap fine substrates and reduce turbidity by filtering upland runoff and trapping waterborne sediments and debris.

SAV is defined as the collection of benthic plants (e.g., seagrasses) that settle and grow in marine and/or estuarine waters, but do not emerge above the water's surface. They are a vital component of coastal aquatic ecosystems, with at least 26 species of SAV growing in the northern GOM (Carter et al. 2011; Yarbro and Carlson 2013). According to the most recent and comprehensive data available, an estimated 1.25 million ac (500,000 ha) of SAV beds exist in exposed, shallow coastal/nearshore waters and embayments of the GOM; over 80 percent of these beds are in Florida Bay and Florida coastal waters (calculated from Handley et al. 2007). In the northern GOM from south Texas to Mobile Bay, Alabama, marine SAV occurs in relatively small beds behind barrier islands in bays, lagoons, and coastal waters, while freshwater SAV occurs in the upper regions of estuaries and rivers (Castellanos and Rozas 2001; Handley et al. 2007; Onuf 1996). SAV provides several vital ecological functions, including foraging material for grazers, shelter and protection from predation, and EFH for numerous commercially and recreationally important fish and invertebrates.

3.2 Hard Bottom Benthic Habitats

The Call and Project Areas, and the potential export cable corridors, contain a variety of hard bottom habitats including live bottoms (e.g., oyster reefs), topographic features (banks), scattered hard bottoms referred to by BOEM as potentially sensitive biological features (PSBFs), coral reefs (shallow, mesophotic and deepwater), and chemosynthetic communities (i.e., cold seeps) that aggregate and support (as EFH) diverse fish and invertebrate communities.

3.2.1 *Call area*

The Call Area encompasses a variety of hard bottom, benthic features including topographic features (banks), chemosynthetic communities (i.e., cold seeps), and other hard bottoms (i.e., those not identified as topographic features or chemosynthetic communities). These sensitive features provide habitat for corals and commercially and/or recreationally managed species. Figure 2 identifies the topographic features both within and outside of the Flower Garden Banks National Marine Sanctuary (FGBNMS). Other, less-prominent hard bottom features are scattered throughout the Call Area. BOEM anticipates all potential impacts to hard bottom features from bottom-disturbing activities will be avoided or mitigated to no adverse effect through BOEM review and conditioning of permitted activities and adherence to proposed mitigations, monitoring, and reporting standards listed in Section 6 Proposed Mitigation Guidance.

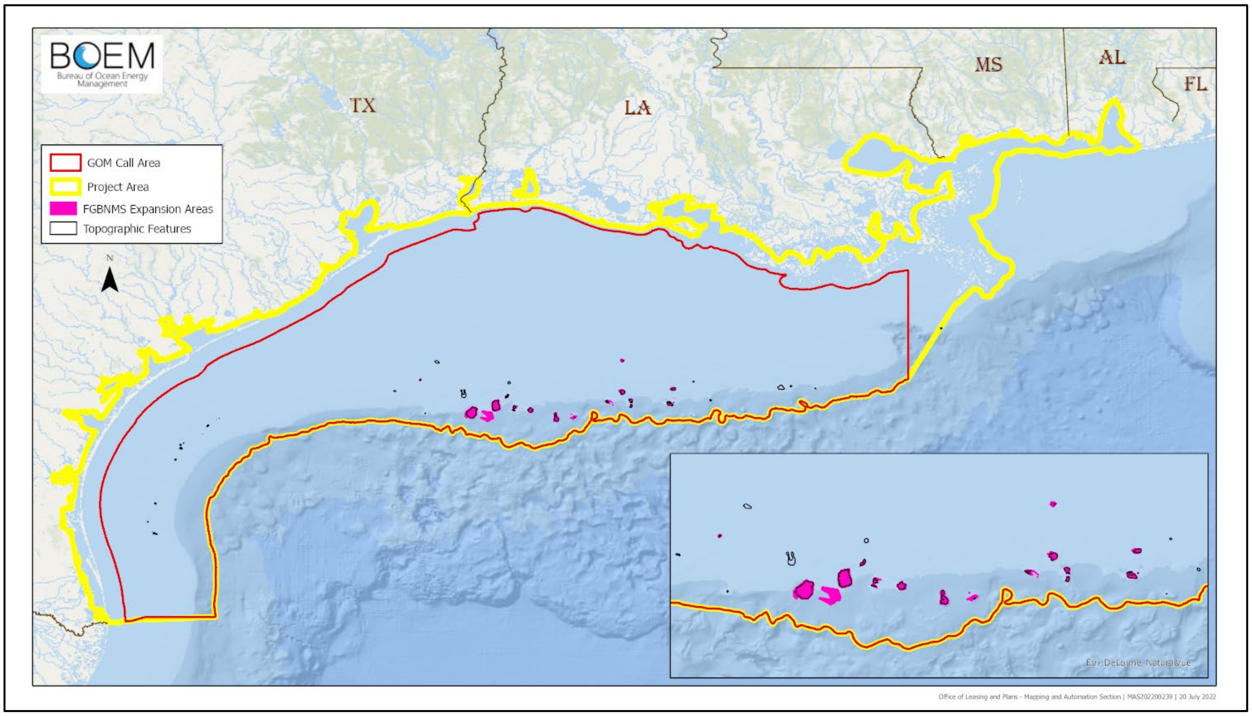

Figure 2. Topographic features (banks) within the Call and Project Areas.

BOEM considers topographic features (banks) to be isolated areas of moderate to high relief that provide habitat for hard bottom communities of high biomass and diversity including corals (shallow and mesophotic) and large numbers of plant and animal species. Topographic features support, either as shelter or food, large numbers of commercially and recreationally important fish. They are typically up thrusts of rock due to uplift (salt diapirs) by underlying layers of salt deep under the seafloor. Some others, like the South Texas banks, are relic coral reefs left over from the last sea-level low stand (about 10,000 years ago) or fossilized shorelines (Berryhill Jr. 1987; Bright and Rezak 1976; Rezak and Bright 1981). Other identified topographic features in the GOM include mid-shelf and shelf-edge banks (including those within the FGBNMS). All hard bottom features present in the Call Area are assumed to provide important habitat for structure-oriented fish and invertebrates and suitable habitat for sessile invertebrates like corals. Hard bottoms may be located at any water depth and in deeper waters may be suitable habitat (depending on abiotic factors) for mesophotic and deepwater corals.

Coral reefs contribute to high diversity and density of marine species in the GOM and provide habitat and other resources for a variety of fish, invertebrates, sea turtles, marine birds, and marine mammals. The Call Area encompasses a range of habitats that may support shallow, mesophotic, and deepwater corals. Shallow water corals occupy only about 2,640 km^2 (< 0.2%) of the GOM, most of which are near the coast of Florida (Gil-Agudelo et al. 2020) but can also be found in the northwestern GOM (e.g., within the FGBNMS). Morphologies of shallow corals in the northwestern GOM are typically mounding and/or boulder shapes that flatten into plating structures with depth through the mesophotic zone (Voss 2019). Boulder star coral (*Orbicella franksi*), symmetrical brain coral (*Pseudodiploria strigosa*), and mustard hill coral (*Porites asteroides*) are common to the shallow and upper mesophotic depths of the East and West Flower Garden Banks (Johnston et al. 2020). The GOM mesophotic zone consists of a mixture of shallow and deepwater corals that can exist under low to no light conditions, approximately 30 to 150 m (98.4–492.1 ft) deep (Gulf of Mexico Fishery Management Council 2018). A variety of scleractinian, antipatharian, stylasterid and gorgonian corals can therefore be found in this zone, and these corals can exist on substrate of biogenic origin or on banks or mounds formed by underlying salt diapers raising the seabed (e.g., East and West Flower Garden Banks) (Boland et al. 2017). Deepwater coral communities of the GOM live at depths greater than 50 m (164 ft) down to over 3000 m (9,842.5 ft) and survive on hard bottom substrate across the GOM continental slope, which is made up of either exposed bedrock or relict authigenic carbonate coral reef (Brooks et al. 2016). Scleractinian, gorgonian, and antipatharian corals are present in deep waters of the GOM (Brooks et al. 2016). Several species of Scleractinian corals (e.g., *Lophelia pertusa*, *Madrepora oculate, Enallopsammia profunda*, *Solenosmilia variabilis*) can form reef-like structures and have been found in depths of over 1500–3000 m (4,921.3–9,842.5 ft) (Brooks et al. 2016). Other megafauna found at these depths include sponges, anemones, echinoderms, crustaceans, and demersal fish.

The East and West Flower Garden Banks are important shallow and mesophotic coral reef locations approximately 200 km (120 mi) south of the Louisiana-Texas border and within the Call Area. These Banks lie within warm, oceanic currents and have weak coastal influences, making them a favorable location for coral growth (Aronson et al. 2005). The banks contain an average of over 50 % living coral cover, with 24 species of hermatypic corals as shallow as 18 m deep, although the majority of the FGBNMS habitat exists in the mesophotic zone (Atchison et al. 2008; NOAA 2021; Sammarco et al. 2012; Schmahl et al. 2008). The East and West Flower Garden Banks continue to exhibit high live coral cover compared to deteriorating reefs of the Caribbean and may act as refuge from changing climate and oceanographic conditions for coral reef conservation (Hickerson et al. 2012). The McGrail Bank is another northwest GOM bank that contains high numbers of reef-building corals; at least 9 coral and 78 fish species have been found there (Simmons et al. 2014). Other corals are found in lower cover along the northern GOM shelf at mesophotic banks (Atchison et al. 2008).

Cold seeps are areas of the ocean floor where high concentrations of oil or reduced compounds, including methane, sulphide, hydrogen, and iron (II), are expelled forming hydrocarbon or gas plumes. Hydrocarbon seep ecosystems are composed of mosaic habitats with a range of physio-chemical constraints for organisms including temperature, salinity, pH, oxygen, carbon dioxide, hydrogen sulfide, inorganic volatiles, hydrocarbon components, and heavy metals (Levin and Sibuet 2012). These habitats support chemosynthetic communities. Such communities on natural substrate typically occur in the GOM at water depths greater than 300 m (984 ft), at a temperature range of 13°C to 4°C (~55°F to 30°F), with seafloor currents from 5 to 10 cm/s (2 to 4 in/s), and in locations with moderate hydrocarbon flow. GOM seep communities tend to be large, up to several hundred meters across (MacDonald 1992). Typical chemosynthetic fauna in the GOM include chemoautotrophic bacteria, vestimentiferan tubeworms, mussels, epibenthic clams, and burrowing clams (MacDonald et al. 1990). Over 330 chemosynthetic communities are confirmed in the GOM at depths ranging from 290 m (952 ft) (Roberts et al. 1990) to 2,750 m (9,022 ft) in Alaminos Canyon (Roberts et al. 2010). Hard- and soft-bodied corals are often found in association with high-density chemosynthetic communities.

3.2.2 Export cable corridor

Oyster reefs, an important EFH, can be found adjacent to the Call Area in primarily shallow waters of coastal and estuarine areas in both Texas and Louisiana. They serve as nursery habitat for recreationally and commercially important fish, crustaceans, and other invertebrates. The cycle of oyster recruitment, growth, death, and degradation creates a succession of available benthic habitat. Oyster reefs provide a natural filter for phytoplankton, detritus, bacteria, and contaminants, prevent coastal erosion, and act as sentinels for environmental monitoring (Volety et al. 2014). Relict oyster reefs can create habitat that provides refuge from predation and substrate for egg-laying by mobile organisms (Tolley and Volety 2005). A synthesis of occupancy studies identified a total of 115 fish and 41 decapod crustacean species inhabiting oyster reefs in northern GOM estuaries (La Peyre et al. 2019). Along the northern Texas and western Louisiana coastline, salinity is variable and water clarity is low, providing ideal conditions for oyster reefs (Byrnes et al. 2017). In northern Texas bays, oysters are commonly found in intertidal and subtidal areas. However, their distribution in a southern Texas Bay (Corpus Christi Bay), was found to be limited to intertidal habitats due to a combination of abiotic factors and increased predation (Johnson and Smee 2014). Oysters may be found along proposed routes for renewable energy export cable corridors.

3.3 Pelagic Habitat

Pelagic habitat encompasses the entire water column from the surface down to the greatest depths, excluding the seafloor. Within the Call and Project Areas, pelagic habitats include the neritic zone (coastal shelf waters), epipelagic zone (from the shelf break down to 200 m [656 ft]), and the deepwater, mesopelagic zone (200–1,000 m [656–3,280 ft]). The relationships of organisms and communities to their pelagic habitat are complex and frequently tied to physical and chemical attributes that vary seasonally and annually. Although, some pelagic habitats (i.e., deep sea) are more static and less susceptible to large-scale variations.

The full range of pelagic habitats and complexity of associated communities within and adjacent to the Call and Project Areas are beyond the scope of this analysis due to the limited scope and nature of activities expected to follow leasing. As such, this section provides a brief overview of pelagic EFH (i.e., water column and *Sargassum*) present within and adjacent to the Call and Project Areas, including factors influencing water quality. For detailed descriptions of the aforementioned pelagic habitats (i.e., zones) and associated communities, including EFH species, in the north central and western GOM; see Sections 3.3 and 3.5 in BOEM's *Biological Environmental Background Report for the Gulf of Mexico OCS Region* (BOEM 2021). For a list of pelagic species that could occur within the Call and Project Areas and described EFH, including coastal pelagic, highly migratory, and shark species, see Tables 8, 10 and 11, respectively.

Coastal waters within and adjacent to the Call and Project Areas are highly productive and largely influenced by freshwater inputs from the many rivers and estuaries in Louisiana and Texas. Along the Louisiana coast, the major freshwater inputs influencing pelagic habitats and communities originate from the Mississippi and Atchafalaya River deltas. In Texas, freshwater inputs influencing pelagic habitats and communities in coastal waters originate from river inflows into seven major estuaries that include, from north to south along the Texas coast, the Sabine-Neches Trinity-San Jacinto, Lavaca-Colorado, Guadalupe, Missino-Aransas, Nueces, and the Laguna Madre.

In the north central region of the GOM, riverine inputs cause shelf stratification that results in a large hypoxic zone on the Louisiana-Texas shelf (see Figure 3) in bottom waters during the summer months (Turner et al. 2005). This phenomenon persists until wind-driven circulation mixes the water column and the large, seasonal influxes of river discharge subside. Hypoxic conditions (i.e., low oxygen) can be problematic for marine biota, including EFH species. Free-swimming, pelagic organisms are generally less susceptible to hypoxia than benthic organisms as they can detect and actively avoid hypoxic waters (Howell and Simpson 1994). Although, some pelagic species present in the region, like Gulf menhaden, may be more susceptible than others (Thronson and Quigg 2008). Overall, the effects of hypoxia on pelagic habitats and associated communities are stratified and seasonal, correlating with oxygen depleted waters present in the lower water column. The negative effects on pelagic species appear to be species-specific with many showing behavioral alterations to avoid less favorable environmental conditions (Thronson and Quigg 2008; Zhang et al. 2009).

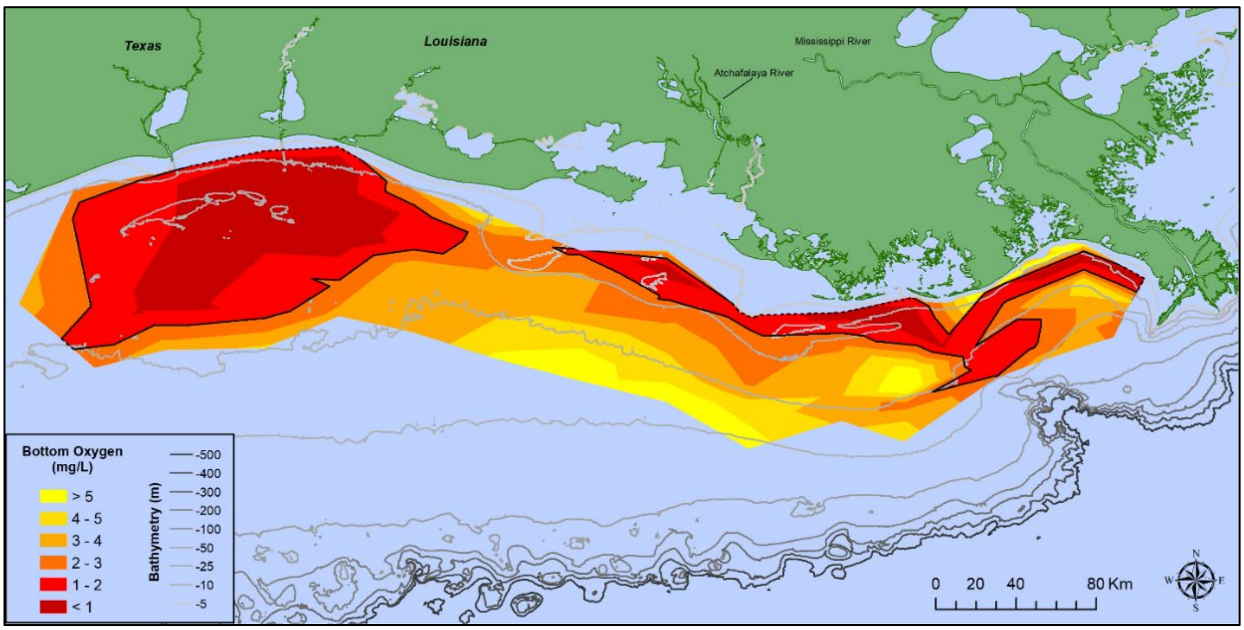

Figure 3. Map depicting the 2021 hypoxic zone in the Northern Gulf of Mexico.

Data source: N.N. Rabalais, R.E. Turner, and C. Glaspie, Louisiana State University and Louisiana Universities Marine Consortium. Funding: NOAA's National Centers for Coastal Ocean Science; see https://gulfhypoxia.net

The term "water quality" describes the condition or environmental health of a waterbody or resource. It reflects particular biological, chemical, and physical characteristics and the ability of the water column, a type of EFH, to maintain the ecosystems and EFH species it supports and influences. The primary factors influencing water quality in coastal and offshore waters are temperature, salinity, dissolved oxygen, chlorophyll content, nutrients, potential hydrogen (pH), oxidation-reduction potential (Eh), pathogens, transparency (i.e., water clarity, turbidity, or suspended matter), and contaminant concentrations (e.g., heavy metals, hydrocarbons, and other organic compounds). Overall, the water quality in the GOM has been rated as *fair* by the U.S. Environmental Protection Agency (EPA 2012) and is greatly affected by both natural and anthropogenic factors.

Lower salinities are naturally characteristic in the shallow, coastal waters of Louisiana and Texas where fresh water from rivers and estuaries enter and mix with coastal waters. There is a widespread surface turbidity layer in the north central GOM associated with the freshwater plumes from the Mississippi and Atchafalaya Rivers. This is due to suspended sediment in river discharge, especially during seasonal periods of heavy precipitation and snowmelt in the upper Mississippi River. Outside of these areas, water clarity in the GOM is good to excellent, with low levels of suspended sediment. As mentioned previously, during summer months, shelf stratification results in a large hypoxic zone on the Louisiana-Texas shelf in bottom waters (Turner et al. 2005). Tropical storms can also affect coastal water quality within and adjacent to the Call and Project Areas by altering levels of oxygen, salinity, and pollutants (both from terrestrial runoff and resuspension of bottom sediments).

Offshore water quality, especially deepwater along the continental margin, are directly affected by natural hydrocarbon and brine seeps. Natural seeps are extensive throughout the continental slope of the GOM and are chronic contributors of petroleum hydrocarbons to the offshore environment. Pelagic tar, which can have both natural and anthropogenic origins (Green et al. 2018; Warnock et al. 2015), is a common form of hydrocarbon contamination present within the water column in offshore waters (i.e., deeper margins of the Call and Project Areas). Aggregates of pelagic tar (e.g., tar balls and tar mats) can eventually reach Louisiana and Texas coastal waters.

Anthropogenic factors that affect coastal water quality in and adjacent to the Call and Project Areas include urban runoff containing oil and trace metals; agricultural runoff containing fertilizer (e.g., nutrients including nitrogen and phosphorus); pesticides, and herbicides; upstream withdrawals of water for agricultural, industrial, and domestic purposes; upriver flood control measures that introduce large volumes of freshwater; and contamination by industrial and sewage discharges, dumping, air emissions, and spills of oil and hazardous materials. Urban and agricultural runoff can cause excess nutrients to enter coastal waters and contributes to the formation of algal blooms in the GOM. Some may result in harmful algal blooms, which can result in mass mortalities of fish and invertebrates in coastal waters. Mixing or circulation of coastal water can either improve these water quality issues through flushing or be the source of factors contributing to its decline.

Pelagic *Sargassum* algae are one of the most ecologically important brown algal genera found in the pelagic environment of tropical and subtropical regions of the world. Throughout the GOM, *Sargassum* is ubiquitous in surface waters, generally forming large mats or “floating islands” that can be up to dozens of meters long in diameter. *Sargassum* from the northwest GOM (offshore Texas) is first detected and becomes highly concentrated between March and June, ultimately spreading eastward in the GOM and eventually the Atlantic via prevailing surface currents and winds; low amounts of *Sargassum* are detected in the GOM from September onwards (Gower and King 2011). The pelagic complex in the GOM is mainly comprised of *S. natans* and *S. fluitans* (Lee and Moser 1998; Littler and Littler 2000; Stoner 1983). Both species of macrophytes (aquatic plants) are hyponeustonic (living immediately below the surface) and fully adapted to a pelagic existence (Lee and Moser 1998). As EFH, *Sargassum* serves as nurseries, sanctuaries, and forage grounds for both commercially and recreationally exploited fish such as billfish, jacks, tunas, and dolphinfish (Dooley 1972; Lafolley et al. 2011).

3.4 Habitat Areas of Particular Concern (HAPCs)

HAPCs are subsets of EFH that exhibit one or more of the following traits:

- ecologically important for federally managed species (e.g., spawning and/or nursery grounds);
- especially sensitive or vulnerable to anthropogenic impacts (e.g., overfishing);
- stressed by development (e.g., nutrient and sediment pollution); and/or
- rare area as compared with the rest of a species' EFH geological range.

Although the HAPC designation does not provide added protection for or restriction to an area, it can be used to prioritize conservation efforts or as a focus for additional fishery management efforts. Among documented reefs and topographic features, the following are several of the currently designated GOM HAPCs within and near the Call and Project Areas (unnamed features are referred to by the OCS lease block in which they occur): Alderdice Bank; Atwater Valley 047 and 357; Bouma Bank; East Flower Garden Banks; 29 Fathom; Garden Banks 299 and 535; Geyer Bank; Green Canyon 140, 272, 234, 354, and 852; Harte Bank; Jakkula Bank; McGrail Bank; MacNeil; Mississippi Canyon 751 and 885; Rankin Bright Bank; Rezak Sidner Bank; Sonnier Bank; Southern Bank; Stetson Bank; and West Flower Garden Banks. Many of the banks are ecologically important habitat for protected corals and federally managed fish species. A large HAPC for the spawning, eggs, and larval life stage of Atlantic bluefin tuna (*Thunnus thynnus*) in the GOM encompasses the water column from the 100 m (328 ft) isobath to the seaward limit of the EEZ (Texas to the Florida Straights), and there is some overlap of this HAPC with the deep water margins of the Call and Project Areas. Though not anticipated, it is possible that vessels could travel over additional HAPCs if primary ports become unusable (e.g., Alabama Alps, Viosca Knoll 826, 862, and 906, Mississippi Canyon 118, L & W Pinnacles, Scamp Reef, Rough Tongue Reef). For a map of HAPCs within and near the Call and Project Areas, see Figure 4, and the NOAA Essential Fish Habitat Mapper[3] for all HAPCs in the GOM. New HAPCs or revisions to existing HAPC boundaries can be made by the GMFMC and NOAA Fisheries as new information becomes available.

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[3] See the NOAA Essential Fish Habitat Mapper at https://www.habitat.noaa.gov/apps/efhmapper/

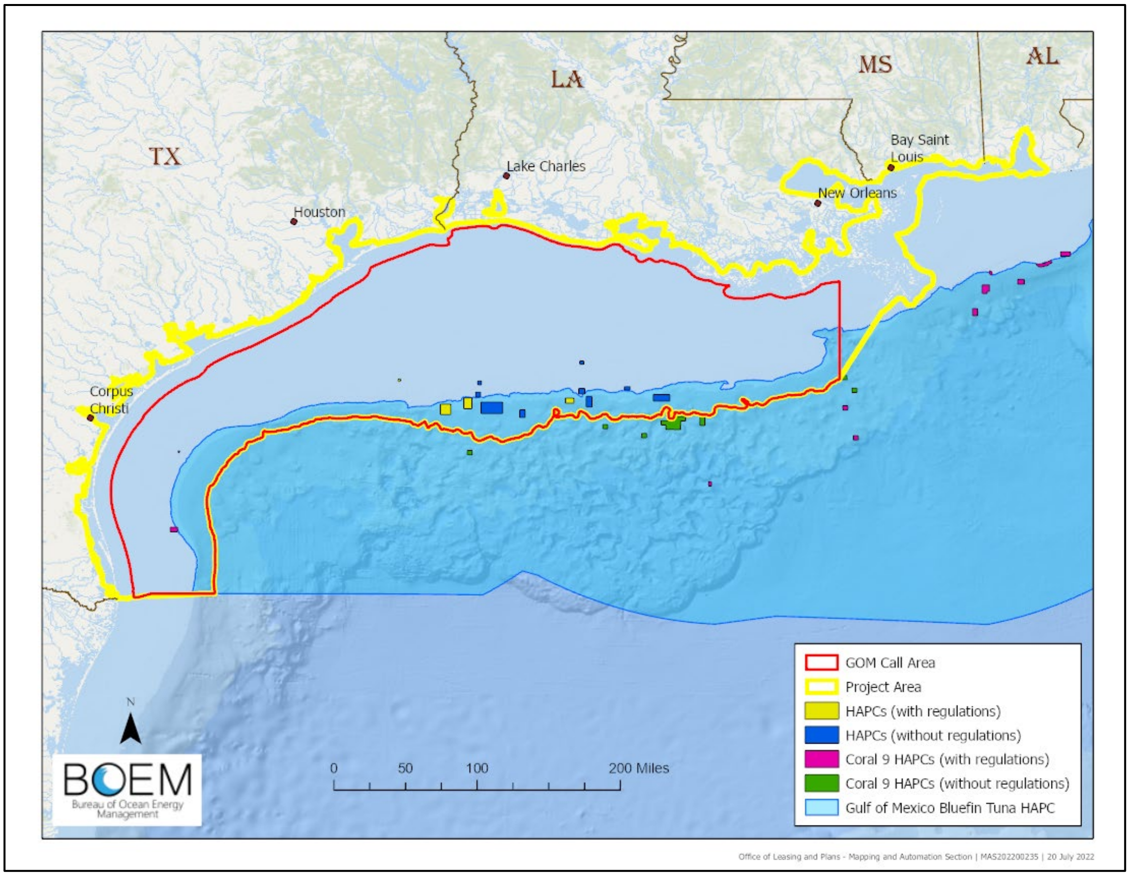

Figure 4. Gulf of Mexico HAPCs within and near the Call and Project Areas.

The publicly available data were downloaded from NOAA (Reef & Banks Essential Fish Habitat (EFH) Habitat Area of Particular Concern (HAPC) Map & GIS Data[4] on 1/15/22 (i.e., coral HAPCs) or provided by NOAA staff (i.e., bluefin tuna HAPC).

[4] See https://www.fisheries.noaa.gov/resource/map/reef-banks-essential-fish-habitat-efh-habitat-area-particular-concern-hapc-map-gis

4.0 Analysis of Effects

The purpose of this section is to evaluate if the Proposed Action would have an adverse effect on EFH, including managed and associated species within the Call and Project Areas. The EFH rules define an adverse effect as "any impact which reduces quality and/or quantity of EFH . . . [and] may include direct (e.g., contamination or physical disruption), indirect (e.g., loss of prey, reduction in species' fecundity), site-specific or habitat wide impacts, including individual, cumulative, or synergistic consequences of actions." Three types of habitat are included in this analysis: soft bottom benthic, hard bottom benthic, and pelagic (water column).

As mentioned previously, site assessment activities would most likely include the temporary placement of one to two anchored met buoys within each lease area, while site characterization activities would most likely include geophysical, geotechnical, and biological surveys within each lease area and along up to two export cable corridors per lease. Site characterization surveys for a proposed transmission cable route to shore would occur linearly along a 1,000-m wide corridor centered on the potential transmission cable location. These export cable corridor routes would traverse inshore habitats in state waters but, at present, specific locations are not known. Inshore habitats and EFH (e.g., SAV, oyster reefs, and emergent vegetation) represented in bays, estuaries, and river mouths of the project area support various life stages of managed species and their prey. Though site characterization activities that extend into state waters and onshore to ports or existing substations are a reasonably foreseeable result of a wind energy lease issued in the GOM Call Area, BOEM is not authorizing any activities in state waters and onshore areas and does not have the regulatory authority to apply mitigation measures outside of the OCS. Lessees would be responsible for obtaining any permits or other clearances required for operations conducted in state waters. Nonetheless, potential effects to EFH and managed and associated species, including those expected to occur along export cable corridors and/or easements, are analyzed here.

The following subsections include impact analyses for each habitat category (i.e., soft bottom, hard bottom, and pelagic) for geophysical surveys, and they include combined impact analyses for both geotechnical and benthic habitat surveys using the survey scenarios, calculations, and assumptions seen in Table 4. Table 4 includes the estimated number of sampling stations, samples to be collected, and bottom disturbance areas for two reference levels of activity (low- and high-end). Both activity levels are applied to single lease and 18 lease scenarios, assuming an average 80,000 acre lease area and up to two proposed export cable corridors per lease. In each scenario, it is assumed that either a 4-legged jack-up rig and/or lift boat or anchors would be used at each sampling station within a lease area and export cable corridors and/or easements. Both methods of anchoring result in an approximate benthic disturbance area of 10 m^2. It is important to note that approximately 50% of deployments for this sampling work could involve a boat having dynamic positioning capability (BOEM 2014); however, this assumption is not incorporated into the seafloor impact calculations. The types of geotechnical equipment used at a particular sampling station would depend on the sediment type, and the table includes calculations of areal benthic impacts using the type of geotechnical equipment with the largest area of bottom disturbance. For example, within a lease area and along export cable corridors and/or easements, a lessee may only choose to collect geotechnical samples using the deep boring method (1 m^2 area of impact), but the calculations provided in the tables assume the maximum area of bottom disturbance using the CPT method (4 m^2 area of impact). Areal bottom disturbances are provided for the samples (both geotechnical and benthic habitat) collected at each sampling station with and without the use of a jack-up rig and/or lift boat or anchors.

In this analysis, BOEM assumes lessees performing geotechnical and benthic habitat surveys would collect, at a minimum, six benthic habitat samples (i.e., triplicate benthic grabs and SPI/PV samples) and one geotechnical sample at each sampling station (i.e., low-end level of activity). The high-end scenario assumes that a lessee would collect six benthic habitat samples (i.e., triplicate benthic grabs and SPI/PV samples) and four geotechnical samples at each sampling station. Table 5 shows the percent total bottom disturbance for each scenario (i.e., low- and high-end) for both a single lease and up to 18 leases relative to the total acreage of seabed within the Call Area and export cable corridors, as well as the lease areas and export cable corridors.

In this analysis, it is assumed that all geotechnical and benthic habitat surveys would be conducted on soft bottom habitats. BOEM proposes that all bottom-disturbing activity avoid physical impacts to all hard bottom habitats (see BOEM's proposed mitigation, monitoring, and reporting standards in Section 6 Proposed Mitigation Guidance). Hard bottom benthic habitats are discussed in Section 3.2 Hard Bottom Benthic Habitats. As such, the analysis of the primary impacts associated with the Proposed Action (i.e., bottom-disturbing activities from geotechnical and benthic habitat surveys) to EFH is heavily focused on soft bottom habitats (Section 4.1 Soft Bottom Benthic Habitats).

4.1 Soft Bottom Benthic Habitats

Geophysical, geotechnical, and benthic habitat surveys and the placement of met boys are expected to have limited impacts to soft bottom seafloor habitats and associated EHF species. Managed species with designated EFH known to inhabit soft bottom benthic habitat within the Call and Project Areas include: penaeid shrimps (e.g., brown, white, and pink shrimp), snappers (e.g., red and lane), tilefish (e.g., blueline and golden), and coastal sharks (e.g., blacktip, bull sharks, and bonnetheads). Juveniles of the commercially and recreationally important red snapper are typically found and prefer to settle over low-relief sand, shell rubble, and mud bottom substrates in nearshore waters (Patterson et al. 2005; Rooker et al. 2004; Wells et al. 2008). Important prey species such as Atlantic croaker, Gulf menhaden, and various crab species can also be found over soft bottom habitats and provide vital linkages in fishery food webs. These species may be directly affected by the activities expected to occur as a result of the Proposed Action that would disturb soft bottom habitats.

It is anticipated that the bottom sediments within a lease area and export cable corridors will consist primarily of mud, clay, and/or silt sediments, which are ubiquitous in the region of the Call and Project Areas. BOEM and NOAA's National Centers for Coastal Ocean Science (NCCOS) worked jointly on a marine spatial planning model to site Wind Energy Areas (WEAs) (i.e., within which wind energy leases are located) and this siting process included the avoidance of significant sediment resource areas (i.e., predominantly large sand shoals) within the Call and Project Areas. Potential export cable corridors through inshore and/or state waters are expected to be sited in a manner that reduces or avoids impacts to soft bottom EFH, such as SAV. Though it is reasonable to assume that limited areas of sandy and/or shell substrates and SAV could potentially be present within a lease area and associated cable corridors, BOEM proposes lessees be required to avoid physical impacts to sensitive benthic habitats, including SAV (see Section 6 Lease Stipulations and Guidance).

4.1.1 Geophysical surveys

High-resolution geophysical surveys use a variety of acoustic sources to acquire imagery of the ocean floor or to detect characteristics (e.g., roughness, bathymetry) of the seafloor. This information is used to determine whether the seabed will adequately support the turbines, to identify the presence of archaeological resources or other shallow hazards, to characterize benthic habitats, and to conduct bathymetric charting. Multibeam echosounders, side-scan sonars, boomers, sparkers, and sub-bottom profilers may be used during HRG surveys; each of these sources introduces noise to the marine environment (Table 2). The introduction of noise can result in effects ranging from behavioral changes, masking of biologically important signals, temporary hearing loss, or, more rarely, physiological injury (Popper et al. 2019). The actual effects observed will depend upon a number of factors, including the source type (e.g., impulsive or non-impulsive), signal characteristics (e.g., frequency, source level, duration), the distance between the animal and the source, the cumulative sound exposure of the entire noise event, and the species' hearing sensitivity (Popper et al. 2014; Popper et al. 2019).

It is generally assumed that fishes and invertebrates are capable of sensing the particle motion component of the sound wave, which is the tiny back-and-forth motion of water particles that accompanies a passing pressure wave (Popper and Hawkins 2018). The particle motion associated with sound waves that move through the sediment is generally referred to as "substrate vibration", and animals that live on or in the seafloor may also detect acoustic energy in this way (Hawkins et al. 2021). Fishes that possess special adaptations of the swim bladder are also capable of detecting acoustic pressure, which enables them to detect a broader range of acoustic frequencies over larger distances (Popper et al. 2021; Wiernicki et al. 2020). Close to the seafloor and sea surface, complex patterns of particle motion can occur, as sound waves are reflected and refracted by these boundaries. Despite this complexity, one can generally assume that most fish and invertebrates would be able to detect sound within a few wavelengths of a sound source. At greater distances, only pressure-sensitive species could hear it (i.e., those with connections between the swim bladder and the ear). The research thus far shows that the primary hearing range of most particle-motion sensitive organisms is below 1 kHz (Popper and Hawkins 2018).

Of the sources that may be used in HRG surveys, only a handful (e.g., boomers, sparkers, bubble guns, and some sub-bottom profilers, (Crocker and Fratantonio 2016) emit sounds at frequencies that are within the expected hearing range of most fishes and invertebrates. This means that side-scan sonars, multibeam echosounders, and some sub-bottom profilers would not be audible to most fishes, and thus would not affect them. For the sources that are audible, it is important to consider other factors such as source level, beamwidth, and duty cycle. Boomers, sparkers, hull-mounted SBPs, and bubble guns have source levels close to the threshold for injury for pressure-sensitive fishes, so unless a fish was within a few meters of the source, injury is highly unlikely (Crocker and Fratantonio 2016; Popper et al. 2014). Behavioral impacts could occur over slightly larger spatial scales. For example, if one assumes a 150 dB re 1 µPa RMS threshold for behavioral disturbance of fishes (Buehler et al. 2015), sounds with source levels of 190 dB re µPa-m RMS would fall below this threshold at approximately 100 m from the source due to propagation loss (assuming spherical spreading). This means that the most commonly-used, lowest-powered sparkers, boomers, and bubble guns would not result in behavioral disturbance beyond approximately 100 m (Crocker and Fratantonio 2016). Towed SBPs are generally lower in power than hull-mounted systems, so behavioral impacts are likely to occur over smaller scales (e.g., 10m from the source). It should be noted that these numbers are reported in terms of acoustic pressure because there is currently no behavioral disturbance threshold for particle motion, but it is expected that these ranges would be even smaller for particle-motion sensitive species.

Beamwidth is also an important consideration: sparkers are omnidirectional, but boomers have beamwidths < 90°, meaning that sound is emitted in a 90° cone below the source (Crocker and Fratantonio 2016). The beamwidth of bubble guns is not well-quantified. Generally, any source emitting sound in a directional manner is less likely to result in harm to marine species compared to an omnidirectional source, because less of the water column is ensonified, which decreases the likelihood that an animal will encounter the sound beam. Finally, duty cycle should be considered. Most HRG sources are typically "on" for short periods with silence in between. This means that only a handful of "pings" emitted from a moving vessel towing an active acoustic source would reach fish or invertebrates below, at received levels sufficient to elicit behavioral responses.

The level of disturbance from HRG surveys is expected to be extremely small for fishes and invertebrates due to the frequency range of most sources, the small spatial scale of sound propagation given the source levels, the short duration of the sound pulses, and the beamwidths of some sources. Impacts to soft-bottom benthic habitats are expected to occur over very small spatial scales, essentially limited to areas directly underneath vessels towing the active acoustic sources. Towed subbottom profilers, while lower in energy than hull-mounted systems, emit sound just a few meters above the seabed, so it is likely that some of the acoustic energy that travels through the substrate could affect burrowing organisms in the sediment (Hawkins et al. 2021). Impacts are still expected to occur within a few wavelengths of the source and will be transient in nature.

4.1.2 Geotechnical and benthic habitat surveys

Geotechnical surveys occurring in soft bottom habitats may involve the use of vibracores, piston or gravity cores, deep borings, cone penetrometers, and other forms of bottom-sampling gear, and benthic habitat surveys would involve the use of benthic grabs (e.g., standard Van Veen) and SPI/PV imagery (Table 3). These methods could impact soft bottom habitats and associated communities through bottom disturbances and adding underwater sound from sampling equipment. Sampling equipment would physically disturb soft bottom seafloor habitats and by creating holes and pits. Benthic grab samplers used for assessing infaunal assemblages remove on average about 0.1 m^2 of the upper 10 to 15 cm of seafloor sediment and organisms collected in those sample would not survive. Epifaunal and infaunal resources important to bottom feeding fishes may be crushed and/or buried around areas where geotechnical and biological sampling gear contacts the bottom. Recovery times of soft bottom habitats following bottom disturbances are difficult to generalize due to a paucity of studies in the region and many factors impacting recovery (e.g., sediment types, water depth, and species); however, recovery is estimated to potentially occur between three months and 2.5 years for soft bottom habitats, such as sand shoals (Brooks et al. 2006; Wilber and Clarke 2007). Geotechnical sampling methods would also generate noise up to 160 dB for vibracores (Table 3). This level is below the threshold considered detrimental to fish physiology (i.e., resulting in damage to hearing structures), but could result in masking or behavioral responses (Popper et al. 2014). These sampling methods would also generate noise up to 160 dB for vibracores (Table 3). This level is below the threshold considered detrimental to fish physiology (i.e., resulting in damage to hearing structures), but could result in masking or behavioral responses (Popper et al. 2014).

It is anticipated that export cable corridors will avoid known areas of sensitive coastal habitats such as mangroves, wetlands, and SAV communities (all considered soft bottom habitats in this analysis). However, it is possible that unmapped/unknown areas of SAV could be adversely impacted by geotechnical and benthic habitat survey equipment, anchors, propellors, and prop wash in shallow waters. Benthic grabs, coring equipment, anchors, and propellor interactions could remove and/or injure small portions of SAV if present at a sampling station. The disturbance of bottom sediments from sample collection, anchors, and prop wash could also increase turbidity in the water column, potentially resulting in sedimentation of SAV and limiting light penetration needed for photosynthesis. This can result in indirect adverse impacts to associated species using this EFH for foraging, shelter from predation, and nursery habitat.

4.1.2.1 Lease area

Within a single lease, BOEM estimates there to be a total of 71 geotechnical/benthic habitat sampling stations and depending on the scenario, between 497 and 710 samples would be collected for an average (80,000 acre) lease area (Table 4). This would result in approximately 0.29–0.49 acres of bottom disturbance combined for both geotechnical and benthic habitat samples without the use of anchors. If anchoring (i.e., jack-up rig/lift boat or anchors) at each sampling station, between 0.47 and 0.67 acres could be disturbed, representing 0.0006–0.0008 % of an average 80,000 acre lease area.

For 18 leases, BOEM estimates there to be a total of 1,278 geotechnical/benthic habitat sampling stations and depending on the scenario, between 8,946 and 12,780 samples would be collected for 18 average (80,000 acre) lease areas (Table 4). This would result in approximately 5.16–8.95 acres of bottom disturbance combined for both geotechnical and benthic habitat samples without the use of anchors. If anchoring (i.e., jack-up rig and/or lift boat or anchors) at each sampling station, between 8.36 and 12.15 acres could be disturbed, representing 0.0006–0.0008 % of 18 total lease areas.

4.1.2.2 Export cable corridor and/or easement

Within the two potential export cable corridors from a single lease, low- to high-end activity scenario, BOEM estimates 9,821–14,030 samples could be collected from a total of 1,403 geotechnical/benthic habitat sampling stations, linearly spaced along the corridors. This would result in approximately 5.66–9.83 acres of areal bottom disturbance combined for both the geotechnical and benthic habitat samples without the use of anchors. If anchoring (i.e., jack-up rig and/or lift boat or anchors) at each sampling station, between 9.17 and 13.34 acres could be disturbed, representing 0.0026–0.0038 % of the two potential export cable corridors.

Within the two potential export cable corridors for up to 18 leases, low- to high-end activity scenario, BOEM estimates 176,778–252,540 samples could be collected from a total of 25,254 geotechnical/benthic habitat sampling stations. This would result in approximately 101.90–176.90 acres of areal bottom disturbance combined for both the geotechnical and benthic habitat samples without the use of anchors. If anchoring at each sampling station, between 165.04 and 240.04 acres could be disturbed, representing 0.0026–0.0038 % of the two potential export cable corridors.

Table 4. Summary of bottom disturbance from geotechnical and benthic habitat surveys

No. Leases [a]	Project Component		No. Sampling Stations	No. Samples	Bottom Disturbance (acres)			Area Sampled (Acres)	Percent of Bottom Disturbance	Assumptions
					Sample Area	Anchoring Area	Total			
Low-End Activity [b]										
Single Lease	Lease Area	Turbines and OSS Locations	69	483	0.28	0.17	0.45	80,000	0.0006	69 turbine and Offshore Substation (OSS) locations within an 80,000acre lease
		Met Buoy Locations	2	14	0.01	0.01	0.02			2 met buoy locations
	Export cable corridors		1403	9,821	5.66	3.51	9.17	346,689	0.0026	~701-km long and 1,000-meters-wide export cable corridor survey One sampling station every kilometer Two export cable corridors per lease (1,403 km total)
TOTAL					**5.95**	**3.69**	**9.64**	**426,689**	**0.0023**	
18 Leases	Lease Area	Turbines and OSS Locations	1,242	8,694	5.01	3.11	8.12	1,440,000	0.0006	69 turbine and OSS locations within an 80,000-acre lease
		Met Buoy Locations	36	252	0.15	0.09	0.24			2 met buoy locations
	Export cable corridors		25,254	176,778	101.90	63.14	165.04	6,240,402	0.0026	~701-km long and 1,000-meters-wide export cable corridor survey One sampling station every kilometer Two export cable corridors per lease (1,403 km total)

No. Leases [a]	Project Component		No. Sampling Stations	No. Samples	Bottom Disturbance (acres)			Area Sampled (Acres)	Percent of Bottom Disturbance	Assumptions
					Sample Area	Anchoring Area	Total			
TOTAL					**107.06**	**66.34**	**173.40**	**7,680,402**	**0.0023**	
High-End Activity [c]										
Single Lease	Lease Area	Turbines and OSS Locations	69	690	0.48	0.17	0.65	80,000	0.0008	69 turbine and OSS locations within an 80,000-acre lease
		Met Buoy Locations	2	20	0.01	0.01	0.02			2 met buoy locations
	Export cable corridors		1,403	14,030	9.83	3.51	13.34	346,689	0.0038	~701-km long and 1,000-meters-wide export cable corridor survey One sampling station every kilometer Two export cable corridors per lease (1,403 km total)
TOTAL					**10.32**	**3.69**	**14.01**	**426,689**	**0.0033**	
18 Leases	Lease Area	Turbines and OSS Locations	1,242	12,420	8.70	3.11	11.81	1,440,000	0.0008	69 turbine and OSS locations within an 80,000-acre lease
		Met Buoy Locations	36	360	0.25	0.09	0.34			2 met buoy locations
	Export cable corridors		25,254	252,540	176.90	63.14	240.04	6,240,402	0.0038	~701-km long and 1,000-meters-wide export cable corridor survey One sampling station every kilometer Two export cable corridors per lease (1,403 km total)
TOTAL					**185.85**	**66.34**	**252.19**	**7,680,402**	**0.0033**	

No. Leases [a]	Project Component	No. Sampling Stations	No. Samples	Bottom Disturbance (acres)			Area Sampled (Acres)	Percent of Bottom Disturbance	Assumptions
				Sample Area	Anchoring Area	Total			

Notes:

[a] Assumes all leases are 80,000 acres.

[b] Low-End Activity scenario Assumptions

Within Lease Area Samples (n=7):

- 3 Van Veen benthic sample (0.1m^2, 0.000025-acre);
- 3 SPI sample (4m^2, 0.00099-acre); and
- 1 CPT sample (4m^2, 0.00099-acre)

Export cable corridor Samples (n=7):

- 3 Van Veen benthic sample (0.1m^2, 0.000025-acre);
- 3 SPI sample (4m^2, 0.00099-acre]; and
- 1 CPT sample (4m^2, 0.00099-acre)

Anchoring at each Station:

- Jack-up rig/lift boat (4 spuds: 10.18m^2, 0.0025-acre) or standard anchoring (10m^2, 0.0025-acre)

[c] High-End Activity Scenario Assumptions

Within Lease Area Samples (n=10):

- 3 Van Veen benthic sample (0.1m^2, 0.000025-acre);
- 3 SPI sample (4m^2, 0.00099-acre); and
- 4 CPT samples (4m^2 each sample, 0.00099-acre each sample)

Export cable corridor Samples (n=10):

- 3 Van Veen benthic sample (0.1m^2, 0.000025-acre);
- 3 SPI sample (4m^2, 0.00099-acre]; and
- 4 CPT samples (4m^2 each sample, 0.00099-acre each sample)

Anchoring at each Station:

- Jack-up rig/lift boat (4 spuds: 10.18m^2, 0.0025-acre) or standard anchoring (10m^2, 0.0025-acre)

SPI = Sediment Profile Imaging

CPT = Cone Penetration Test

Table 5. Percent of bottom disturbance relative to the lease and call evaluation areas

Scenario [a]	No. Leases	Bottom Disturbance (acres)	Lease Evaluation Area (acres)			Call Area Evaluation Area (acres)			Percent Disturbed of the Evaluation Area	
			Lease Area [b]	Export cable corridors [c]	Total	Call Area	Export cable corridors [c]	Total	Lease	Call Area
Low-End	1	9.64	80,000	346,689	426,689	29,901,285	346,689	30,247,974	0.002	0.00003
	18	173.40	1,440,000	6,240,402	7,680,402	29,901,285	6,240,402	36,141,687	0.002	0.00048
High-End	1	14.01	80,000	346,689	426,689	29,901,285	346,689	30,247,974	0.003	0.00005
	18	252.19	1,440,000	6,240,402	7,680,402	29,901,285	6,240,402	36,141,687	0.003	0.00070

Notes:

[a] The low-end activity scenario consists of six benthic habitat samples and one geotechnical sample per sampling station. The high-end activity scenario consists of six benthic habitat samples and four geotechnical sample per sampling station.

[b] Includes all of the future leases. Assuming average 80,000 acre lease areas.

[c] Two ~701-km long and 1,000-meters-wide export cable corridor surveys per lease (1,403 km total).

4.1.3 *Meteorological buoy installation*

The installation of met buoys used for the collection of site assessment data (i.e., meteorological and oceanographic conditions) within a lease area would involve the placement of mooring anchors (e.g., clump weights) and chains on the seafloor to moor the met buoys in place. BOEM anticipates that either a boat-shaped or discus-shaped hull buoy will be used. The buoys are either towed or carried aboard a vessel to the installation location and either lowered to the surface from the deck of the vessel or placed over the final location where the mooring anchor is dropped (BOEM 2014).

Mooring anchors for boat-shaped or discus-shaped buoys would each weigh about 2,721 to 3,628kg (6000–8,000 lbs) and have a footprint of about $0.5m^2$ ($5.38\ ft^2$) and an anchor sweep of about $34,398\ m^2$ ($370,256\ ft^2$). The maximum number of buoys expected for the project is 36 (i.e., two met buoys in up to 18 leases), resulting in a potential impact to soft bottom habitat from mooring anchors of $18\ m^2$ ($194\ ft^2$; 0.004 acres); impacts from anchor sweep could potentially impact up to 306 acres. Vessels used to deploy met buoys may use vessel anchors or dynamic positioning capabilities to keep the vessel stationary during installation. Transport and installation vessel anchoring for one day is anticipated for these types of buoys. If a dynamically positioned vessel is not used for met buoy installation, BOEM assumes the areal bottom disturbance from vessel anchoring would be the same as the areal footprint associated with the collection of geotechnical and benthic habitat sampling (i.e., $10\ m^2$). Under the 18 lease scenario, this would result in an additional .09 acres of soft bottom, benthic disturbance.

The types of impacts from anchor installation likely to occur are similar to those previously described for seafloor disturbance from geotechnical and benthic habitat sampling (e.g., crushing of sessile benthic organisms and increased turbidity and burial from sediment suspension). The presence of buoy anchors could also result in a limited artificial reef effect, which is described in Section 4.4.3 in more detail. When buoys are eventually decommissioned (i.e., lifted from the seabed and towed back to shore), encrusted organisms would not survive and mobile, reef associated species would be expected to leave the area. The soft bottom habitat within the footprint of the buoy anchors is expected to recover and be recolonized over time.

4.1.4 *Summary*

The large majority of site assessment and site characterization activities will take place over mud, clay, and/or silt sediments, which are EFH for a limited number of managed species (e.g., penaeid shrimps, tilefish, and red snapper). Sound from HRG surveys and bottom disturbances from met buoy placement and site characterization surveys (i.e., geotechnical and benthic habitat) are the primary factors that could impact EFH and associated species in the Call and Project Areas. However, these activities (i.e., HRG, geotechnical, and benthic habitat surveys) would occur intermittently over several years and across large areas within the Call and Project Areas.

Although some of the sound sources used during HRG surveys (e.g., boomers and sparkers) could generate sound levels that could potentially cause physiological damage to hearing structures or behavioral disturbance, these impacts are not expected to result in population or stock-level changes. Due to propagation effects, impacts would occur very close to the source (Crocker and Fratantonio, 2016) and given the fact that these sources emit short “pings” with silence in between, it is unlikely that vessels towing these sources would result in significant impacts to EFH. Substrate vibrations caused by these sound sources could be detectable by fish and invertebrates living within soft bottom substrates, potentially resulting in behavioral responses; however, this impact is also expected to be transient and limited to very small spatial scales.

The maximum benthic disturbances to soft bottom habitats from geotechnical and benthic habitat surveys under both the low- and high-end activity scenarios for 18 leases would be small relative to the total acreage of available habitat within the Lease Evaluation Area (i.e., low-end = .002% and high-end = .003%; Lease Evaluation Area includes export cable corridors) and also small relative to the Call Evaluation Area (i.e., low-end = .00048% and high-end = .00070%; Call Evaluation Area includes export cable corridors) (see Table 5). In addition, the estimated maximum benthic disturbance impacts from installing 36 met buoys (0.004 acres), including met buoy anchor sweep (306 acres), and vessel anchor disturbance (.09 acres) is also small relative to the available habitat within the Lease Evaluation Area (.004%) and Call Area Evaluation Area (.0008%). The soft bottom habitats within the footprint of vessel and mooring anchors, as well as the anchor sweep of the met buoys are expected to recover over time (estimated three months to 2.5 years; Brooks et al. 2006; Wilber and Clarke 2007), both physically and biologically, following the removal of vessel anchors and decommissioning of met buoys and anchors. The benthic disturbances represent a relatively small addition compared to existing human activities (e.g., bottom trawling) and natural disturbances (e.g., hurricanes) impacting these ubiquitous habitats within the Call and Project Areas. Overall, the impacts of buoy installation and HRG, geotechnical, and benthic habitat surveys are not anticipated to significantly impact soft bottom EFH or inhibit the ability of these habitats to support managed species and their prey.

4.2 Hard Bottom Benthic Habitat

BOEM understands that hard bottom habitats (e.g., HAPCs) and their associated communities, particularly slow-growing corals, are sensitive to activities that disturb the seafloor. These features are important EFH to many managed species including commercially and recreationally valuable reef fish such as snappers, groupers, and jacks, as well as shallow water, mesophotic, and deepwater corals. It is expected that physical impacts to all hard bottom features will be avoided (see Section 6 Proposed Mitigation Guidance). Underwater sound produced from HRG surveys could reach hard bottom habitats and their associated communities.

4.2.1 Geophysical surveys

Underwater sound produced by HRG survey equipment, including multibeam echosounders, side scan sonars, and sub-bottom profilers, has the potential to reach hard bottom habitats and associated communities of fish and invertebrates. However, many of these systems operate at frequencies that are not detectable by fish and invertebrates (see Section 4.1.1), and even surveys using sources that are audible are not expected to result in significant levels of physical injury (both lethal and recoverable) that could result in population- or stock-level impacts.

Recent tagging studies investigating the behavioral impacts to fish and invertebrates from seismic airguns (e.g., Davidsen et al. 2019; Hubert et al. 2020; Meekan et al. 2021; van der Knaap et al. 2021), a higher-intensity and lower-frequency sound source that is detectable by most fish and invertebrates, have tended to show subtle, short-term behavioral changes with no evidence that fish are fleeing an area, ceasing feeding, or permanently abandoning habitat. Despite the range of species and methods covered in this research, a common trend that emerges is that fish often show an initial response (either a startle response or a change in schooling behavior), but this response is reduced with repeated exposure or ramp-up of the sound source. As such, the impacts from less intense, medium penetration sub-bottom profiling equipment typically used during HRG surveys of renewable energy leases are expected to be less or similar to those previously described for seismic airguns. Though acoustic impacts could result in temporary and spatially limited changes in behavior and displacement among fish and invertebrates that could increase vulnerability to predation and stress (Spiga et al. 2017), there is little chance this would have population- or stock-level effects to hard bottom associated fish and invertebrates.

4.2.2 Geotechnical and benthic habitat surveys

BOEM expects that no geotechnical or benthic habitat samples will be collected on or directly adjacent to hard bottom habitats due to a proposed mitigation requiring that lessees avoid impacts from bottom-disturbing activities via distance requirements (see Section 6 Proposed Mitigation Guidance).

4.2.3 Summary

Overall, adverse impacts to sensitive, hard bottom habitats are not anticipated to occur due to the Proposed Action. Geotechnical and benthic habitat surveys that could otherwise cause direct, physical impacts to benthic habitats are not expected due to BOEM's proposed mitigation requiring avoidance of hard bottom habitats. Impacts to inshore hard bottom habitats such as oyster beds are expected to be avoided (see Section 4.2.2); although, unknown hard bottom in shallow waters may experience limited interactions with the hulls and/or propellors of vessels conducting geotechnical and benthic habitat sampling surveys in shallow inshore waters. Underwater sound produced from HRG surveys occurring over or near hard bottom habitats are the only impact-producing factor anticipated to cause impacts to hard bottom associated fish and invertebrates. However, it is expected these sound sources would largely result in localized, short-term impacts to behavior and not result in significant levels of physical damage to hearing structures of hard bottom associated fish and invertebrates. Fish and invertebrates would be expected to resume normal behaviors after the sound source has ceased or is below thresholds that would cause effects (e.g., behavioral changes). Further, the short-term and transient nature of HRG surveys and produced sound would not inhibit the ability of hard bottom habitats in a lease area to act as EFH for managed species and their prey.

4.3 Pelagic Habitat

Pelagic habitat supports, either directly or indirectly, all marine life within the GOM. It hosts a wide diversity of fishes and invertebrates that use its various physical and chemical attributes. Species of recreational and commercial interest known to occupy the pelagic habitat, either as adults, juveniles, or larvae, include jacks, rudderfish, amberjack, triggerfish, red drum, cobia, mackerels, and HMS species such as tuna, marlin, sailfish, and swordfish. *Sargassum* mats found within the pelagic environment support many juvenile stages of marine fishes. Key impact-producing factors for the pelagic environment related to renewable energy site assessment and site characterization activities are noise generated by geophysical surveys, sediment suspension from geotechnical and benthic habitat surveys, habitat modification from met buoy installation and decommissioning, as well as vessel traffic that could physically disturb *Sargassum* and associated communities.

4.3.1 Geophysical surveys

The primary impact of HRG surveys is noise added to the pelagic environment; the anticipated impacts to associated communities of pelagic fish and invertebrates would be similar to those described previously for soft bottom habitats (see Section 4.1.1) and hard bottom habitats (see Section 4.2.1). A notable difference between soft and/or hard bottom associated communities and pelagic communities is the comparatively large proportion of zooplankton present in the pelagic environments (i.e., the water column).

Zooplankton, which includes the eggs and larvae of vast numbers of fish and invertebrate species (including managed species and their prey) are of concern due their inability to flee an oncoming vessel and towed sound sources. However, the eggs and larvae of fish and invertebrates in the water column or near the water surface are unlikely to experience impacts ranging from recoverable injury to behavioral impacts from exposure to impulsive sounds (e.g., boomers and sparkers), unless they are within tens of meters from the sound source (Popper et al. 2014). Lethal injury to hearing structures would be expected to occur at even shorter distances, if at all (Popper et al. 2014). Thus, only a small percentage of the zooplankton assemblage present in the Project Area is expected to be adversely affected. Any mortalities to eggs and larvae occurring very close to HRG survey equipment are not anticipated to result in population- or stock-level impacts to fish and invertebrates, including managed species and their prey.

Overall, the expected impacts to pelagic fish and invertebrates (including adults, eggs, and larvae) from exposure to HRG sound sources would largely consist of localized and temporary behavior and distribution changes. Any reductions in the quality of the pelagic environment and its ability to support EFH species in the project area would be short-term and localized due to the transient nature of HRG survey activities.

4.3.2 Geotechnical and benthic habitat surveys

The seabed would be disturbed locally during geotechnical and benthic habitat surveys, suspending sediments into the water column and increasing turbidity. Elevated turbidity can result in species-specific impacts such as behavioral responses, reduced feeding efficiency, and decreased predator avoidance, as well as lead to physiological changes in adult pelagic fishes (Wenger et al. 2017). For example, gill cavities can be clogged by suspended sediment, which can mechanically affect food gathering in planktivorous species, and even erode gill lamellae disrupting normal gill respiration (Wenger et al. 2017); although, it is expected that highly mobile pelagic species could easily avoid these areas. For areal impacts of the geotechnical and benthic habitat survey equipment, see Table 3. Though motile species (e.g., jacks, drums, mackerels, herrings, large pelagics) could avoid turbid areas, sessile invertebrates and demersal fishes may temporarily experience impaired sensory abilities. Similarly, zooplankton (including eggs and larvae of managed species) cannot avoid sediment plumes and may be exposed for longer durations than adults. However, evidence suggesting increased turbidity, which may reduce hatching success or delay larval development, is limited, and other studies have shown larval foraging success and growth may benefit from nutrient-rich plumes (Gray et al. 2012; Wenger et al. 2014). Overall, the amount of bottom disturbance resulting from renewable-energy site characterization activities is anticipated to create only short-term and small-scale impacts to the water column that are expected to dissipate quickly. The impacts would be limited to individuals or small groups of pelagic fish and invertebrates in the vicinity and given the relatively small footprint of impacted pelagic habitat, population-level impacts to associated communities of fish and invertebrates are not expected.

4.3.3 Meteorological buoy installation

Although structure emplacements, such as met buoys, are temporary, the operational life may be long-term and would locally modify pelagic habitat. Met buoys would provide a small amount of subsurface structure, which could result in a limited artificial reef effect and act as fish attracting devices for pelagic fishes. Lease sale(s) would result in a minimal number of met buoy emplacements (maximum two buoys per lease) that are spread out over large areas, resulting in an overall non-significant effect on pelagic fish and invertebrate populations. Lights mounted on met buoys would introduce a longer-term source of artificial lighting in surrounding surface waters; although, this introduced light is not expected to significantly impact fish and invertebrate populations due to the small number of buoys deployed and relatively limited area of illuminated surface water around each buoy. The hydrodynamic environment of the project area likely would not be adversely affected by placement of small water column footprint of met buoys. Placement of moored met buoys is expected to only affect currents around the mooring lines of the structure, creating minor turbulence at that point. The decommissioning of met buoys would remove the available subsurface habitat that pelagic fish in the area may be attracted to, they would be expected to leave the area after removal.

4.3.4 Vessel use

HRG surveys, geotechnical and benthic sampling, and met buoy installation, maintenance, and decommissioning would cause increased vessel traffic in coastal and offshore areas. Vessel traffic can introduce noise into the pelagic environment, increase turbidity levels, degrade water quality, and increase the possibility for vessel strikes to EFH (e.g., *Sargassum*). Continuous noise from routine vessel traffic (i.e., boat propellors) produces low-frequency, nearly continuous sound that is audible by most fishes and invertebrates and could cause acoustic masking. Masking of biologically relevant sounds has the potential to increase predation, reduce foraging success, and may preclude individuals from finding a mate, thus affecting reproductive success. Vessel traffic in shallow, coastal waters may also cause localized increases in turbidity from prop wash-related bottom disturbances and routine discharges and effluents such as deck wash and graywater could locally degrade water quality. However, such discharges are permitted and regulated by the EPA and subject to regulation under Section 404 of the CWA. Vessel activity occurring in offshore waters may cause physical damage and mortality to portions floating *Sargassum* mats. Damages to these habitats could cause indirect impacts to associated communities of fish an invertebrates (e.g., loss of habitat and/or shelter and foraging opportunities, stress, and/or increased predation).

Overall, none of the aforementioned impacts resulting from vessel traffic associated with the Proposed Action are expected to significantly impact the quality of EFH or HAPCs in the Project Area or their ability to support managed species or their prey. The amounts of vessel traffic associated with the proposed site assessment and site characterization activities would be small, particularly when compared to existing background levels of vessel traffic in the GOM, a highly industrialized water body. Impacts from vessel traffic are generally expected to be highly localized (limited to a few existing ports or new cable easements), short in duration, and the activities would be spread out over large areas of the OCS or in several ports or coastal areas adjacent to the Call and Project Areas.

4.3.5 Summary

Pelagic EFH and associated fish and invertebrate communities are not expected to be significantly affected by activities associated with the Proposed Action. Noise from HRG surveys, and increased turbidity and artificial lighting input from geotechnical and/or benthic habitat surveys and met buoy installation are also expected to be highly localized, short-term, and not result in population- or stock-level impacts. A significant artificial reef effect from installation of met buoys is not expected due to the small amounts of buoys deployed per lease and the relatively small amount of subsurface structure area. Turbidity caused by bottom disturbance (e.g., geotechnical and/or benthic habitat surveys and installation of met buoy anchors) would be temporary, localized, and be expected to dissipate quickly within the water column. Vessel strikes and resulting fragmentation of *Sargassum*, an important pelagic habitat component, are not expected to occur in significant amounts or diminish its ability to act as EFH. Therefore, activities associated with the Proposed Action are not expected to significantly affect pelagic EFH and associated fish and invertebrate populations (including managed EFH species and prey). Last, the expected impacts associated with the Proposed Action represent a small addition to other stressors cumulatively impacting pelagic EFH in the Call and Project Areas and along export cable corridors (e.g., other Federal and State agency actions, point and nonpoint sources of pollution, natural events or processes, recreational/commercial vessel traffic, canal and channel maintenance dredging, etc.).

5.0 Accidental Events

Equipment used during site characterization and site assessment activities (e.g., towed HRG survey equipment, geotechnical sampling equipment and components, grab sampler, buoys, lines, cables) could be accidentally lost during survey operations. Additionally, it is possible (although unlikely) that the met buoy could disconnect from the clump anchor. In the event of lost equipment, recovery operations may be undertaken to retrieve the equipment. Recovery operations may be performed in a variety of manners depending on the equipment lost. A commonly used method for retrieval of lost equipment on the seafloor is through dragging grapnel lines (e.g., hooks, trawls). A single vessel deploys a grapnel line to the seafloor and drags it along the bottom until it catches the lost equipment, which is then brought to the surface for recovery. This process can result in significant bottom disturbances because it requires dragging the grapnel line along the bottom until it hooks the lost equipment, and this may require multiple passes in a given area. Also, after the line catches the lost equipment, it would drag all the components along the seafloor until recovery. However, considering that lease stipulations would distance bottom disturbing survey activities from sensitive, benthic habitats (e.g., hard bottoms), accidental interactions between gear recovery equipment and these habitats would be minimized.

Where lost survey equipment is not able to be retrieved because it is either small, is buoyant enough to be carried away by currents, or is completely or partially embedded in the seafloor (for example, a broken vibracore), the equipment may become a potential hazard for bottom-tending fishing gear or cause additional bottom disturbance. For example, a broken vibracore that cannot be retrieved may need to be cut and capped 1 to 2 m below the seafloor. For the recovery of lost survey equipment, BOEM will work with the lessee/operator to develop an emergency response plan. Selection of a mitigation strategy will depend on the nature of the lost equipment, and further consultation may be necessary.

Vessel strikes could result from increased vessel traffic, either to habitat (e.g., running aground near a port; damaging benthic EFH such as SAV) or to managed fish and invertebrate species while underway. These activities are not reasonably foreseeable and would result in localized effects that would not significantly impact essential fish habitat or fish and invertebrate populations (including managed EFH species and prey).

Accidental discharges of trash and debris from vessels could pollute the water column and affect localized water quality (e.g., introduction of microplastics). Trash and debris disposal at sea is prohibited by USCG (International Convention for the Prevention of Pollution from Ships [MARPOL], Annex V, Public Law 100-220 [101 Stat. 1458]), and BOEM requires lessees, applicants, operators, or holders of a ROW grant, RUE grant, or Alternate Use RUE grant to take measures to prevent unauthorized discharge of pollutants including marine trash and debris into the offshore environment (30 CFR § 585.105). Any accidental discharges of trash and debris from vessels would represent a negligible cumulative addition compared to existing sources of trash and debris (e.g., commercial shipping and fishing vessel activity and terrestrial inputs) and would not be expected to significantly alter EFH.

6.0 Proposed Mitigation Guidance

A Lessee's rights to conduct activities on leased areas are subject to lease terms, conditions, and stipulations. Even after lease issuance, BOEM reserves the right to impose additional terms and conditions incident to the future approval or approval with modifications of plans, such as a Site Assessment Plan (SAP) or Construction and Operations Plan (COP). BOEM's primary mitigation strategy has and will continue to be avoidance. Lease stipulations (likely in the form of standard operating conditions or SOCs) may be incorporated into lease agreements to require compliance with mitigation, monitoring, and/or reporting standards derived from interagency consultation. Once consultation is complete, BOEM will draft additional guidance and examples of methods that may be assumed to meet required standards. BOEM's guidance or best management practices will be publicly available, and lessees and operators may choose to follow the guidance or best management practices, or they may propose other methods that meet or exceed required standards. If alternate methods are proposed, BOEM recommends an internal review for adequacy (i.e., meets or exceeds required standards) and, if deemed adequate, will contact NMFS to determine if project-specific consultation is required.

BOEM proposes the following mitigation, monitoring, and reporting standards to avoid potential impacts to EFH.

6.1 Avoiding Sensitive, Benthic Habitat Protocol:

Background

Under 30 CFR 585.611 and 585.627, BOEM requires Lessees' plans to provide information about benthic habitats as well as methods for avoiding, minimizing, reducing, eliminating, and monitoring environmental impacts. Activities associated with renewable energy development on the Outer Continental Shelf (OCS of the Gulf of Mexico (GOM) and in the vicinity of sensitive benthic habitats, including site characterization and site assessment activities, have the potential to cause deleterious impacts to those habitats. The following guidelines were developed in consultation with NMFS and are assumed to satisfy the responsibilities of BOEM to protect the environment and to conserve the natural resources of the OCS as provided by 30 CFR 585.102. Although other methods may be used to satisfy the regulatory requirements, alternate methods may require project-specific consultation(s) and could extend the time necessary to complete the review of the Lessee's proposed activities.

Definitions

1. *Bottom-disturbing activity* is any activity that results in physical contact with the seafloor. This includes, but is not limited to, the emplacement of infrastructure (e.g., buoy installation, cable laying), trenching, drilling, coring, boring, anchor placement and drag, and the use of chains, cables, and wire ropes.
2. *Sensitive benthic features* include chemosynthetic communities, topographic banks, pinnacles, live bottoms (e.g., submerged aquatic vegetation [SAV] and oyster beds), or any other hard bottom benthic feature(s).

Protocol

All bottom-disturbing activities shall be distanced at least 1,000 ft from any National Marine Sanctuary boundary and 500 ft from any other sensitive benthic features including chemosynthetic communities, topographic banks, pinnacles, live bottoms (e.g., submerged aquatic vegetation [SAV] and oyster beds), or any other hard bottom benthic feature(s). The lessee shall also maintain a minimum vertical clearance of at least 15 ft for mooring or anchoring lines, chains, and/or cables that cross sensitive benthic features. Departure from the above distancing requirements may be approved through coordination with BOEM's New Orleans Office and may require further project-specific EFH consultation with NMFS's Habitat Conservation Division, Southeast Regional Office. However, if consultation with NMFS results in avoidance standards greater than those referenced above, the lessee shall comply with the more conservative distance requirements.

For all site characterization and site assessment activities that propose bottom disturbing activity (e.g., anchoring and benthic sampling), the lessee shall include, at minimum, in its survey plan how hard bottom and other potentially sensitive benthic features will be avoided.

Reporting Requirements

The lessee shall provide as a section within the progress report (submitted to BOEM every six months during the site assessment term) the as-placed locations of all bottom-disturbing activities. The lessee should provide evidence that bottom-disturbing activities did not physically impact any sensitive benthic features. The lessee shall additionally submit a map or maps at a scale of 1 inch = 1,000 ft that accurately shows the location of the seafloor disturbance relative to all identified sensitive, benthic features within 1,000 ft of any seafloor contact. The lessee shall also depict the location of any mid-line buoys used. Sensitive benthic features include, but are not limited to, chemosynthetic communities, topographic banks, pinnacles, live bottoms (e.g., submerged aquatic vegetation [SAV] and oyster beds), or any other hard bottom benthic feature(s). The lessee shall also provide a geodatabase that includes spatial data (e.g., GIS point and/or polygon shapefiles) of all hardbottoms and bottom-disturbing activity locations (e.g., anchoring, coring, and benthic sampling). Provided anchoring information must include drop and recovery locations for every anchor.

6.2 Marine Debris Protocol

The lessee must implement the Marine Debris Protocol described herein. *Marine Debris* means as any object or fragment of wood, metal, glass, rubber, plastic, cloth, paper or any other solid, man-made item or material that is lost or discarded in the marine environment by the Lessee while conducting site characterization and site assessment activities on the OCS in connection with a lease, grant, or approval issued by the DOI. The discharge of garbage and debris has been the subject of strict laws, such as MARPOL-Annex V and the Marine Debris Act, 33 U.S.C. 1951 *et seq.*, and regulations imposed by various agencies including the United States Coast Guard and the Environmental Protection Agency.

Protocol

1. Marine Debris Placards
   The Lessees must post placards that include each of the information text boxes in Attachment 1 of this Protocol in prominent places on all vessels, offshore training or orientation areas engaged in REN operations in the GOM OCS or where activity occurs. Each of the placards depicted, with the language specified, must be displayed on a 5x8 inch format or larger. One or more areas may be omitted if there is insufficient space. These notices must be referenced, and their contents explained, during any initial orientation given on the vessel. Placards must be sturdy enough to withstand the local environment and must be replaced when damage or wear compromises readability.

2. Marine Debris Training and Certification Process
   All vessel operators, employees, and contractors performing OCS activities on behalf of the Lessee (collectively, "Lessee Representatives") must complete marine debris awareness training annually. The training consists of two parts: (1) viewing a marine debris training video or slide show (described below); and (2) receiving an explanation from management personnel that emphasizes their commitment to the requirements. The marine debris training videos, training slide packs, and other marine debris related educational materials may be obtained at https://www.bsee.gov/debris. The training videos, slides, and related material may be downloaded directly from the website. Lessee Representatives engaged in site characterization and site assessment activities must continue to develop and use a marine debris awareness training and certification process that reasonably assures that they, as well as their respective employees, contractors, and subcontractors are, in fact, trained.

   The training process must include the following elements:

   1) viewing of either the video or the slide show by the personnel specified above;
   2) an explanation from the management that conveys the commitment of the company to achieve the objectives of the debris containment requirement;
   3) attendance measures (initial and annual); and
   4) recordkeeping and availability of records for inspection by DOI.

   Training Report: By January 31st of each year, the Lessee must provide BSEE with an annual report (1-2 pages) signed by a company official that describes your marine debris awareness training process, number of people trained, estimated related costs, and certifies that the training process has been followed for the previous calendar year. You should send the report and any questions concerning compliance by email to marinedebris@bsee.gov. In lieu of emailing the report, you may send a printed copy to:

   Bureau of Safety and Environmental Enforcement
   Gulf of Mexico OCS Region
   Office of Environmental Compliance
   1201 Elmwood Park Blvd.
   New Orleans, Louisiana 70123

3. Marine Debris Marking and Securing

Marking: Materials, equipment, tools, containers, and other items used in OCS activities which could be lost or discarded overboard must be clearly marked with the vessel or facility identification. All markings must clearly identify the owner and must be durable enough to resist the effects of the environmental conditions to which they may be exposed. **Securing:** Materials, equipment, tools, containers, and other items used in OCS activities which could be lost or discarded overboard must be properly secured to prevent loss overboard.

4. Marine Debris Incidents
Recovery: Lessees must recover marine debris that is lost or discarded in the marine environment while performing OCS activities. If the marine debris is located within the boundaries of a potential archaeological resource/avoidance area, or a sensitive ecological/benthic resource area, the Lessee must contact DOI for approval prior to conducting any recovery efforts that could impact the seafloor. The Lessee must enact steps throughout its OCS program to prevent similar incidents and must submit a description of these actions to DOI in the Recovery Report below.
48-Hour Report: Lessees must submit a report to DOI within 48 hours of a marine debris incident (using the email address listed on DOI's most recent incident reporting guidance). The "48-Hour 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 DOI does not agree with the reasons provided by the Lessee to be relieved from the obligation to recover the marine debris. The 48-Hour Report must also include the following:

   a. project identification and contact information for the Lessee, operator, and/or contractor;

   b. the date and time of the incident;

   c. the lease number, OCS area and block, and coordinates of the object's location (latitude and longitude in decimal degrees);

   d. a detailed description of the dropped object to include dimensions (approximate length, width, height, and weight), composition (e.g., plastic, aluminum, steel, wood, paper, hazardous substances, or defined pollutants), and whether it floats or sinks in seawater;

   e. pictures, data imagery, data streams, and/or a schematic/illustration of the object, if available;

   f. indication of whether the lost or discarded item could be a magnetic anomaly of greater than 50 nanotesla (nT), a seafloor target of greater than 0.5 meters (m), or a sub-bottom anomaly of greater than 0.5m when operating a magnetometer or gradiometer, side scan sonar, or sub-bottom profiler in accordance with DOI's applicable guidance;

g. an explanation of how the object was lost; and

h. a description of immediate recovery efforts and results, including photos.

Recovery Plan: The Lessee must submit a "Recovery Plan" to DOI (using the email address listed on DOI's most recent incident reporting guidance) if marine debris is not recovered in 48 hours and DOI determines that recovery is warranted. If the DOI does not object to an assertion in the 48-Hour Report that recovery is not warranted, then a Recovery Plan is not needed. The Recovery Plan must be submitted no later than 10 calendar days from the date in which the incident occurred and must detail a plan to recover the debris within 30 days from the date in which the incident occurred. Unless otherwise objected to by DOI within 48 hours of the filing of the Recovery Plan, the Lessee can proceed with the activities described in the Recovery Plan. The Lessee must request and obtain approval of a time extension if recovery activities cannot be completed within 30 days from the date in which the incident occurred.

Recovery Report: The Lessee must submit a "Recovery Report" to DOI (using the email address listed on DOI's most recent incident reporting guidance) within 10 calendar days from the date in which the recovery activities are completed. The Recovery Report must inform DOI whether the debris has been recovered, a description of the recovery activities, and any substantial deviation from recovery activities as proposed in the Recovery Plan. The Lessee must describe steps enacted throughout all the Lessee's OCS leases to prevent similar incidents. If recovery was performed within 48 hours and described in the 48-Hour Report, or recovery is unwarranted, a Recovery Report is not required.

Decommissioning Application: Information on unrecovered marine debris must be included and addressed in the description of the site clearance activities provided in the decommissioning application required under 30 CFR § 585.906.

Attachment 1

Marine Debris Placards

WHAT IS MARINE DEBRIS?

Marine debris is any object or fragment of wood, metal, glass, rubber, plastic, cloth, paper or any other man-made item or material that is lost or discarded in the marine environment. Marine debris may be intentionally dumped, accidentally dropped, or indirectly deposited. Whatever the source, marine debris is a direct result of human activities on land and at sea. Depending upon its composition, marine debris may sink to the seafloor, drift in the water column, or float on the surface of the sea. Certain debris, such as plastics, can persist for hundreds of years in the marine environment without decomposing.

WARNING!

YOUR ACTIONS MAY SUBJECT YOU TO SEVERE LEGAL CONSEQUENCES!

The disposal and/or discharge of any solid waste anywhere in the marine environment (other than ground-up food particles) is strictly prohibited by U.S. Coast Guard and Environmental Protection Agency regulations. THIS INCLUDES MATERIALS OR DEBRIS ACCIDENTALLY LOST OVERBOARD.

The disposal of equipment, cables, chains, containers or other materials into offshore waters is prohibited by the Bureau of Safety and Environmental Enforcement (30 CFR 250.300(b)(6)). THIS INCLUDES MATERIALS OR DEBRIS ACCIDENTALLY LOST OVERBOARD.

ATTENTION!

MARINE DEBRIS MAY CAUSE SEVERE ECOLOGICAL DAMAGE!

Marine debris discarded or lost from offshore and coastal sources may injure or kill fish, marine mammals, sea turtles, seabirds and other wildlife.

Thousands of marine animals, including marine mammals, sea turtles and seabirds, die every year from entanglement in fishing line, strapping bands, discarded ropes and nets and plastic six-pack rings. Additionally, unknown numbers of marine animals die each year from internal injury, intestinal blockage and starvation as a result of ingesting marine debris.

Marine debris fouls boat propellers and clogs water intake ports on engines thereby endangering the safety of fishermen and boaters and resulting in heavy loss of time and money.

Marine debris detracts from the aesthetic quality of recreational beaches and shorelines and increases the cost of park and beach maintenance.

ATTENTION!

SECURE ALL LOOSE ARTICLES!

NOAA Fisheries now expects petroleum industry personnel to pick up and recover any articles lost overboard from boats and offshore structures as safety conditions permit. Additionally, 30 CFR 250.300 (d) requires recording and reporting items lost overboard to the District Manager through facility daily operations reports.

Protect marine animals, as well as your valuable time and money, by doing the following to prevent accidental loss of these items:

Properly securing all materials, equipment, and personal belongings. Articles such as hardhats, life vests, sunglasses, cigarette lighters, parts bags, buckets, shrink wrap, strip lumber, and pipe thread protectors become marine debris when lost overboard.

Making sure that all trash receptacles have tight fitting lids and that the lids are used.

Providing and using secure cigarette butt containers. Cigarette butts are one of the most common forms of marine debris. Many cigarette butts contain some form of plastic and do not decompose in the ocean. Cigarette butts pose a major threat to marine wildlife as they resemble food and cause gut blockages and starvation when ingested.

Do your part to eliminate marine debris. Encourage others to be responsible about marine debris by making suggestions to secure potential marine debris on your boat or structure or by participating in a beach cleanup.

As mentioned previously, the issuance of a lease or grant would allow only the submittal of Site Assessment Plans (SAP) for BOEM's consideration and approval. Therefore, BOEM will also require lessees to coordinate with BOEM on all other proposed survey and other bottom disturbing activities prior to mobilization, including site characterization surveys (e.g., HRG surveys, geotechnical, and biological surveys). BOEM staff will request additional information of lessees if proposed activities do not adequately describe the operator's methods for avoiding or otherwise mitigating potential impacts to EFH.

7.0 Conclusion

Based on the analysis in the preceding sections, the Proposed Action is not expected to have lasting adverse effects on EFH or federally managed species within or around the Call and Project Areas, nor would these activities comprise significant, cumulative additions to preexisting and ongoing anthropogenic and natural stressors present in the region. Impacts on the water column would be localized and transient, with no significant adverse effect on EFH for any pelagic species. The presence of met buoys (max of 36 buoys over approximately 17 years) would constitute a long-term habitat modification but is anticipated to create a negligible artificial reef effect due to the small, overall area of subsurface structures present in the water column and on the seafloor. The majority of bottom-disturbing activities are expected to occur on soft bottom habitats (i.e., mud and/or clay and/or silt). No noticeable adverse effects to soft bottom benthic habitats are expected due to the small area of seafloor disturbance relative to the available habitat in the Call and Project Areas, and any disturbed habitat would be expected to recover and recolonize overtime (i.e., three months to 2.5 years; Brooks et al. 2006; Wilber and Clarke 2007). Hard bottom habitats would be identified (via HRG surveys) and avoided during met buoy placement and during geotechnical and benthic habitat sampling due to avoidance standards outlined above (see Section 6 Proposed Mitigation Guidance); thus, no or negligible adverse effects to these habitats are anticipated.

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Appendix A

Table 6. Gulf of Mexico managed species

Coastal Migratory Pelagic Fish	**Highly Migratory Species (continued)**	**Highly Migratory Species (continued)**
cobia (*Rachycentron canadum*)	Caribbean reef shark (*Carcharhinus perezi*)	smooth hammerhead shark (*Sphyrna zygaena*)
king mackerel (*Scomberomorus cavalla*)	Caribbean sharpnose shark (*Rhinocodon porosus*)	spinner shark (*Carcharhinus brevipinna*)
Spanish mackerel (*Scomberomorus maculatus*)	common thresher shark (*Alopias vulpinus*)	swordfish (*Xiphias gladius*)
Corals	dusky shark (*Carcharhinus obscurus*)	tiger shark (*Galeocerdo cuvieri*)
Class Hydrozoa (stinging and hydrocorals)	finetooth shark (*Carcharhinus isodon*)	whale shark (*Rhinocodon typus*)
Class Anthozoa (sea fans, whips, precious coral, sea pen, stony corals)	Florida smoothhound (*Mustelus norrisi*)	white marlin (*Tetrapturus albidus*)
*Listed corals also covered under ESA consultation	Galapagos shark (*Carcharhinus galapagensis*)	white shark (*Carcharodon carcharias*)
Highly Migratory Species	great hammerhead shark (*Sphyrna mokarran*)	**Red Drum Fishery**
Atlantic albacore tuna (*Thunnus alalunga*)	Gulf smoothhound (*Mustelus sinusmexicanus*)	red drum (*Sciaenops ocellatus*)
Atlantic angel shark (*Squatina dumerili*)	lemon shark (*Negaprion brevirostris*)	**Reef Fish Fishery**
Atlantic bigeye tuna (*Thunnus obesus*)	longbill spearfish (*Tetrapturus pfluegeri*)	almaco jack (*Seriola rivoliana*)
Atlantic blue marlin (*Makaira nigricans*)	longfin mako shark (*Isurus paucus*)	banded rudderfish (*Seriola zonata*)
Atlantic bluefin tuna (*Thunnus thynnus*)	narrowtooth shark (*Carcharhinus brachyurus*)	black grouper (*Mycteroperca bonaci*)
Atlantic sailfish (*Istiophorus platypterus*)	night shark (*Carcharhinus signatus*)	blackfin snapper (*Lutjanus buccanella*)
Atlantic sharpnose shark (*Rhinocodon terraenovae*)	nurse shark (*Ginglymostoma cirratum*)	blueline tilefish (*Caulolatilus microps*)
Atlantic skipjack tuna (*Katsuwonus pelamis*)	oceanic whitetip shark (*Carcharhinus longimanu*)	cubera snapper (*Lutjanus cyanopterus*)
Atlantic yellowfin tuna (*Thunnus albacares*)	porbeagle shark (*Lamna nasus*)	gag (*Mycteroperca microlepis*)
basking shark (*Cetorhinus maximus*)	roundscale spearfish (*Tetrapturus georgii*)	goldface tilefish (*Caulolatilus chrysops*)

bigeye sand tiger shark (*Odontaspis noronhai*)	sand tiger shark (*Odontaspis taurus*)	goliath grouper (*Epinephelus itajara*)
bigeye sixgill shark (*Hexanchus vitulus*)	sandbar shark (*Carcharhinus plumbeus*)	gray snapper (*Lutjanus griseus*)
bigeye thresher shark (*Alopias superciliosus*)	scalloped hammerhead shark (*Sphyrna lewini*)	gray triggerfish (*Balistes capriscus*)
bignose shark (*Carcharhinus altimus*)	sevengill shark (*Heptranchias perlo*)	greater amberjack (*Seriola dumerili*)
blacknose shark (*Carcharhinus acronotus*)	shortfin mako shark (*Isurus oxyrinchus*)	hogfish (*Lachnolaimus maximus*)
blacktip shark *(Carcharhinus limbatus*)	silky shark (*Carcharhinus falciformis*)	lane snapper (*Lutjanus synagris*)
blue shark (*Prionace glauca*)	sixgill shark (*Heptranchias griseus*)	lesser amberjack (*Seriola fasciata*)
bonnethead shark (*Sphyrna tiburo*)	smalltail shark (*Carcharhinus porosus*)	mutton snapper (*Lutjanus analis*)
bull shark (*Carcharhinus leucas*)	smooth dogfish (*Mustelus canis*)	Nassau grouper (*Epinephelus striatus*)

Table 6. Gulf of Mexico managed species (continued)

Reef Fish Fishery (continued)	**Stone Crab Fishery**
queen snapper (*Etelis oculatus*)	Florida stone crab (*Menippe mercenaria*)
red grouper (*Epinephelus morio*)	Cuban stone crab (*Menippe nodifrons*)
red snapper (*Lutjanus campechanus*)	
scamp (*Mycteroperca phenax*)	
silk snapper (*Lutjanus vivanus*)	
snowy grouper (*Epinephelus niveatus*)	
speckled hind (*Epinephelus drummondhayi*)	
tilefish (*Lopholatilus chamaeleonticeps*)	
vermilion snapper (*Rhomboplites aurorubens*)	
warsaw grouper (*Epinephelus nigritus*)	
wenchman (*Pristipomoides aquilonaris*)	

yellowedge grouper (*Epinephelus flavolimbatus*)
yellowfin grouper (*Mycteroperca venenosa*)
yellowmouth grouper (*Mycteroperca interstitialis*)
yellowtail snapper (*Ocyurus chrysurus*)
Shrimp Fishery
brown shrimp (*Farfantepenaeus aztecus*)
pink shrimp (*Farfantepenaeus duorarum*)
royal red shrimp (*Pleoticus robustus*)
white shrimp (*Litopenaeus setiferus*)
Spiny Lobster Fishery
spiny lobster (*Panulirus argus*)

Table 7. Described Essential Fish Habitat locations for reef fish and red drum in the Gulf of Mexico

Species Name	Eggs	Larvae	Post Larvae	Juveniles	Adults
Almaco jack	From Florida Keys to Pensacola Bay; Freeport, Texas to US-Mexico border; spring through fall; water column	From Florida Keys to Pensacola Bay; Freeport, Texas to US-Mexico border	From Florida Keys to Pensacola Bay; Freeport, Texas to US/Mexico border	Gulf-wide; nearshore and offshore; found August–January and July–October; drifting algae (*Sargassum*); feed on fish, shrimp, copepods	Northern Gulf in summer, southern Gulf year-round; offshore (21–179 m; 69–587 ft); at artificial reefs, shelf edge, hard bottom, bank, and reefs; spawn spring-fall; feed on fish
Banded rudderfish	Nearshore, offshore (10–130m; 33–427 ft)	Nearshore, offshore (10–130 m; 33–427 ft); water column; found all months except Feb, Apr, Sep, Dec	Nearshore, offshore (10–130 m; 33–427 ft); water column; found all months except Feb, Apr, Sep, Dec	Nearshore, offshore (10–130m; 33–427 ft); water column, drifting algae (*Sargassum*); year-round	Nearshore, offshore (10–130m; 33–427 ft); water column; year-round; spawning may be continuous, or occur winter-spring and fall; feed on fish and shrimp
Black grouper	Offshore (18–28m; 59–92 ft); water column	Offshore (10–150m; 33–492 ft); water column	Offshore (10–150m; 33–492 ft); water column	Estuarine, nearshore, offshore (1–19m; 3–62 ft); SAV, reefs, hard bottom, mangroves; found year-round; feed on fish and crustaceans	Nearshore, offshore (10–150m; 33–492 ft); coral reefs, hard bottom; feed on fish; spawn Feb–Mar (18–28m; 59–92 ft)
Blackfin snapper	Offshore, water column (40–300m; 131–984 ft); year-round	40–300m; 131–984 ft	-	Nearshore, offshore (7–40m; 23–131 ft); hard bottom; by the Virgin Islands in spring	offshore (40–300m; 131–984 ft); shelf-edge/slope, hard bottom; found year-round; spawning peaks in spring and fall; feed on fish and crustaceans
Blueline tilefish	Offshore (46–256m; 151–840 ft); water column	Offshore (46–256m; 151–840 ft); water column	Offshore (46–256m; 151–840 ft); water column	Offshore (60–256m; 197–840 ft)	Offshore (60–256m; 197–840 ft); burrows 91–150m (299–492 ft); use hard bottom, sand/shell, soft bottom, shelf edge/slope habitat; feed on demersal fish and benthic invertebrates; spawn offshore (46–256m; 151–840 ft), on shelf edge and/or slope habitats from Feb–Oct, peak spawning Mar–Sep

Species Name	Eggs	Larvae	Post Larvae	Juveniles	Adults
Cubera snapper	Nearshore, offshore (10–85m; 33–279 ft); water column; found in summer	Nearshore, offshore (10–85m; 33–279 ft)	-	Estuarine, nearshore, offshore (0–85m; 0–279 ft); SAV, mangroves, emergent marsh	Estuarine, nearshore, offshore (0–85m; 0–279 ft); mangroves, reefs; spawn on reefs, shelf edges/slopes, hard bottom, and banks/shoals from Apr–Jul, with peak in May at depths of 10–85m (33–279 ft)
Gag	Offshore (50–120m; 164–394 ft); Dec–Apr; water column	Offshore (50–120m; 164–394 ft); early spring; water column	Offshore (50–120m; 164–394 ft); water column	Estuarine, nearshore, offshore (0–50 m; 0–164 ft); SAV, mangroves, hard bottom, reefs; late spring and early fall; feed on crustaceans (amphipods, copepods, grass shrimp, decapods, fish)	Gulf-wide; nearshore, offshore (13–100m; 43–328 ft); hard bottom, reefs; year-round; spawn offshore throughout Gulf on shelf edge/slope and hard bottom habitats at depths of 50–120m (164–394 ft); spawn Dec–May, peak in Feb–Mar; feed on fish, crustaceans, cephalopods
Goldface tilefish	Water column	Water column	Water column	-	Offshore (291 ± 54m; 955 ± 177 ft); shelf edge/slope, soft bottom; feed on bivalves, urchins, worms, crabs; spawn in Sep
Goliath grouper (protected)	Offshore (36–46m; 118–151 ft); late summer-early fall; water column	Offshore (36–46m; 118–151 ft); late summer-early fall; water column	Recruit to mangroves	Estuarine, nearshore (1–5m; 3–16 ft); SAV, mangroves, emergent marsh; feed on crustaceans; late juveniles use reefs and hard bottom	Nearshore, offshore (<1–95m; <3–312 ft); reefs, hard bottom, bank/shoal, and artificial reef/wreck* habitats; feed on crustaceans (e.g., lobster), fish, mollusks (e.g., cephalopods); spawn offshore (36–46m; 118–151 ft) on reefs and hard bottom habitat from Jun–Dec, peak Jul–Sep

Species Name	Eggs	Larvae	Post Larvae	Juveniles	Adults
Gray snapper	Offshore (0–180m; 0–591 ft); water column; Jun–Sep	Offshore (0–180m; 0–591 ft); water column; Apr–Nov, peak in Jun–Aug	Estuarine; SAV; feed on copepods and amphipods	Estuarine (1–3m; 3–10 ft); SAV, mangroves, emergent marsh; settle in SAV Sep–Oct, move to mangroves with age; late juveniles move into deeper water (up to 180m; 591 ft) with growth; feed on penaeid shrimp, crabs, fish, mollusks, polychaetes	Gulf-wide; estuarine, nearshore, offshore (0–180m; 0–591 ft); hard bottom, soft bottom, reef, sand/shell, bank/shoal, emergent marsh habitats; feed on fish, shrimp, crabs; spawn year-round in south Florida and during summer throughout rest of Gulf on reefs and hard bottoms (0–180m; 0–592 ft)
Gray triggerfish	Gulf-wide; nearshore, offshore (10–100m; 33–328 ft); benthic; found late spring and summer	Gulf-wide; water column, drifting algae (*Sargassum*)	Gulf-wide; water column, drifting algae (*Sargassum*)	Gulf-wide; drifting algae (*Sargassum*), hard bottom, mangroves, reefs; feed on algae, hydroids, barnacles, polychaetes; late juveniles found at 10–100m (33–328 ft)	Gulf-wide; nearshore, offshore (10–100m; 33–328 ft); reef, hard bottom habitats; feed on bivalves, barnacles, polychaetes, decapods, gastropods, sea stars, sea cucumbers, brittle stars, sea urchins, and sand dollars; spawning adults are nest builders and harem spawners
Greater amberjack	Gulf-wide; water column	Gulf-wide; offshore; year-round; water column, drifting algae	Gulf-wide; offshore; year-round; water column, drifting algae; found in summer	Nearshore, offshore; water column, drifting algae, settle on hard bottom habitats; found summer–fall; feed on invertebrates	Nearshore, offshore (4.6–187m; 15–614 ft); water column, hard bottom, banks/shoals, reefs; found year-round; feed on fish, crustaceans, and cephalopods; spawn offshore on reefs or in the water column Feb–May
Hogfish	Water column; found Apr–Dec	Water column	Water column; settle to SAV	Estuarine, nearshore; use SAV; found Dec–Apr	Nearshore, offshore (<30m; <98 ft); hard bottom, reefs, artificial reefs*; year-round; feed on benthic invertebrates; spawn nearshore and offshore (1–69m; 3–226 ft) on reef, sand/shell, or hard bottom from Dec–July, peak Mar–Apr

Species Name	Eggs	Larvae	Post Larvae	Juveniles	Adults
Lane snapper	Gulf-wide; offshore (4–132m; 13–433 ft); water column; found Mar–Sep, peak in Jul–Aug	Gulf-wide; estuarine, nearshore, offshore (0–50m; 0–164 ft); water column; found Jun–Aug	Gulf-wide; estuarine, nearshore, offshore (0–50m; 0–164 ft); water column, settle on SAV; found Jun–Aug	Gulf-wide; estuarine, nearshore, offshore (0–24m; 0–79 ft); found late summer–early fall; occupy SAV, sand/shell, reefs, soft bottom, banks/shoals, mangroves; feed on copepods, grass shrimp, and other small invertebrates	Gulf-wide; nearshore, offshore (4–132m; 13–433 ft); sand/shell, hard bottom, reef, bank/shoal, artificial reefs*; feed on fish, crustaceans, annelids, mollusks, algae; spawn May–Aug offshore on reefs and shelf edge/slopes (30–70m; 98–230 ft)
Lesser amberjack	Gulf-wide	Gulf-wide	Gulf-wide	Gulf-wide; offshore (55–348m; 180–1142 ft); drifting algae, hard bottom, reef; found late summer–fall	Gulf-wide; offshore (55–348m; 180–1142 ft); hard bottom, reef; found year-round; feed on squid; spawn Gulf-wide offshore over hard bottom from Sep–Dec and Feb–Mar
Mutton snapper	Water column; found late spring through summer	Water column; found early summer	Water column; found early-mid summer	Estuarine, nearshore; found in summer; settle to SAV and move to reefs with growth	Estuarine, nearshore; found year-round; occupy SAV and reefs; feed on crustaceans, fish, gastropods; spawn offshore Mar–Jul on reefs, banks/shoals, hard bottom, shelf edges/slopes (25–95m; 82–312 ft)
Nassau grouper (protected)	Not offshore but are in highly saline waters in the winter; found Dec–Jan	Not offshore but are in highly saline waters in the winter, and start feeding on other larvae; found Jan–Feb	Found Jan–Mar; feed on copepods, decapod larvae	Saline, shallow, vegetated waters or associated with reefs in similar waters; move offshore with size; found Feb–Aug; feed on dinoflagellates, fish larvae, mysids, gammaridean amphipods, copepods, other crustaceans	Associated with reefs and crevices; 0–100m (0–328 ft); feed on crustaceans and fish; spawn Dec–Feb at full moon over soft corals, stony corals, sponges, and sand
Queen snapper	Offshore (95–680m; 312–2231 ft); water column	Offshore (0–100m; 0–328 ft); water column; found Sep–Nov near Florida Straits	Offshore (0–100m; 0–328 ft); water column; found Sep–Nov near Florida Straits	Offshore (95–680m; 312–2231 ft); water column	Offshore (95–680m; 312–2231 ft); use hard bottom in GOM; outside of GOM, are known to occupy shelf edges/slopes, feed on squid and small fish, and spawn offshore year-round (peaking Oct–Nov)

Species Name	Eggs	Larvae	Post Larvae	Juveniles	Adults
Red drum	Gulf-wide; water column (20–30m; 66–98 ft); found late summer–early fall (peak late Aug to mid–October); hatch outside estuaries	Estuarine; SAV, soft bottom, water column; found Aug–Nov; feed on copepods	Estuarine; SAV, emergent marsh, soft bottom, sand/shell; feed on copepods	Estuarine, nearshore (0–5m; 0–16 ft); SAV, soft bottom, emergent marsh; found Sep–Dec; feed on copepods, mysids, amphipods, shrimp, polychaetes, insects, fish, isopods, bivalves, decapod crabs	Estuarine, nearshore, offshore (1–70m; 3–230 ft); near SAV, emergent marsh, soft bottom, hard bottom, sand/shell, water column; feed on crabs, shrimp, fish; spawn nearshore, near mouths of bays and inlets, on the Gulf side of barrier islands mid-Aug through Oct (peak Sep–Oct)
Red grouper	Offshore (20–100m; 66–328 ft); water column; found Apr–May	Offshore (20–100m; 66–328 ft); water column; found May–Jun; feed on zooplankton	Water column; found May–Jul	Estuarine, nearshore, offshore (0–50m; 0–164 ft); SAV, hard bottom; feed on demersal crustaceans and fishes	Nearshore, offshore (3–190m; 10–623 ft); hard bottom, reefs, artificial reefs*; feed on fish, crustaceans, cephalopods; spawn offshore on shelf edges/slopes or hard bottoms Mar–Jun at depths of 20–100m (66–328 ft)
Red snapper	Gulf-wide; offshore (18–126m; 59–413 ft); water column	Gulf-wide; offshore (18–126m; 59–413 ft); water column; found Jul–Nov	Gulf-wide; offshore (18–126m; 59–413 ft); water column; found Jul–Nov	Gulf-wide; nearshore, offshore (17–183m; 56–600 ft); reef, hard bottom, bank/shoal, soft bottom, sand/shell, artificial reef*; early juveniles found Jul–Nov at depths of 17–183m (56–600 ft) and feed on zooplankton, shrimp, arrow worms, squid, copepods; late juveniles found year-round at depths of 18–55m (59–180 ft) and feed on fish, squid, crabs, and shrimp	Gulf-wide; nearshore, offshore (7–146m; 23–479 ft); reef, hard bottom, bank/shoal, artificial reef*; found year-round; feed on fish, shrimp, squid, octopus, crabs; spawn offshore on sand/shell and bank/shoal habitats from Apr–Oct at depths of 18–126m (59–413 ft)
Scamp	Offshore (60–189m; 197–620 ft); water column; found in spring	Offshore (60–189m; 197–620 ft); water column; found in spring	Offshore (60–189m; 197–620 ft); water column; found in spring	Nearshore, offshore (12–33m; 39–108 ft); hard bottoms and reefs	Nearshore, offshore (12–189m; 33–620 ft); hard bottoms, reefs; feed on fish, crustaceans, cephalopods; spawn offshore (60–189m; 197–620 ft) on shelf edge/slope, reef, hard bottom habitats Feb–Jun

Species Name	Eggs	Larvae	Post Larvae	Juveniles	Adults
Silk snapper	Offshore (90–200m; 295–656 ft); found year-round	Offshore (90–200m; 295–656 ft); found year-round	Offshore (90–200m; 295–656 ft); found year-round	Offshore (30–40m; 98–131 ft); found year-round; feed on fish, shrimp, crabs	Offshore (90–200m; 295–656 ft); shelf edge/slope, soft bottom, hard bottom; feed on fish, shrimp, crabs, gastropods, cephalopods, tunicates; spawn year-round (peak Jul–Aug); spawning adults feed on fish, shrimp, crabs
Snowy grouper	Offshore (30–525m; 98–1722 ft); water column	Offshore (30–525m; 98–1722 ft); water column; found in June and Oct	Offshore (30–525m; 98–1722 ft); water column; found in June and Oct	Early juvenile found nearshore; late juveniles found nearshore and offshore (17–60m; 56–197 ft); reefs; feed on fish, gastropods, cephalopods, and other invertebrates	Offshore (30–525m; 98–1722 ft); occupy hard bottoms and reefs in GOM, shelf edge/slope habitat in Atlantic; feed on fish, crabs, crustaceans, cephalopods, and gastropods; spawn on reef and shelf edge/slope habitat in Atlantic; spawn Arp–Jul in the Florida Keys and May–Aug in west Florida
Speckled hind	Offshore (44–183m; 144–600 ft); water column	Offshore (44–183m; 144–600 ft); water column	Offshore (44–183m; 144–600 ft); water column	Offshore (25–183m; 82–600 ft); occupy reefs	Offshore (25–183m; 82–600 ft); hard bottom; feed on fish, cephalopods, and other invertebrates; spawn Apr–May and Jul–Sep over shelf edges/slopes at depths of 44–183m (144–600 ft)
Tilefish	Gulf-wide; offshore (80–450m; 262–1476 ft); found late spring–summer; water column	Gulf-wide; offshore (80–450m; 262–1476 ft); found in summer, water column	Gulf-wide; offshore (80–450m; 262–1476 ft); found in summer, water column	Gulf-wide; offshore (80–450m; 262–1476 ft); early juveniles found in water column; late juveniles settle over soft bottom along shelf edge/slope	Gulf-wide; offshore (80–450m; 262–1476 ft); soft bottom along shelf edge/slope; feed on bivalves, mollusks, squids, polychaetes, sea cucumbers, decapod crustaceans, elasmobranchs, and ray-finned fishes; spawn Jan–Jun (peak in Apr)
Vermilion snapper	Gulf-wide; offshore (18–100m; 59–328 ft); water column	Gulf-wide; offshore (30–40m; 98–131 ft); water column; found Jun–Nov	Gulf-wide; offshore (30–40m; 98–131 ft); water column; found Jun–Nov	Gulf-wide; nearshore, offshore (18–100m; 59–328 ft); hard bottoms, reefs; feed on copepods, other small pelagic crustaceans, nematodes, fish scales, cephalopods	Gulf-wide; nearshore, offshore (18–100m; 59–328 ft); bank/shoal, reef, hard bottom; found year-round; feed on benthic tunicates, amphipods, cephalopods, and cannibalize juveniles (rare); spawn May–Sep

Species Name	Eggs	Larvae	Post Larvae	Juveniles	Adults
Warsaw grouper	Gulf-wide; offshore (40–525m; 131–1722 ft); water column	Gulf-wide; offshore (40–525m; 131–1722 ft); water column	Gulf-wide; offshore (40–525m; 131–1722 ft); water column	Gulf-wide; offshore (20–30m; 66–98 ft); water column; late juveniles inhabit reefs	Gulf-wide; offshore (40–525m; 131–1722 ft); shelf edge and/or slope and hard bottom, reef (spawning); feed on crabs, shrimp, lobsters, fish; spawn late summer
Wenchman	Offshore (80–200m; 262–656 ft); water column; found in summer	Offshore (80–200m; 262–656 ft); water column; found in summer	Offshore (80–200m; 262–656 ft); found in summer	Offshore (19–481m; 62–1578 ft)	Offshore (19–481m; 62–1578 ft); hard bottom, shelf edge and/or slope; found year-round; feed on small fish; spawn near shelf edges and/or slopes in summer at depths of 80–200m (262–656 ft)
Yellowedge grouper	Gulf-wide; offshore (35–370m; 115–1214 ft); water column	Gulf-wide; offshore (35–370m; 115–1214 ft); water column	Gulf-wide; offshore (35–370m; 115–1214 ft); water column; found Jul–Oct	Gulf-wide; nearshore, offshore (9–110m; 30–361 ft); late juveniles found on hard bottom	Gulf-wide; offshore (35–370m; 115–1214 ft); hard bottom, soft bottom, shelf edge and/or slope; feed on brachyuran crabs, fish, and other invertebrates; spawn over reefs on the upper slope Feb–Sep and Nov (peak Mar–Sep)
Yellowfin grouper	Offshore (25–30m; 82–98 ft)	Offshore (25–30m; 82–98 ft)	Offshore (25–30m; 82–98 ft)	Estuarine, nearshore (2–4m; 7–13 ft); use SAV; late juveniles move offshore and use both SAV and hard bottom; feed on fish, shrimp, squid	Nearshore, offshore (2–214m; 7–702 ft); reef, hard bottom; feed on fish, squid, shrimp; spawn offshore Mar–Aug over shelf edges and/or slopes, reefs, hard bottom, banks and/or shoals in depths 25–30m (82–98 ft)
Yellowmouth grouper	Offshore (20–189m; 66–620 ft); water column	Offshore (20–189m; 66–620 ft); water column	Offshore (20–189m; 66–620 ft); water column	Estuarine (18–24m; 59–79 ft); mangroves; feed on fish	Offshore (20–189m; 66–620 ft); hard bottom, reef, bank and/or shoal; feed om fish crustaceans, and other invertebrates' spawn offshore year-round (peak Apr–May)

Species Name	Eggs	Larvae	Post Larvae	Juveniles	Adults
Yellowtail snapper	Nearshore, offshore (1–183m; 3–600 ft); found Feb–Oct; water column	Nearshore, offshore (1–183m; 3–600 ft); water column	Nearshore, offshore (1–183m; 3–600 ft); water column	Estuarine, nearshore (0.3–1.2m; 0.98–3.94 ft); SAV, mangroves; found in fall; feed on zooplankton; late juveniles move from SAV and mangroves offshore to reefs and hard bottom (1–183m; 3–600 ft)	Nearshore, offshore (1–183m; 3–600 ft); reefs, hard bottoms; feed on benthic and pelagic reef fish, crustaceans, mollusks; spawn Apr–Aug

GOM = Gulf of Mexico; EFH = essential fish habitat; SAV = submerged aquatic vegetation

*Artificial reefs not considered EFH

(-) denotes insufficient information available for that species/life stage

Table 8. Described Essential Fish Habitat locations for coastal migratory species in the Gulf of Mexico

Species	Eggs	Larvae	Juveniles	Adults
Cobia	Estuarine, nearshore (top meter of water column); found in summer; water column	Estuarine, nearshore, offshore (in surface waters above 3–300m; 10–984 ft); found May–Sep; water column; post-larvae found nearshore and offshore (11–53m; 36–174 ft); post-larvae found May–Jul	Nearshore, offshore (in surface waters above 5–300m; 16–984 ft); water column; found Apr–Jul; late juveniles found May–Oct at depths of 1–70m (3–230 ft) and feed on fish, shrimp, and squid	Gulf-wide; nearshore, offshore (1–70m; 3–230 ft); water column, banks and/or shoals (hard bottom); feed on crustaceans and fish; spawn in northern GOM Apr–Sep
King mackerel	Offshore (35–180m; 115–591 ft); water column; found in GOM spring and summer	Offshore (35–180m; 115–591 ft); water column; found May–Oct; feed on other larval fish (e.g., jacks, menhaden, anchovies)	Nearshore (≤9m; ≤30 ft); water column; found May–Oct (peak Jul and Oct); feed on fish, squid	Gulf-wide; nearshore, offshore (0–200m; 0–656 ft); feed on fish, squid, shrimp; feeding sometimes associated with bait schools and *Sargassum*; spawn offshore (35–180m; 115–591 ft) May–Oct; adults migrate to northern GOM in spring and return to south Florida and Mexico in fall
Spanish mackerel	Nearshore, offshore (<50m; <164 ft); water column; found in spring and summer	Gulf-wide; nearshore, offshore (9–84m; 30–276 ft); water column; found May–Oct; feed on larval fish, crustaceans	Estuarine, nearshore (1.8–9m; 5.9–30 ft); water column; found Mar–Nov; feed on fish, crustaceans, gastropods, shrimp; late juveniles additionally occupy offshore areas (1.8–50m; 5.9–164 ft) and feed on fish and squid	Estuarine, nearshore, offshore (3–75m; 10–246 ft); water column; found in northern GOM in spring and south Florida and Mexico in fall; feed on fish, crustaceans, squid; spawn nearshore and offshore (<50m; <164 ft) in the water column May–Sep; northeastern and north central GOM are important spawning areas

Table 9. Described Essential Fish Habitat locations for shrimp in the Gulf of Mexico

Species	Eggs	Larvae and/or Pre–settlement Postlarvae	Late postlarvae and/or Juveniles	Adult
Brown shrimp	Offshore (18–110m; 59–361 ft); soft bottom, sand/shell; found in fall and spring	Estuarine, nearshore, offshore (0–82m; 0–269 ft); water column; found year-round (peak in spring); feed on phytoplankton and zooplankton	Estuarine (<1m; <3 ft); SAV, emergent marsh, oyster reef, soft bottom, sand/shell; found spring–fall; feed on benthic algae, polychaetes, peracarid crustaceans; sub-adults found estuarine and nearshore (1–18m; 3–59 ft) on soft bottom and sand and/or shell	Offshore (14–110m; 46–361 ft); soft bottom, sand/shell; omnivorous feeders; spawn fall and spring at depths of 18–110m (59–361 ft) and year-round in depths >64m (>210 ft)
Pink shrimp	Offshore (9–48m; 30–157 ft); sand and/or shell habitats; found year-round	Estuarine, nearshore, offshore (1–50m; 3–164 ft); water column; found year-round; recruit to nearshore environments; feed on phytoplankton and zooplankton	Estuarine, nearshore (<3m; <10 ft); SAV, soft bottom, sand and/or shell, mangroves; found year-round in Florida and fall–spring in Texas; feed on seagrass, annelids, small crustaceans, shrimp, bivalves; production linked to freshwater input and inshore seagrass beds	Subadults occur in estuarine, nearshore, and offshore waters (1–65m; 3–210 ft); use SAV, soft bottom, sand/shell, oyster reefs, mangroves; present year-round in Florida and fall–spring in Texas; feed on seagrass, annelids, small crustaceans, shrimp, bivalves; adults occur in nearshore and offshore waters over sand and/or shell habitats; non-spawning adults found year-round at depths of 1–110m (3–361 ft), while spawning adults are found year-round off Florida and spring–fall in Texas at depths of 9–48m (30–157 ft)
Royal red shrimp	Offshore (250–550m; 820–1804 ft); shelf edge and/or slope; found year-round	Found at depths of 250–550m (820–1804 ft)	Found at depths of 250–550m (820–1804 ft)	Gulf-wide; offshore (140–730m; 459–2395 ft); found year-round; shelf edge/slope, soft bottom, sand and/or shell, reefs; feed on small benthic organisms; spawn over shelf edges and/or slopes year-round at 250–550m (820–1804 ft) depth
White shrimp	Estuarine, nearshore, offshore (9–34m; 30–112ft); found spring–fall	Estuarine, nearshore, offshore (0–82m; 0–269 ft); found spring–fall; feed on phytoplankton and zooplankton	Estuarine, nearshore (<1m; <3 ft); emergent marsh, SAV, oyster reefs, soft bottom, mangroves; are omnivorous, feeding on detritus, annelids, pericarid crustaceans, caridean shrimp, diatoms	Estuarine, nearshore, offshore (1–34m; 3–112 ft); softbottom, sand and/or shell; sub-adults found summer–fall, adults found late summer and fall, spawning adults found spring–late fall (peak Jun–Jul); are omnivorous, feeding on annelids, insects, detritus, gastropods, copepods, bryozoans, sponges, corals, fish, filamentous algae, vascular plant stems and roots

SAV = submerged aquatic vegetation

Table 10. Described Essential Fish Habitat locations for highly migratory species in the Gulf of Mexico

Species	Spawning, Eggs, Larvae	Juvenile	Adult
Atlantic albacore tuna	-	Offshore pelagic habitat in the western and central GOM	Offshore pelagic habitat in the western and central GOM
Atlantic bigeye tuna	-	Pelagic habitat in the central and western GOM from Alabama/Florida border to offshore of Texas; juveniles found in depths greater than 200m (656 ft)	Pelagic habitat in the central GOM, offshore between Apalachicola and the Louisiana/Texas border; adults found in depths greater than 200m (656 ft)
Atlantic bluefin tuna	Seaward of 100m depth contour of GOM; with temperatures ranging from 23.5 to 28 °C	Temperatures ranging from 4 to 26 °C, often in depths <20m (<66 ft) but can be found in waters 40–100m (131–328 ft) in winter	Pelagic waters of central GOM, from continental shelf break to EEZ between Apalachicola, Florida and Texas
Atlantic skipjack tuna	Offshore out to the EEZ	Offshore waters of central GOM from Texas to Florida panhandle	Offshore central GOM waters seaward of the southeastern edge of the West Florida Shelf to Texas
Atlantic yellowfin tuna	Offshore GOM to EEZ	Central GOM from Florida panhandle to southern Texas	Offshore pelagic GOM from West Florida Shelf to the continental shelf off southern Texas
Atlantic blue marlin	Most of EEZ from Florida Keys to continental shelf off of southern Texas; extends from 200m (656 ft) bathymetric line to seaward boundary of EEZ	Pelagic habitat from Florida Keys to continental shelf off southern Texas; depths greater than 200m (656 ft)	Pelagic habitat from Florida Keys to continental shelf off southern Texas; depths greater than 200m (656 ft)
Longbill spearfish	Pelagic habitat from Florida Keys to the continental shelf off southern Texas; depths >200m (>656 ft)	Pelagic habitat from Florida Keys to the continental shelf off southern Texas; depths >200m (>656 ft)	Pelagic habitat from Florida Keys to the continental shelf off southern Texas; depths >200m (>656 ft)
Atlantic sailfish	Offshore pelagic habitats from Florida Keys to continental shelf off southern Texas; extends from 200m (656 ft) bathymetric contour line to the seaward extent of the EEZ	Localized portions of central and northern GOM between Apalachicola and southern Texas	Coastal habitats off western Florida panhandle and coastal Louisiana to offshore pelagic habitats associated with the continental shelf westward to the coast of Texas

Species	Spawning, Eggs, Larvae	Juvenile	Adult
Atlantic swordfish	Pelagic habitats of western GOM (off Texas) seaward from the 200m (656 ft) isobath to the EEZ boundary	Offshore pelagic habitat from Florida Keys to off the coast of Texas, seaward of continental shelf break; depths greater than 200m (656 ft)	Offshore pelagic habitat from Florida Keys to off the coast of Texas, mostly seaward of continental shelf break; depths greater than 200m (656 ft)
White marlin	-	Pelagic habitat in central GOM between Florida Keys (excluding the west Florida Shelf) and the continental shelf break off southern Texas; depths greater than 200m (656 ft)	Pelagic habitat in central GOM from Florida panhandle to habitat seaward of the continental shelf off southern Texas; depths greater than 200m (656 ft)

GOM = Gulf of Mexico; EEZ = U.S. exclusive economic zone

(-) denotes insufficient information available for that species/life stage

Table 11. Described Essential Fish Habitat locations for shark species in the Gulf of Mexico

Shark Species	Neonates and/or Young of Year	Juveniles	Adult
Atlantic angel shark	From Florida to Mississippi, and from offshore habitats south of eastern Louisiana to the Texas-Mexico border	From Florida to Mississippi, and from offshore habitats south of eastern Louisiana to the Texas-Mexico border	From Florida to Mississippi, and from offshore habitats south of eastern Louisiana to the Texas-Mexico border
Atlantic sharpnose shark	Coastal areas of GOM from Florida to Texas	Coastal areas of GOM from Florida Keys to Texas; out to 200m (656 ft) depth	Coastal areas of GOM from Florida Keys to Texas; out to 200m (656 ft) depth
Basking shark (no EFH described for the GOM)	-	-	-
Bigeye sand tiger shark (no EFH described)	-	-	-
Bigeye thresher shark	From southwestern edge of West Florida Shelf to Key West, Florida, and between Desoto Canyon and pelagic habitats south of Galveston, Texas	From southwestern edge of West Florida Shelf to Key West, Florida, and between Desoto Canyon and pelagic habitats south of Galveston, Texas	From southwestern edge of West Florida Shelf to Key West, Florida, and between Desoto Canyon and pelagic habitats south of Galveston, Texas
Bignose shark (no EFH described)	-	-	-
Blacknose shark	Localized coastal areas of west coast of Florida and Florida panhandle	Localized coastal areas of Florida (including Florida Keys and panhandle), Alabama, Mississippi, Louisiana, and Texas	Localized coastal areas of Florida (including Florida Keys and panhandle), Alabama, Mississippi, Louisiana, and Texas
Blacktip sharks	Coastal areas of GOM including estuaries out to 30m (98 ft) depth contour line; from Florida Keys to southern Texas; localized high importance areas within this range; substrate includes silt, sand, mud, seagrass habitats	Coastal areas of GOM out to 100m (328 ft) depth contour line; from Florida Keys to southern Texas; substrate includes silt, sand, mud, and seagrass habitats	Coastal areas of GOM out to 100m (328 ft) depth contour line; from Florida Keys to southern Texas; substrate includes silt, sand, mud, and seagrass habitats
Blue shark (no EFH described for the GOM)	-	-	-

Shark Species	Neonates and/or Young of Year	Juveniles	Adult
Bonnethead shark	Coastal areas of GOM from Florida Keys through Mississippi and from western Louisiana to Texas; localized high importance areas within this range	Coastal areas of GOM from Florida Keys to Chandeleur Sound and along Texas; localized high importance areas within this range	Coastal areas of GOM from Florida Keys to Chandeleur Sound, and along Texas
Bull shark	Localized coastal areas of west Florida coast including the Florida Keys and panhandle; coastal areas between Mobile Bay and Lake Borgne; coastal areas along Texas to mouth of Mississippi river, particularly in bay and bayou systems of Louisiana; shallow depth (<9m, <30 ft) in lower salinity estuaries	Localized coastal areas of Florida including the Florida Keys and panhandle, coastal areas of Mississippi, Alabama, Louisiana, and Texas	Localized coastal areas of Florida including the Florida Keys and panhandle, coastal areas of Mississippi, Alabama, Louisiana, and Texas
Caribbean reef shark	Coastal areas along Florida Keys and the Flower Garden Banks National Marine Sanctuary	Coastal areas along Florida Keys and the Flower Garden Banks National Marine Sanctuary	Coastal areas along Florida Keys and the Flower Garden Banks National Marine Sanctuary
Caribbean sharpnose shark (no EFH described)	-	-	-
Common thresher shark (no EFH described for GOM)	-	-	-
Dusky shark	-	Offshore waters of western and north GOM, at the continental shelf break and seaward (200m [656 ft] contour line plus additional 10nm buffer to the north); in proximity to banks along the continental shelf line	Offshore waters of western and north GOM, at the continental shelf break and seaward (200m [656 ft] contour line plus additional 10nm buffer to the north); in proximity to banks along the continental shelf line; continental shelf edge habitat from Desoto Canyon west to the Mexican border important habitat for adults
Finetooth shark	Shallow, coastal waters of northeastern GOM; localized areas of Florida panhandle, Alabama, Mississippi, Louisiana; localized areas and along coast of Texas; muddy bottom; seaward side of coastal islands	Shallow, coastal waters of northeastern GOM; localized areas of Florida panhandle, Alabama, Mississippi, Louisiana; localized areas and along coast of Texas; muddy bottom; seaward side of coastal islands	Shallow, coastal waters of northeastern GOM; localized areas of Florida panhandle, Alabama, Mississippi, Louisiana; localized areas and along coast of Texas; muddy bottom; seaward side of coastal islands

Shark Species	Neonates and/or Young of Year	Juveniles	Adult
Great hammerheads	Florida Keys to western coast of Florida; important habitat in localized areas of western Florida	Florida Keys to western coast of Florida; important habitat in localized areas of western Florida	Florida Keys to western coast of Florida; important habitat in localized areas of western Florida
Lemon shark	Florida Keys to west coast of Florida, coastal areas along Texas between Galveston and Texas/Mexico border; nursery areas adjacent to Chandeleur Islands in Louisiana and include seagrass beds in shallow water (<2m; <7 ft)	Florida Keys to west coast of Florida; in mud and seagrass areas; Chandeleur Islands off Louisiana and along Texas coast; out to 200m (656 ft) bathymetric contour line	Florida Keys to west coast of Florida; in mud and seagrass areas; along east coast of Louisiana including Breton Sound to the Chandeleur Islands; out to 200m (656 ft) bathymetric contour line
Longfin mako shark	Florida Keys through southern edge of West Florida shelf; central GOM south of Louisiana through Florida Panhandle (inclusive of Mississippi River plume)	Florida Keys through southern edge of West Florida shelf; central GOM south of Louisiana through Florida Panhandle (inclusive of Mississippi River plume)	Florida Keys through southern edge of West Florida shelf; central GOM south of Louisiana through Florida Panhandle (inclusive of Mississippi River plume)
Shortfin mako shark	Seaward of 200m (656 ft) isobath, although extends closer to shore in some areas (e.g. near Mississippi River delta); along edge of southern West Florida shelf to Key West; from northern central GOM around Desoto Canyon and Mississippi Delta to pelagic habitats of western GOM (roughly near Texas-Louisiana border)	Seaward of 200m (656 ft) isobath, although extends closer to shore in some areas (e.g. near Mississippi River delta); along edge of southern West Florida shelf to Key West; from northern central GOM around Desoto Canyon and Mississippi Delta to pelagic habitats of western GOM (roughly near Texas-Louisiana border)	Seaward of 200m (656 ft) isobath, although extends closer to shore in some areas (e.g. near Mississippi River delta); along edge of southern West Florida shelf to Key West; from northern central GOM around Desoto Canyon and Mississippi Delta to pelagic habitats of western GOM (roughly near Texas-Louisiana border)
Narrowtooth shark (no EFH described)	-	-	-
Night sharks	Florida Keys to Florida panhandle; generally seaward of the West Florida shelf edge but further inshore in northern GOM	Florida Keys to Florida panhandle; generally seaward of the West Florida shelf edge but further inshore in northern GOM	Florida Keys to Florida panhandle; generally seaward of the West Florida shelf edge but further inshore in northern GOM
Nurse sharks	-	Florida Keys to Florida panhandle; important localized areas within this range	Florida Keys to Florida panhandle; important localized areas within this range; in sandy and seagrass areas
Oceanic whitetip shark	Offshore waters of the northern GOM at the Alabama-Florida border to offshore waters of western GOM south of east Texas	Offshore waters of the northern GOM at the Alabama-Florida border to offshore waters of western GOM south of east Texas; Mississippi plume important habitat	Offshore waters of the northern GOM at the Alabama-Florida border to offshore waters of western GOM south of east Texas; Mississippi plume important habitat

Shark Species	Neonates and/or Young of Year	Juveniles	Adult
Porbeagle shark (no EFH described for GOM)	-	-	-
Sand tiger shark (no EFH described for GOM)	-	-	-
Sandbar shark	Localized coastal areas of Florida panhandle; silt and/or clay habitat	Localized areas off Apalachicola Bay, Florida	Coastal areas and shelf habitat from Florida Keys through Mississippi River area; offshore continental shelf habitats from Louisiana to Texas in cool, deep, clear water
Scalloped hammerhead	Coastal waters from Florida to Texas (5–6m; 16–20 ft); mud and seagrass substrate	Northern GOM from eastern Louisiana to Pensacola, Florida, and Florida Keys	Northern GOM from eastern Louisiana to Pensacola, Florida, and Florida Keys
Silky sharks	Pelagic waters of GOM from Florida Keys, across the central GOM, to southern coastal waters of Texas (deeper than 50m; 164 ft)	Pelagic waters of GOM from Florida Keys, across the central GOM, to southern coastal waters of Texas (deeper than 50m; 164 ft)	Pelagic waters of GOM from Florida Keys, across the central GOM, to southern coastal waters of Texas (deeper than 50m; 164 ft)
Smooth hammerhead (no EFH described)	-	-	-
Spinner shark	Coastal areas near Florida Keys, and from the Big Bend Region to southern Texas; sandy bottoms	Coastal areas from Apalachicola, Florida to southern Texas; shore to 20m (66 ft)	Coastal areas from Apalachicola, Florida to southern Texas; shore to 90m (295 ft)
Tiger shark	Coastal and offshore areas from Florida Keys to Alabama	Pelagic and coastal areas between Florida Keys to west Florida and the edge of the West Florida Shelf; area off eastern Louisiana, Mississippi, and Alabama to offshore pelagic habitat in central GOM; grass flats are considered feeding areas (and EFH)	Pelagic and coastal areas between Florida Keys to west Florida and the edge of the West Florida Shelf; area off eastern Louisiana, Mississippi, and Alabama to offshore pelagic habitat in central GOM; grass flats are considered feeding areas (and EFH)
Whale shark	Areas of west Florida, Florida Keys, Straits of Florida; central GOM from the Florida panhandle to Texas	Areas of west Florida, Florida Keys, Straits of Florida; central GOM from the Florida panhandle to Texas	Areas of west Florida, Florida Keys, Straits of Florida; central GOM from the Florida panhandle to Texas

Shark Species	Neonates and/or Young of Year	Juveniles	Adult
White sharks (no EFH described for GOM)	-	-	-

(-) denotes insufficient information available for that species/life stage