Offshore Wind Leasing Activities for Oregon:

Biological Assessment and Essential Fish Habitat Assessment

Prepared for the National Marine Fisheries Service
in Accordance with Section 7(c) of the Endangered Species Act of 1973, and the Magnuson-Stevens Fishery Conservation and Management Act, as Amended

May 2024

Photo credits: D. Pereksta (whales), D. Schroeder (habitat and rockfish), BOEM

U.S. Department of the Interior
Bureau of Ocean Energy Management
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Bureau of Ocean Energy Management

Pacific Regional Office

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Contents

Contents ... i

List of Figures ... ii

List of Tables ... iii

List of Abbreviations and Acronyms ... iv

1 Proposed Action and Action Area ... 1

1.1 Purpose and Structure of this Document ... 1
1.2 Proposed Action and Resulting Activities ... 1
1.3 Action Area ... 2

2 Site Assessment Activities: Metocean Buoys ... 6

2.1 Description of Buoys and Expected Numbers ... 6
2.2 Buoy Hull Types and Anchoring Systems ... 7
2.3 Buoy Installation, Operation, and Decommissioning ... 7
2.4 Other Equipment and Instrumentation ... 8
2.5 Vessel Use for Site Assessment ... 8

3 Site Characterization Activities: Geophysical, Geotechnical, and Biological ... 9

3.1 Geophysical Information: High-Resolution Geophysical (HRG) Surveys ... 9
3.2 Geotechnical Surveys and Sampling ... 12
3.3 Vessel Use for HRG Surveys and Geotechnical Sampling ... 14
3.4 Biological Surveys and Vessel Use ... 14

4 Project Design Criteria and Best Management Practices ... 15

4.1 Reinitiation of Consultation ... 15

5 Potential Impacts to Species and Habitats: Summarizing the Proposed Activities ... 17

5.1 Noise ... 17
5.2 Vessel Interactions ... 20
5.3 Habitat Alteration ... 21
5.4 Entanglement in ROV Cables and Metocean Buoy Moorings ... 22
5.5 Accidental Release of Pollutants and Marine Debris ... 23

6 BA: Marine Mammals and Sea Turtles—Species and Descriptions ... 24

6.1 List of Marine Mammals ... 24
6.2 List of Sea Turtles ... 27
6.3 Maps of Biologically Important Areas and Critical Habitat ... 29
6.4 Marine Mammals Likely to Occur in the Action Area ... 32
6.5 Marine Mammals Unlikely to Occur in the Action Area ... 40
6.6 Sea Turtles Likely to Occur in the Action Area ... 41
6.7 Sea Turtles Unlikely to Occur in the Action Area ... 42

7 BA: Fishes and Invertebrates—Species Lists and Descriptions ... 43

7.1 List of Fishes and Invertebrates ... 43
7.2 Salmonids ... 46
7.3 Other Anadromous Fish: Green Sturgeon and Eulachon ... 52
7.4 Invertebrates ... 53
7.5 Species Excluded from Analysis ... 53

8 BA: Marine Mammals and Sea Turtles—Assessment of ESA-Listed Species and Critical Habitat ... 54

8.1 Noise Impacts ... 54
8.2 Vessel Collisions: Monitoring, Reporting, and Avoiding ... 58

8.3 Entanglement or Entrapment in Cables, Moorings, Moon Pools, or Other Potential Hazards ... 59
8.4 Accidental Release of Pollutants and Marine Debris ... 60
8.5 Critical Habitat Impacts and Determinations ... 60

9 BA: Fishes and Invertebrates—Assessment of ESA-Listed Species and Critical Habitat ... 61

9.1 Noise ... 61
9.2 Habitat Alteration and Turbidity ... 63
9.3 Critical Habitat Impacts and Determinations ... 64

10 BA: Cumulative Effects and Conclusions for ESA-Listed Species ... 64

10.1 Cumulative Effects ... 64
10.2 Conclusions for ESA-listed Species ... 65

11 Essential Fish Habitat (EFH) Assessment ... 67

11.1 Purpose ... 67
11.2 Project Description ... 67
11.3 Managed Species ... 67
11.4 Potential Impacting-Producing Factors ... 71
11.5 Effects on EFH ... 71
11.6 Cumulative Analysis ... 74
11.7 EFH Conservation Recommendations and Mitigation ... 75
11.8 EFH Conclusion ... 76

12 Works Cited ... 76

12.1 EFH Assessment Literature ... 76
12.2 BA Literature and Literature for All Other Sections ... 78

Appendix A: Project Design Criteria and Best Management Practices ... 1

List of Figures

Figure 1. Map of the consultation Action Area which extends north and south of the two Oregon Wind Energy Areas (black striped polygons near Coos Bay and Brookings, OR) and the Humboldt lease areas (gray-striped polygons near Eureka, CA) ... 3

Figure 2. Distances (in miles) within the Action Area to ports near the Coos Bay and Brookings Wind Energy Areas ... 4

Figure 3. Vessel Traffic from 2019 for a portion of the Action Area. PACPARS Corridors (diagonal pink shading) are potential routes proposed as voluntary fairways by the U.S. Coast Guard (USCG). ... 5

Figure 4. Reproduced from Carlton et al. (2024): Seafloor habitat data layers including Rocky Reef HAPC in relation to the Coos Bay and Brookings WEAs and Call Areas. Map symbols, such as blue dots representing methane bubble streams, are sized for visibility in figure and not to scale. 6

Figure 5. Buoy schematic diagrams from the National Data Buoy Center (2008). ... 7

Figure 6. Core biologically important areas (BIAs) for four species of baleen whales and for killer whales (Calambokidis et al. 2024) relative to the Action Area and Coos Bay and Brookings WEAs. 29

Figure 7. Parent biologically important areas (BIAs) for four species of baleen whales and for killer whales (Calambokidis et al. 2024) relative to the Action Area and Coos Bay and Brookings WEAs. 30

Figure 8. Critical habitat for the leatherback sea turtle, Steller sea lion, humpback whale, and south resident killer whale (Calambokidis et al. 2024; Carlton et al. 2024; Carretta et al. 2023) relative to the Action Area and WEAs. ... 31

List of Tables

Table 1. Vessel trips and information for buoy activities over a 5-yr period, based on one lease with six buoys with total trips representing two leases. 9

Table 2. HRG survey equipment: types of geophysical sensors expected for use in the Action Area during the 5-year period following lease issuance. 10

Table 3. Geotechnical sampling methods, associated sounds, and estimated seabed disturbance. 12

Table 4. Estimated number of vessel trips (up to 24 hrs/trip) for HRG surveys and geotechnical sampling for one leased area and potential cable corridors, based on a representative survey plan. Max Total Trips is based on the issuance of two leases. 14

Table 5. Estimated number of vessel trips for biological resource surveys over a 5-year period, as a range for animal surveys which typically last 10 hrs per roundtrip; benthic habitat trips are assumed to be 24-hr operations and only a maximum number of survey trips was estimated. Numbers of vessel trips are intended to be conservative estimates, with actual numbers likely to be lower. 14

Table 6. BOEM's proposed Project Design Criteria for protected species and EFH. These PDCs are in addition to existing statutory and regulatory requirements, review procedures, and other BMPs that may apply. See Appendix A for PDC and BMP details. 16

Table 7. Impulsive acoustic thresholds identifying the onset of PTS and TTS for marine mammal, sea turtle, and fish species. 18

Table 8. The ranked classification of active acoustic sources based on impacts to marine mammals, with the first three columns reproduced from Ruppel et al. (2022: Table 3). The other columns are for the activities from the Proposed Action. 20

Table 9. Summary of vessel trips estimated for a 5-year period following lease issuance (Total Trips are based on issuance of 2 leases). 21

Table 10. Marine mammal species (MMPA stock or DPS) that may occur in the Action Area, ESA and MMPA status, occurrence (or seasonality), and critical habitat designation. Bolded species are ESA-listed and/or have critical habitat designation that overlaps the Action Area; these species are described further in this section. 24

Table 11. Sea turtle species that may occur in the Action Area, their ESA status, occurrence (or seasonality), and critical habitat (CH) designation. The proposed green sea turtle CH (not bolded) does not overlap the Action Area. 28

Table 12. Species of fishes and invertebrates that may occur in the Action Area. 43

Table 13. PTS Exposure Distances (in meters) for marine mammal hearing groups from mobile HRG sources towed at 4.5 knots for a) impulsive and b) non-impulsive sources. 55

Table 14. Maximum disturbance distances (in meters) for marine mammal hearing groups from mobile HRG sources towed at 4.5 knots for a) impulsive and b) non-impulsive sources. 56

Table 15. Summary analysis of effects from the Proposed Action on ESA-listed species covered in this BA for a) installation of data collection devices; b) HRG and geotechnical surveys; and c) vessel operations. NLAA = Not Likely to Adversely Affect; NE = No Effect. 66

Table 16. Fish and invertebrate species managed or monitored by the Pacific Fishery Management Council. Species distributions that overlap with the WEAs and nearby Action Area = X; species distributions that potentially overlap within the WEAs and nearby Action Area = ?; species distributions that do not overlap with the WEA or nearby Action Area = *. Distribution data obtained from Love et al. (2021). 67

List of Abbreviations and Acronyms

ADCP	Acoustic Doppler Current Profilers
AIS	Automatic Identification System
AMP	Alternative Monitoring Plan
ASV	Autonomous surface vessel
AUV	Autonomous Underwater Vehicle
BA	Biological Assessment
BIA	Biologically important areas
BMP	Best Management Practices
BOEM	Bureau of Ocean Energy Management
BSEE	Bureau of Safety and Environmental Enforcement
CHIRP	Compressed High Intensity Radar Pulse
CNP	Central North Pacific
COP	Construction and Operations Plan
COW	California/Oregon/Washington
CPT	Cone penetration tests
DOI	Department of the Interior
DPS	Distinct Population Segment
EFH	Essential Fish Habitat
ENP	Eastern North Pacific
ESA	Endangered Species Act
ESU	Evolutionarily Separate Units
FMP	Fishery Management Plans
GPS	Global Positioning
HAPC	Habitat areas of particular concern
HRG	High-Resolution Geophysical
IPF	Impact-producing factors
IWC	International Whaling Commission
LiDAR	Light detection and ranging
LLS	Lateral line system
MBARI	Monterey Bay Aquarium Research Institute
MISLE	Marine Information for Safety and Law Enforcement
MMC	Marine Mammal Commission
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OCS	Outer Continental Shelf
PCFG	Pacific Coast Feeding Group
PDC	Project design criteria

PFMC	Pacific Fishery Management Council
PTS	Permanent Threshold Shift
ROW	Rights of way
RUE	Rights of use and easements
SAP	Site assessment plan
SCBD	Secretariat of the Convention on Biological Diversity
SCPA	Southern California Planning Area
SOC	Standard operating conditions
SRKW	Southern Resident killer whales
SSWS	Sea star wasting syndrome
TOPP	Tagging of Pacific Pelagics
TTS	Temporary Threshold Shift
UME	Unusual mortality events
USACE	United States Army Corps of Engineers
USCG	US Coast Guard
USV	Uncrewed Surface Vessels
UTP	Underwater Transponder Positioning
WEA	Wind Energy Areas

1 Proposed Action and Action Area

1.1 Purpose and Structure of this Document

The purpose of this consultation document is to evaluate the potential impacts on **ESA-listed species and their critical habitats** and on **Essential Fish Habitat (EFH)** from a Proposed Action of issuing leases for wind energy offshore southern Oregon. This document thus contains a Biological Assessment (BA) for threatened and endangered marine mammals, sea turtles, fishes, and invertebrates likely to occur in the Action Area (Figure 1) and an EFH Assessment for this area. For activities that could occur following lease issuance, the document analyzes potential effects including cumulative effects on listed species and EFH and summarize the effects determinations.

This BA and EFH Assessment are consistent with the revised Guidance for Combining EFH Consultations with ESA Section 7 Consultations (Guidance) within NMFS Policy Directive 03-201-05.

Under Section 7(c) of the Endangered Species Act (ESA), as amended, Federal agencies are required to ensure actions they authorize do not jeopardize the existence of any species listed under the ESA. National Marine Fisheries Office of Protected Resources in Long Beach, CA provided technical input on the list of species considered here.

Sections 1 through 5 of this document provide information relevant to both the BA and EFH assessment. Sections 6 through 10 contain the BA. Species lists and information for marine mammals and sea turtles are in section 6. Species lists and information for fishes and invertebrates are in section 7. Sections 8 and 9 draw from the previous sections to present the assessment of marine mammals and sea turtles (section 8) and fishes and invertebrates (section 9). The BA concludes with section 10 in which section 10.1 describes cumulative effects, and 10.2 has conclusions and table with the summary of determinations.

The EFH Assessment is contained in section 11, which largely acts as a stand-alone section. Section 12 has references for the EFH (section 12.1) and for the rest of the document (section 12.2). Following section 12 is an appendix which has information on Project Design Criteria (PDCs) and Best Management Practices (BMPs) relevant to the BA and EFH assessment.

1.2 Proposed Action and Resulting Activities

BOEM's Proposed Action is the issuance of commercial wind energy leases with associated easements within the Coos Bay Wind Energy Area (WEA) and Brookings WEA offshore southern Oregon (maximum of one lease per WEA; Figure 1), and the granting of related rights of way (ROWs) and rights of use and easements (RUEs). ROWs, RUEs, and easements would be within the Oregon Outer Continental Shelf (OCS) and may include corridors from the OCS through State waters to the onshore energy grid. Under the Proposed Action, BOEM may issue easements associated with each lease and issue grants for subsea cable corridors and associated offshore collector/converter platforms.

A lease allows a lessee to submit plans for environmental data collection through activities called **site assessment** and **site characterization**. **Site assessment** involves data collection on wind, typically through the temporary placement of meteorological and oceanographic buoys (i.e., metocean or met buoys) within a WEA; thus, this activity involves temporary installation, operation, and decommissioning of met buoys. **Site characterization** typically includes geophysical and geotechnical surveys and collection of seafloor samples, and biological surveys conducted from a vessel. BOEM reviews site characterization survey plans (survey plans) and all comments must be resolved prior to a lessee conducting survey activities. BOEM also reviews site assessment plans (SAPs) from lessees, and lessees must have BOEM's approval of SAPs to proceed. All survey plans and SAPs are reviewed to ensure inclusion of appropriate protective measures.

BOEM does not consider the issuance of a lease to constitute an irreversible and irretrievable commitment of agency resources toward the authorization of a commercial wind power facility. The Proposed Action does not include cable installation or connection to shore-based facilities, or consideration of commercial-scale wind energy facilities. Should a lessee propose to construct and operate a commercial-scale wind energy facility within the WEAs, they would submit a Construction and Operations Plan (COP) to BOEM. Consideration of construction and operation of wind facilities is a separate federal action under the National Environmental Policy Act and BOEM would consider under a separate consultation.

BOEM reasonably expects the Proposed Action of lease issuance will be followed by site assessment and characterization activities. Site characterization surveys inform SAPs, which are required to deploy and decommission metocean buoys. Together, site assessment and site characterization collect information for a Construction and Operations (COP) plan. Information here focuses on common methods and equipment used offshore the U.S. West Coast or in similar ocean conditions for similar activities.

1.3 Action Area

The Action Area includes the coastal and OCS waters north from the Brookings and Coos Bay WEAs to Astoria, Oregon and south to San Francisco, California (Figure 1) and encompasses the two proposed WEAs offshore Southern Oregon. It also encompasses Northern California lease areas offshore Humboldt, California (BOEM 2022a) and overlaps the Action Area used in consultation with NMFS in 2022 (BOEM 2022b).

The Coos Bay WEA consists of approximately 61,203 acres, and the Brookings WEA consists of approximately 133,792 acres, for a total of 194,995 acres (about 79,000 ha). The five California lease areas that were leased starting in 2022 (https://www.boem.gov/renewable-energy/state-activities/california) cover a total of 373,268 acres. These fives California leases range in size from 63,338 acres to 80,418 acres per lease. Rounded to the nearest 1,000 acres, the average size (± standard deviation) of these five California leases is 75,000 (± 8,000) acres. Thus, the Coos Bay WEA is smaller, and the Brookings WEA larger, than the California lease areas and the average size of these five areas.

The Action Area incorporates the possible transit routes to and from harbors to the WEAs, and activities within the WEAs and along the possible cable routes to shore. Several ports are within 90 mi of the WEAs (Figure 2). San Francisco is over 300 mi from the Brookings WEA and over 450 mi from the Coos Bay WEA.

BOEM does not have regulatory authority to approve any activities in State waters and onshore areas or apply mitigation measures outside of the OCS.

Figure 1. Map of the consultation Action Area which extends north and south of the two Oregon Wind Energy Areas (black striped polygons near Coos Bay and Brookings, OR) and the Humboldt lease areas (gray-striped polygons near Eureka, CA).

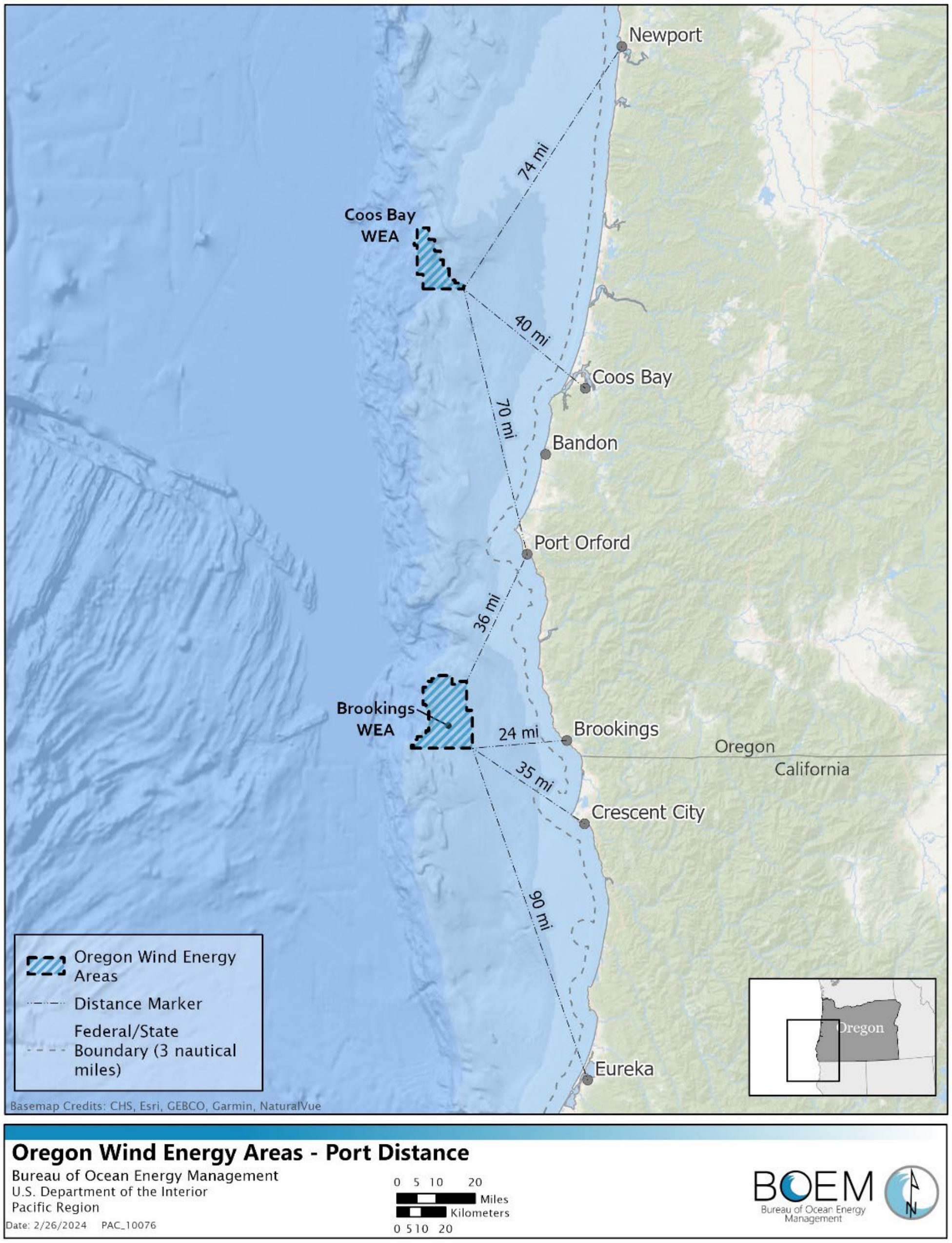

Figure 2. Distances (in miles) within the Action Area to ports near the Coos Bay and Brookings Wind Energy Areas.

1.3.1 Vessel Traffic

BOEM assumes that shipping and marine transportation activities will increase above the density estimated for 2019 based on data from Automatic Identification System (AIS), an automated and autonomous tracking system that can track different classes of marine vessels (Figure 3). AIS vessel traffic data for 2019 indicates multiple tracks of 10-100 vessels crossed through the WEAs, and multiple tracks of up to at least 125 vessels each crossed the Action Area (Figure 3). Densities and numbers of vessels in each swath greatly increased at ports.

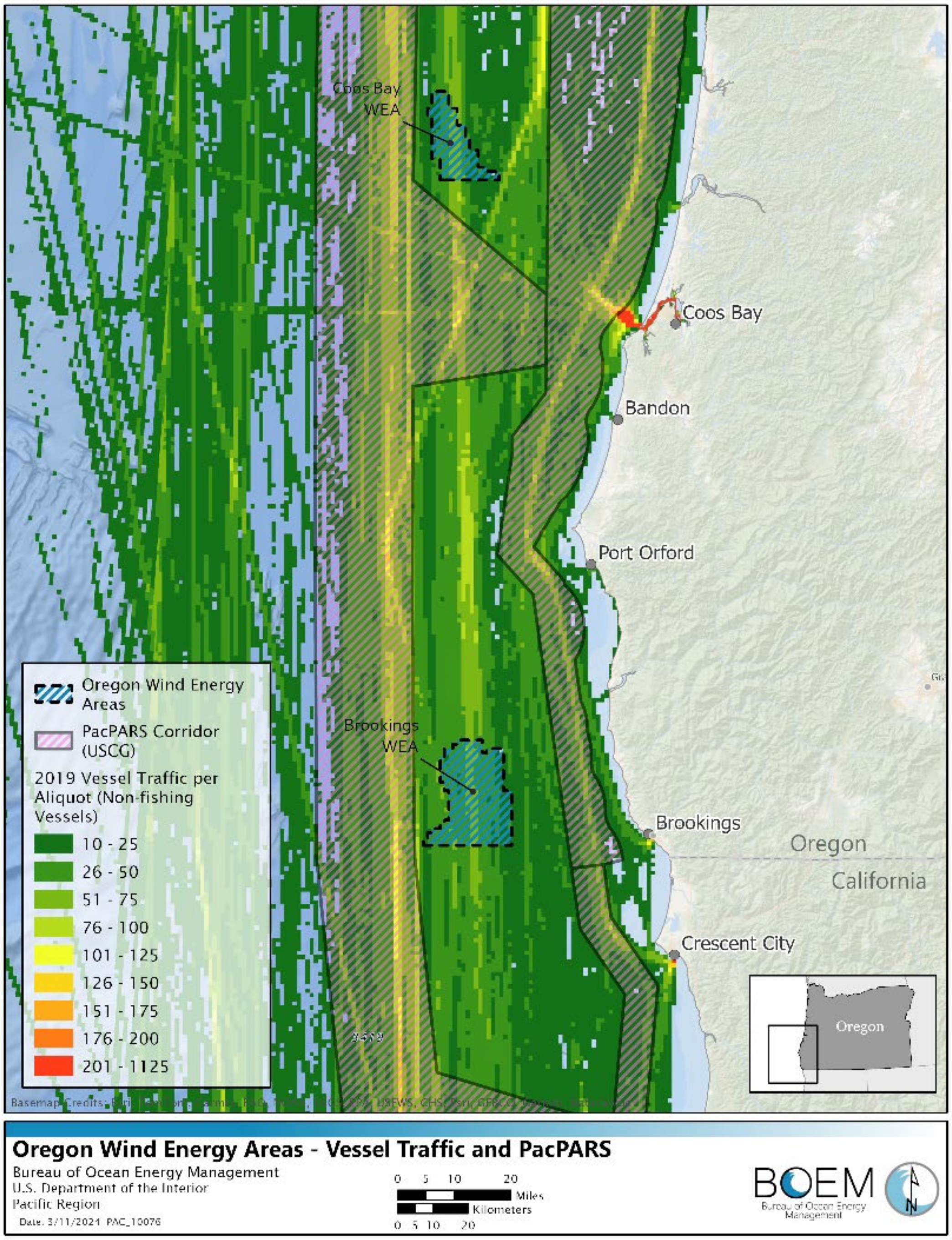

Figure 3. Vessel Traffic from 2019 for a portion of the Action Area. PACPARS Corridors (diagonal pink shading) are potential routes proposed as voluntary fairways by the U.S. Coast Guard (USCG).

1.3.2 Seafloor Features

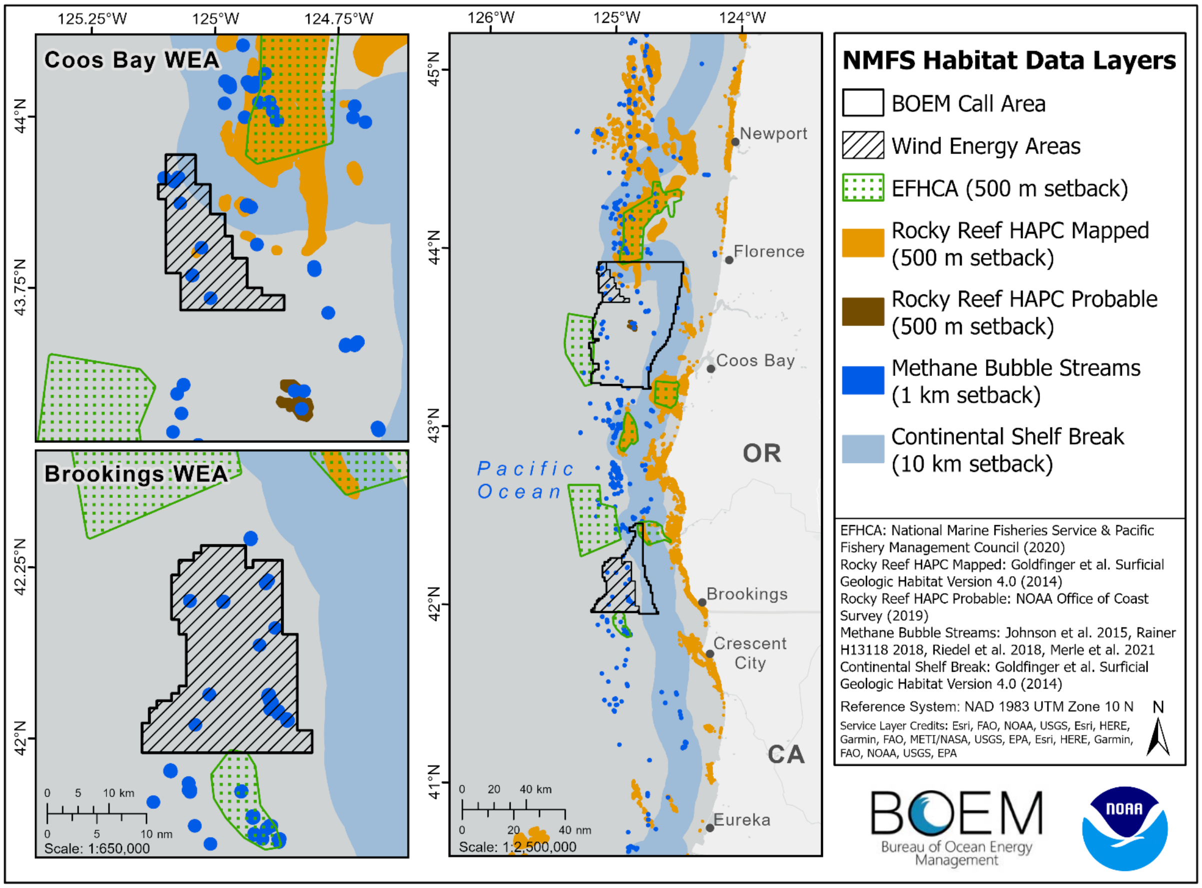

Figure 4. Reproduced from Carlton et al. (2024): Seafloor habitat data layers including Rocky Reef HAPC in relation to the Coos Bay and Brookings WEAs and Call Areas. Map symbols, such as blue dots representing methane bubble streams, are sized for visibility in figure and not to scale.

2 Site Assessment Activities: Metocean Buoys

Site assessment involves the deployment and decommissioning of metocean buoys, which will be permitted by the USACE under the Nationwide Permit 5. Lessees have up to 5 years to perform site assessment activities before they must submit a COP (30 CFR 585.235(a)(2)).

2.1 Description of Buoys and Expected Numbers

Metocean buoys are anchored at fixed locations to monitor and evaluate the viability of wind as an energy source. These buoys may include floating light detection and ranging (LiDAR) to measure wind speeds at multiple heights, and anemometers, vanes, barometers, temperature transmitters and other devices may be mounted on a buoy.

Onboard power supply sources for buoys may include solar arrays, lithium or lead-acid batteries, and diesel generators, which require an onboard fuel storage container with appropriate spill protection and an environmentally sound method to perform refueling activities.

As described in BOEM's Draft EA for the Oregon WEAs (BOEM 2024), BOEM anticipates up to six buoys will be deployed in and near to each leased area in the Oregon WEAs, for a possible total of 12 buoys if BOEM issues two leases.

2.2 Buoy Hull Types and Anchoring Systems

Discus-shaped, boat-shaped, and spar buoys (Figure 5) are the buoy types that would most likely be adapted for offshore wind data collection. A large discus-shaped hull buoy has a circular hull 10–12 m (33–40 ft) in diameter. A boat-shaped hull buoy is an aluminum-hulled buoy that is 6 m long, in the case of NOAA's NOMAD buoy (Figure 5).

Mooring depends on hull type, location, and water depth (National Data Buoy Center 2012). On the OCS, a larger discus-type or boat-shaped hull buoy may require a combination of a chain, nylon, and buoyant polypropylene materials designed (National Data Buoy Center 2008) with one or two weights. In 2020, PNNL installed two LiDAR buoys off California that had a boat-shaped hull and were moored with a solid cast iron anchor weighing approximately 4,990 kg (11,000 lb) with a 2.3-m^2 footprint. The mooring line was comprised of chain, jacketed wire, nylon rope, polypropylene rope, and subsurface floats to keep the mooring line taut to semi-taut. The mooring line was approximately 1,200 m long in the Morro Bay WEA (PNNL 2019).

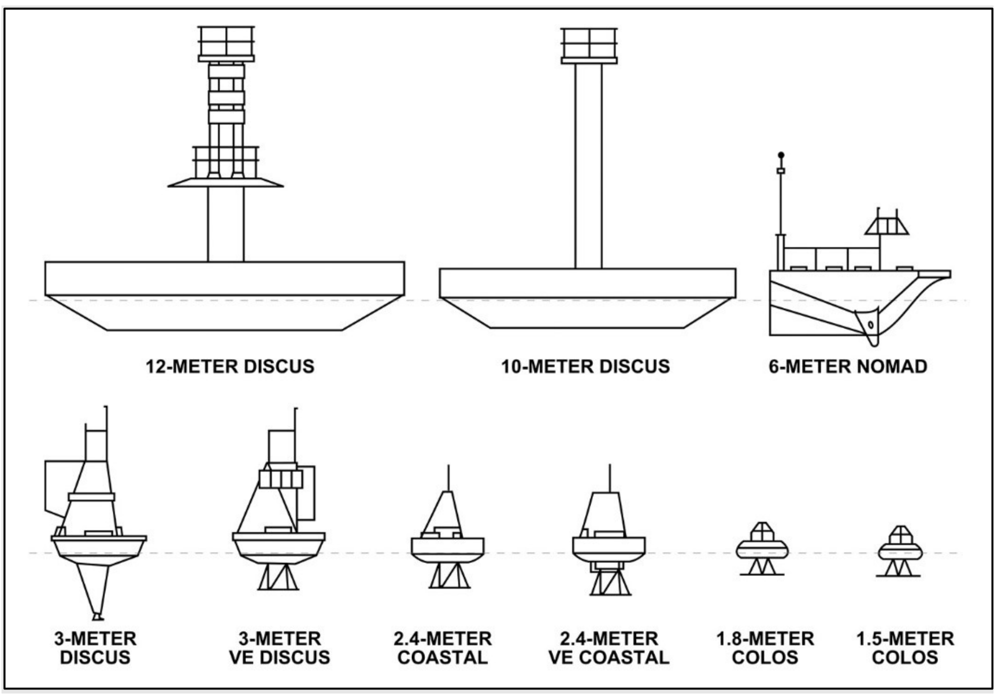

Figure 5. Buoy schematic diagrams from the National Data Buoy Center (2008).

2.3 Buoy Installation, Operation, and Decommissioning

Buoy installation and decommissioning operations would take approximately one day, based on typical deployment procedures. Operation and maintenance are expected to occur with one vessel trip per year per buoy.

Boat-shaped and discus-shaped buoys are typically towed or carried aboard a vessel to the installation location. The buoy is then lowered to the ocean from the deck of the transport vessel or placed over the final location and the mooring anchor dropped. The buoy is anchored to the seafloor with a solid cast iron anchor weighing approximately 11,000 lb (2.3 m^2 footprint). The approximate 1,650-meter-long mooring line is comprised of various components and materials, including chain, jacketed wire, nylon rope, polypropylene rope, and subsurface floats to keep the mooring line taut to semi-taut, reduce slack, and eliminate looping. The buoy will have a watch circle (i.e., excursion radius) of approximately 1,250 m. After installation, the transport vessel would likely remain in the area for several hours while technicians configure proper operation of all systems (PNNL 2019).

Monitoring information transmitted to shore would include systems performance information such as battery levels and charging systems output, the operational status of navigation lighting, and buoy positions. Additionally, all data gathered via sensors would be fed to an onboard radio system that transmits the data string to a receiver onshore (Tetra Tech EC Inc. 2010).

Decommissioning, which may occur in Year 6 or Year 7, is expected to be completed within one day per buoy and performed with the support of a vessel equivalent in size and capability to that used for installation. All buoys will be permitted by USACE under the Nationwide Permit 5.

2.4 Other Equipment and Instrumentation

2.4.1 Other Instruments: General

Conventional anemometers, sonic detection, and ranging equipment may be used to obtain meteorological data in addition to LiDAR. A met buoy could also accommodate environmental monitoring equipment such as avian monitoring equipment including thermal imaging cameras, tagging receivers, acoustic monitoring for marine mammals, data logging computers, visibility sensors, water measurements including temperature, and communications equipment.

2.4.2 Acoustic Doppler Current Profilers (ADCPs)

The speed and direction of ocean currents will likely be assessed with Acoustic Doppler Current Profilers (ADCPs). The ADCP is a remote sensing technology that transmits sound waves at a constant frequency and measures the ricochet of the sound wave off fine particles or zooplanktons suspended in the water column. A typical ADCP is about one to two feet tall and one to two feet wide, with a mooring, base, or cage (surrounding frame) that is several feet wider. A typical ADCP has 3 to 4 acoustic transducers that emit and receive acoustical pulses from different directions. The frequencies range from 300–600 kHz with a sampling rate of every 1 to 60 minutes. ADCPs may be mounted independently on the seafloor, attached to a buoy, or have multiple instruments deployed as a subsea current mooring. In the case of a seafloor mount, the ADCP would likely be located near the meteorological buoy. A subsea current mooring might have 8–10 ADCPs vertically suspended from an anchor combined with several floats made of syntactic foam. These moorings do not breach the surface.

Based on information from existing West Coast lessees, BOEM is anticipating that up to three ADCP moorings could be installed in a lease area, and up to seven may be installed along the export cable route associated with a lease.

2.5 Vessel Use for Site Assessment

Buoy installation vessels are typically 65 to 100 ft (20 to 30 m) in length (Table 1). Crew boats used for buoy operations and maintenance are usually 51 to 57 ft (16 to 17 m) long (Table 1) with 400 to 100-horsepower engines and 1,800-gallon fuel capacity. The estimated numbers of vessel trips (where 1 trip =

1 vessel used for up to 24 hrs) for buoy activities are 92 per lease (Table 1) or 184 for two leases (based on 6 buoys for a lease in Coos Bay WEA and six buoys in the Brookings WEA) over a 5-yr period. Numbers of vessel trips are intended to be conservative estimates of survey requirements, with actual numbers likely to be lower. Numbers of vessel trips are summarized for all site assessment and site characterization activities in section 5.2.1.

Vessels with moon pools may be utilized to deploy buoys. A moon pool is a vertical opening through the hull from the deck to the bottom of a vessel for lowering tools and instruments into the sea (see also Appendix A). This is a safer way to deploy instruments at sea.

Table 1. Vessel trips and information for buoy activities over a 5-yr period, based on one lease with six buoys with total trips representing two leases.

Survey Task	Estimated Number of Round Trips for 1 lease	Max Total Trips (up to 12 buoys)	Vessel Size
Buoy installation	6	12	65 to 100 ft (20 to 30 m)
Buoy maintenance at once per year per buoy for 5 years	30	60	51 to 57 ft (16 to 17 m)
Metocean buoy decommissioning (may occur after year 5)	6	12	65 to 100 ft (20 to 30 m)
Additional maintenance trips as needed (e.g., if severe weather)	60	100	51 to 57 ft (16 to 17 m)
Summary	**Total: 102**	**204**	**Vessel size range: 51 to 100 ft**

3 Site Characterization Activities: Geophysical, Geotechnical, and Biological

Site characterization activities involve geological, geotechnical, and geophysical surveys and sampling of the seafloor, and biological surveys of marine habitats and animals. Surveys can be conducted before and after met buoy approval to collect data for a COP (30 CFR 585.626).

Lessees would conduct HRG surveys and geotechnical sampling within WEAs and ROW/RUE routes (i.e., the corridors from WEAs to the onshore energy grid; potential cable easement routes) during the 5-year site assessment term. It is assumed that the ROW/RUE routes would consist of a minimum **300-meter-wide corridor centered on anticipated cable locations**. Because any ROW or RUE grants considered as part of this undertaking have not been issued, BOEM is uncertain of the locations of cable corridor surveys.

3.1 Geophysical Information: High-Resolution Geophysical (HRG) Surveys

BOEM anticipates that site characterization will use **high-resolution geophysical (HRG) surveys** to chart bathymetry, archaeological resources, and benthic zone hazards (following BOEM's guidelines for geophysical data requirements: 30 CFR 585.610(b)(2) and 30 CFR 585.610(b)(3)). HRG surveys can inform site selection for geotechnical sampling and whether hazards will interfere with seabed support of the turbines.

3.1.1 HRG Equipment: Active Acoustic Sources

HRG surveys use electrically-induced sonar transducers to emit and record acoustic pulses, and do not use air or water compression to generate sound. HRG sonar equipment may include swath bathymetry systems, magnetometers or gradiometers (two or more magnetometers to measure a gradient), side-scan sonar, shallow and medium (seismic) sub-bottom profiler systems, and multibeam echosounders from a vessel (Table 2). This equipment does not contact the seafloor. It may be towed from a moving survey vessel that does not require anchoring or onboard unmanned vehicles--ROV, AUV, and HOV types and may be used in conjunction with UTP technology. The equipment may be deployed and retrieved over the side or back of a vessel, or through a moon pool.

Better technologies that may become available must meet requirements for SAPs (30 CFR § 585.606(5)) If new technology is proposed by lessees for site characterization, and if the potential impacts from this new technology are similar or less than those analyzed for the equipment described in this document, BOEM may approve the survey plans without reinitiating consultation.

The line spacing for HRG surveys varies depending on the data purpose. To collect geophysical data for shallow hazards assessments (including multibeam echosounder, side-scan sonar, and sub-bottom profiler systems), BOEM recommends surveying at a 150-m (492-ft) primary line spacing and a 500-m (1,640-ft) tie-line spacing over the proposed lease area. For the collection of geophysical data for archaeological resources assessments (including magnetometer, multibeam echosounder, side-scan sonar, and sub-bottom profiler systems), BOEM recommends surveying at a 30-m (98-ft) primary line spacing and a 500-m (1640-ft) tie-line spacing over potential pre-contact archaeological sites once part of the terrestrial landscape and since inundated by global sea level rise during the Pleistocene and Holocene, generally thought to be in waters less than 100 m depth, which is typically in cable landing areas.

Table 2. HRG survey equipment: types of geophysical sensors expected for use in the Action Area during the 5-year period following lease issuance.

Sensor Type	Uses	Equipment Description
Bathymetry/ depth sounder (multibeam echosounder)	Collect bathymetric data for shallow hazards, archaeological resources, and benthic habitats	A depth sounder is a microprocessor-controlled, high-resolution survey-grade system that measures precise water depths in both digital and graphic formats. Records with a sweep appropriate to the range of water depths expected in the survey area. May be better suited than other tools for characterizing areas with complex bathymetric features and hardbottom areas.
Gradiometer	Collect geophysical data for shallow hazards and archaeological assessments. Help identify objects with distinct magnetic signatures.	The gradiometer (2 or more magnetometers) is typically towed close to the seafloor at no more than approximately 6 m (20 ft) above the seafloor. Better suited for depths < 500 m than deeper waters.
Side-scan sonar	Collect geophysical data for shallow hazards and archaeological assessments. 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") on the sides which generate and record the returning sound that travels through the water column at a known speed. May have dual or tri frequencies (230–1600 kHz) to record continuous planimetric images of the seafloor.

Sensor Type	Uses	Equipment Description
Shallow and medium (seismic) penetration sub-bottom profilers	Collect geophysical data for shallow hazards, archaeological assessments, and profile views of subsurface sediments for geologic cross-sections under tracklines.	High-resolution Compressed High Intensity Radar Pulse (CHIRP) system sub-bottom profilers (a narrow frequency around 5.7 kHz). Also, medium penetration systems, such as boomers, sparkers (2.7 kHz), and bubble pulsers (4.3 kHz), or other impulse-type systems. Can penetrate sediment depths of 3 m (10 ft) to > 100 m (328 ft).

3.1.2 Methods for HRG data collection

Several survey methods can be used to collect high resolution geophysical data. Typically, these methods are based on the water depth of the survey area. However, restrictions on available equipment may affect which survey methods are chosen. The following is a description of each of the possible decisions for these survey methods:

- Autonomous Underwater Vehicle (AUV) survey. AUV surveys consist of an autonomous (non-tethered) submersible with its own power supply and basic navigation logic. An AUV can run many geophysical sensors at once and typically would consist of a multibeam echosounder, side-scan sonar, magnetometer, and a sub-bottom profiler. AUVs also have forward looking sonar for terrain avoidance, a doppler velocity logger for velocity information, an internal navigation system for positioning, an ultra-short baseline pinger for positioning, and an acoustic modem for communication with a surface survey vessel. For single AUV operations, the surface survey vessel follows the AUV, keeps in communication via the acoustic modem, provides navigation information to the AUV, and monitors the health of the AUV. During multiple AUV surveys, several AUVs are deployed at once. These AUVs run independently from the survey vessel.Navigation updates and modem communication are provided by a network of Underwater Transponder Positioning devices (UTPs). These transponders are deployed to the seabed in known locations. In both methods of operation, the survey vessel recovers, maintains, and launches the AUVs and UTPs (see also BOEM's EA for Oregon, Appendix F, BOEM 2024). A survey vessel may deploy AUVs and UTPs through a moon pool, which is a large opening through the hull from the deck and to the bottom of a vessel for lowering tools and instruments into the sea.
- Shallow multi-instrument towed surveys. Towed surveys typically happen in shallower waters. A survey vessel will tow side-scan sonar, magnetometers or gradiometers with winches to provide altitude adjustments. In addition, passive acoustic monitoring, and, if needed, medium penetration seismic, can be towed from hardpoints (e.g., cleats) on the vessel. The survey vessel usually has hull mounted multibeam echosounders, a sub-bottom profiler, and an ultra-short baseline system.
- Deep-tow survey. Deep-tow surveys use towed methodology in deep waters. The vessel uses a large winch with thousands of meters of cable to tow the survey instruments at depth. The survey instruments usually consist of a large weight (depressor) followed by a side-scan, sub-bottom, and potentially a multibeam. Mounted in a survey vehicle. In deep waters the survey vehicle might be 8–10 km behind the survey vessel, sometimes requiring the use of a chase vessel to provide ultra-short baseline navigation for the survey vehicle. Vessels maintain speeds of 4.5 kn or slower when towing equipment.
- Uncrewed Surface Vessel survey. Uncrewed Surface Vessels (USV) or Automated Surface Vessel (ASV) are remote controlled vessels that are controlled by operators on shore or from another vessel. USVs can be simple with a single instrument, designed for shallow waters, and

controlled by an operator that maintains visual contact with the USV. USVs can also be larger, the size of a small survey vessel, are operated over the horizon, could tow instruments, and use radar and cameras to operate safely and monitor for protected species. USVs can be electrically powered with batteries, sail/solar powered, and/or use diesel motors and generators.

3.2 Geotechnical Surveys and Sampling

Geotechnical surveys measure the physical properties of shallow sediments through samples of the seafloor (30 CFR 585.610(b)(1), 30 CFR 585.610(b)(4)). These measurements can indicate the suitability of shallow foundation soils to support anchoring systems or transmission cable under any operational and environmental conditions (including extreme events). Thus, the results inform the design of anchor systems and foundations, the armor level of export cables, and cable burial methods.

Seafloor samples for geotechnical evaluation are collected by direct sampling of the substrate or in-situ measurements of sediments (Table 3). Direct sampling usually employs a dredge or corer off a survey vessel to retrieve a sediment sample from the seabed and return it to the deck of the vessel for further analysis. In-situ methods use a probe, that is pushed, or dropped into the seabed, and can record various properties of the sediment. Typical sampling sites include proposed anchor sites, cable touchdown points, regular intervals along proposed cable routes, and selected sites for slope stability studies. Data from HRG surveys are used to avoid archeological, geological, and benthic hazards in selection of sampling sites.

Geotechnical investigation may include the use of gravity cores, piston cores, vibracores, deep borings, and cone penetration tests (CPT), among others (Table 3).

The area of seabed disturbed by individual sampling events (e.g., collection of a core or grab sample) and placement of met buoy anchors could range up to an estimated 10 m^2 although the maximum disturbance for many methods is less than half that area (Table 3). If every sample collected results in 10 m^2 disturbance, then 1,000 samples could theoretically disturb up to 10,000 m^2 (1 ha; 2.5 acres) of seafloor in the Action Area (see Figure 4). This is an overestimate of impacted area as the number of samples collected by one lessee will likely be 100 or fewer though, representing a maximum of 1,000 m^2 (0.1 ha; 0.25 acres) of seafloor disturbance.

Deployments for geotechnical sampling typically use vessels with dynamic positioning capability which do not have seafloor anchoring impacts. Vessel anchoring is unlikely in deep waters. However, if a vessel needs to anchor, an anchoring plan must be submitted (see Appendix A, section A.1.1).

Table 3. Geotechnical sampling methods, associated sounds, and estimated seabed disturbance.

Method	Use	Description of Equipment and Methods	Acoustic Noise	Disturb-ance
Dredge	Collect upper 5–10 cm of sediment (direct sampling)	Spring loaded dredge is lowered to the seabed by hand or with a small winch. Interaction with the seabed causes spring to release and tension on the line provides the closing force for the dredge. Useful for identifying the type of seabed sediment.	None	< 1 m^2

Method	Use	Description of Equipment and Methods	Acoustic Noise	Disturb-ance
Box Cores	Collect undisturbed "box" of sediment up to 0.5 m x 0.5 m x 1.0 m. (direct sampling)	A box core is lowered to the seabed by winch and penetrates the seabed, when tension is applied the box core jaws close, sealing the sample inside. Once on deck various tests can be performed. This type of equipment is also used for benthic studies.	USBL beacon for positioning.	< 4 m^2
Gravity / Piston Coring / Jumbo Piston Coring	Collect a core of sediments for analysis. 3–4" diameter, 10 m–20 m. (direct sampling)	Coring is typically conducted off a survey vessel. Gravity coring simply uses a weighted core barrel to take a sample. Piston coring uses a trigger to drop the weighted core barrel into the seabed with a piston that attempts to preserve the seabed. A jumbo piston core is a larger piston corer with increased diameter and length.	USBL beacon for positioning.	< 4 m^2
Cone Penetrometer (CPT)	Measure several properties including tip resistance, pore water pressure, sleeve resistance, among others. (in situ)	An electrically operated machine pushes a coiled rod into the seabed with a cone penetrometer at the tip. Typically deployed from survey vessels. They are winched to the seabed and remain connected to the survey vessel via umbilical for data transmission and power.	USBL beacon for positioning. Motor noises during operation.	< 10 m^2
Stinger CPT	Measure several properties including tip resistance, pore water pressure, sleeve resistance, among others. (in situ)	A hydrodynamic dart with a cone penetrometor at the tip. CPT Stingers are typically deployed from survey vessels, much like a gravity core. The CPT records as the equipment embeds into the seafloor. It may then push the CPT further into the seafloor.	USBL beacon for positioning. Motor noises during operation.	< 4 m^2
Vibracore	Obtain samples of unconsolidated sediment; may also be used to gather information to aid archaeological interpretation of features identified through HRG surveys (BOEM 2020) (direct sampling)	Vibracore samplers typically consist of a core barrel and an oscillating driving mechanism that propels the core barrel into the sub-bottom. 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 long with 8 cm diameters are obtained, although some devices have been modified to obtain samples up to 12 m long (MMS 2007; USACE 1987).	Vibrations from the motor.	< 10 m^2
Borings	Sampling and characterizing the geological properties of sediments at the maximum expected depths of the structure foundations (MMS 2007) (direct sampling)	A drill rig is used to obtain deep borings. The drill rig is mounted over a moon pool on a dynamically positioned vessel with active heave compensation. Geologic borings can generally reach depths of 30–61 m 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).	Vessel and drill noise.	< 10 m^2

3.3 Vessel Use for HRG Surveys and Geotechnical Sampling

Like BOEM (2022a), BOEM (2024) describes vessel use based on 10-hour and 24-hour days, with more vessel trips estimated as needed if trips are 10-hours. Here we use the upper end of the number of trips estimated (the number estimated based on 10-hour trips) and assume all trips could last up to 24 hours. In other words, we selected the higher end of both trip duration and number of trips (Table 4). Numbers of vessel trips are summarized for all site assessment and site characterization activities in section 5.2.1.

Table 4. Estimated number of vessel trips (up to 24 hrs/trip) for HRG surveys and geotechnical sampling for one leased area and potential cable corridors, based on a representative survey plan. Max Total Trips is based on the issuance of two leases.

Survey Task	Vessel Trips for 1 Lease	Max Total Trips
HRG surveys per lease	140	280
Geotechnical sampling per lease	200	400
Total estimated # survey days for 1 lease	**340**	**680**

3.4 Biological Surveys and Vessel Use

Site characterization surveys for animals (birds, bats, marine mammals, sea turtles, fishes, and invertebrates) may involve visual observations from vessels or from the air and technologies to detect animals (Table 5). Biological resource surveys (30 CFR 585.610(b)(5)) for birds, fishes, and marine mammals, and sea turtles from vessels are typically done during daylight hours, with day trips lasting about10-hours. These surveys may occur at the same time from the same vessel but not concurrently with HRG surveys. Numbers of vessel trips are summarized for all site assessment and site characterization activities in section 5.2.1.

Table 5. Estimated number of vessel trips for biological resource surveys over a 5-year period, as a range for animal surveys which typically last 10 hrs per roundtrip; benthic habitat trips are assumed to be 24-hr operations and only a maximum number of survey trips was estimated. Numbers of vessel trips are intended to be conservative estimates, with actual numbers likely to be lower.

Biological Resources	Survey Methods	# Trips for 1 Lease	Max Trips Total
Birds	Aerial digital imaging; visual observation; radar; thermal or acoustic monitoring	30–60	120
Bats	Ultrasonic detectors installed on buoy and survey vessels, radar, thermal monitoring (concurrent with other vessel trips)	NA	NA
Marine mammals, sea turtles	Aerial or vessel-based surveys, acoustic monitoring	30–60	120
Fishes, some invertebrates	Underwater imagery; acoustic monitoring; eDNA	8–370	740
Benthic habitats	Grab sampling; benthic sled; underwater imagery/ sediment profile imaging	50	100
All biological resources	**Total across methods**	**Up to 540**	**1,080**

4 Project Design Criteria and Best Management Practices

BOEM has developed project design criteria (PDC) and best management practices (BMPs) to avoid and minimize potential environmental risks to or conflicts with protected resources and EFH from site assessment and site characterization activities (Table 6). Through consultation with NMFS and coordination with stakeholders, BOEM developed BMPs for implementation of PDCs (see Appendix A for detailed descriptions), and BOEM can further modify BMPs based on new information or new consultation. BOEM will implement BMPs and PDCs through review survey plans through standard operating conditions (SOCs).

4.1 Reinitiation of Consultation

BOEM will follow ESA Regulations for reinitiation of consultation: reinitiation may be triggered when the action agency retains jurisdiction over activities and: (1) If the amount or extent of taking specified in the incidental take statement is exceeded; (2) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion or written concurrence; or (4) If a new species is listed or critical habitat designated that may be affected by the identified action (50 CFR 402.16).

Table 6. BOEM's proposed Project Design Criteria for protected species and EFH. These PDCs are in addition to existing statutory and regulatory requirements, review procedures, and other BMPs that may apply. See Appendix A for PDC and BMP details.

#	Project Design Criteria	Applicable to	Purpose
PDC 1	Hard Bottom Avoidance: Metocean Buoy Anchoring and Prohibition of Trawling	Employees, all at-sea contract personnel, vessels	Met Buoy Anchoring: To protect rocky reefs, a Habitat of Particular Concern for Pacific Groundfish EFH, and reduce effects associated with habitat alteration to minimally adverse levels. No Trawling: To reduce possibility of bycatch of protected fish species and to protect benthic habitats.
PDC 2	Marine Debris Awareness and Elimination	All at-sea and dockside operations	To provide informational training to all employees and contract personnel on the proper storage and disposal practices at-sea to reduce the likelihood of accidental discharge of marine debris that can impact protected species through entanglement or incidental ingestion.
PDC 3	Minimize Interactions with ESA-listed Species During Geophysical Survey Operations	Survey vessels operating HRG equipment at or below 180 kHz	To avoid injury of ESA-listed species and minimize the likelihood of adverse effects associated with potential disturbance to discountable levels through the establishment of pre-clearance, exclusion zones, shut-downs, PSO monitoring, and other BMPs to avoid and reduce exposure of ESA-listed species to underwater survey noise.
PDC 4	Minimize Vessel Interactions with ESA-listed species	All vessels	To avoid injuring or disturbing ESA-listed species by establishing a 10 knot or less speed limit for vessels within the Action Area that are associated with leases; minimum separation distances between vessels and marine protected species; and operational protocols for vessels when animals are sighted.
PDC 5	Entanglement Avoidance	Mooring and anchoring systems for buoys and devices for metocean data collection.	To use the best available mooring systems using anchors, chain, cable, or coated rope systems that prevent or reduce to discountable levels any potential entanglement of marine mammals and sea turtles.
PDC 6	Protected Species Observers	Geophysical Surveys	To specify PSO requirements for monitoring shutdown and clearance zones, including requirements for qualified third-party PSOs; PSO approval by NMFS prior to deployment on a project; training for crew members serving as lookouts; 360-degree visual monitoring; and specifications for PSO equipment.
PDC 7	Reporting Requirements	PSOs and project-related personnel who observe a dead or injured protected species.	To document and record monitoring requirements for geophysical surveys, project-related incidents involving ESA-listed species, and to report any impacts to protected species in a project area whether or not the impact is related to the project.

5 Potential Impacts to Species and Habitats: Summarizing the Proposed Activities

The primary impact-producing factors (IPFs) associated with site assessment and site characterization that could affect ESA-listed species of marine mammals, sea turtles, fishes, and invertebrates are sound from surveys and vessels, vessel collisions, entanglement, chemical and toxic pollution, and marine debris. For EFH (section 11), the identified IPFs are noise and habitat alteration/turbidity.

5.1 Noise

5.1.1 Background on Animal Hearing and Potential for Injury

The assessment of potential hearing effects in ESA-listed species is based on NMFS' technical guidance for assessing acoustic impacts, defined as Permanent Threshold Shift (PTS) and Temporary Threshold Shift (TTS) (NMFS 2018) (Table 7). The methodology developed by the U.S. Navy is currently thought to be the best available data to evaluate the effects of exposure to the survey noise by sea turtles that could result in physical effects (Anderson 2021; U.S. Navy 2017).

For a sound to potentially directly disturb or injure an animal, the animal must be able to hear it. Effects on hearing ability can result in disturbance of important biological behaviors such as migration, feeding, resting, communication, and breeding. Baleen whales hear lower frequencies; sperm whales, beaked whales and dolphins hear mid-frequencies; porpoise hear high frequencies; seals from 50 hertz (Hz) to 86 kHz, and sea lions from 60 Hz to 39 kHz (Table 7; NMFS 2016d; 2018). Sea turtles are low frequency hearing specialists with a range of maximum sensitivity between 100 to 800 Hz (Table 7; Bartol et al. 1999; Bartol and Ketten 2006; Lenhardt 1994; 2002; Ridgway et al. 1969). Cartilaginous fish are known to be sensitive to low frequency sounds up to 1.5 kHz, peaking between 200 and 600 Hz, depending on the species (Chapuis et al. 2019).

Injury and mortality in fishes exposed to impulsive sources may vary depending on the presence or absence of, and type of swim bladder. Injury and mortal injury due to impulsive sources have not been observed in fishes without a swim bladder (Halvorsen et al. 2011; 2012a). Therefore, if effects were to occur, they would likely occur above the given thresholds in Table 7. Invertebrates, which do not contain air spaces within their bodies, are expected to respond similarly to fishes with no swim bladder (see section 9.1). Cumulative sound exposure thresholds for mortality and injury in fish with a swim bladder were measured by investigators (Halvorsen et al. 2011; 2012a; 2012b). However, only the single strike peak sound pressure level was measured during these experiments; therefore, mortality and injury thresholds are assumed to be the same across all hearing groups with a swim bladder (Popper et al. 2014). Although the Proposed Action does not include the use of air guns, data on fishes exposed to sound from an air gun provide the only sound-exposure data for assessment. These data showed that a cumulative sound exposure level of 186 dB re 1 μPa^2-s resulted in TTS in fishes (Popper et al. 2005). TTS is not likely to occur in fishes without a swim bladder or invertebrates, and would likely occur above the given threshold in Table 7 for fishes with a swim bladder not involved in hearing.

Table 7. Impulsive acoustic thresholds identifying the onset of PTS and TTS for marine mammal, sea turtle, and fish species.

Hearing Group	Generalized Hearing Range	Permanent Threshold Shift Onset	Temporary Threshold Shift Onset
Low frequency (e.g., baleen whales)[1,2]	7 Hz to 35 kHz	219 dB Peak 183 dB cSEL	213 dB Peak 179 cSEL
Mid-frequency (e.g., dolphins and sperm whales)[1,2]	150 Hz to 160 kHz	230 dB Peak 185 dB cSEL	224 dB Peak 178 dB cSEL
High frequency (e.g., porpoise)[1]	275 Hz to 160 kHz	202 dB Peak 155 dB cSEL	148 dB Peak 153 dB cSEL
Phocid pinnipeds (true seals) (underwater)[1,2]	50 Hz to 86 kHz	218 dB Peak 185 dB cSEL	212 dB Peak 181 dB cSEL
Otariid pinnipeds (sea lions and fur seals) (underwater)[1,2]	60 Hz to 39 kHz	232 dB Peak 203 dB cSEL	226 dB Peak 199 dB cSEL
Sea Turtles[2]	30 Hz to 2 kHz	230 dB Peak 204 dB cSEL	226 dB Peak 189 dB cSEL
Atlantic/Shortnose Sturgeon[3]	100 Hz to 800 Hz	> 207 Peak[5] 203 dB cSEL	186 dB cSEL
Atlantic Salmon[3]	< 380 Hz	> 207 Peak[5] 203 dB cSEL	186 dB cSEL
Sharks[4]	< 1.5 kHz	> 213 dB Peak[5] > 216 dB cSEL	NC

Notes: cSEL = Cumulative sound exposure level (decibel referenced to 1 micropascal squared seconds [dB s]), Peak = Peak sound pressure level (decibel referenced to 1 micropascal [dB re 1 μPa]), “> indicates that the given effect would occur above the reported threshold, NC = effects not likely to occur

[1] NMFS 2018b; [2] Navy 2017; [3] Hawkins and Johnstone 1978; [4] Chapuis et al. 2019; [5] Popper et al. 2014

5.1.2 Noise from Vessels

For most of the world oceans, shipping and seismic exploration noise dominate the low-frequency portion of the spectrum (Hildebrand 2009). In particular, noise generated by shipping has increased as the number of ships on the high seas has increased. On the West Coast of North America, long-term monitoring data suggest an average increase of about 3 dB per decade in low-frequency ambient noise (Andrew et al. 2002; McDonald et al. 2006; 2008).

The sound generated by individual vessels can contribute to overall ambient noise levels in the marine environment on variable spatial scales. The survey vessels would contribute to the overall noise environment by transmitting noise through both air and water. Underwater noise produced by vessels is a combination of narrow-band (tonal) and broadband sound, with speed of vessels factoring into the sound-levels received (Houghton et al. 2015; Putland et al. 2018). Tones typically dominate up to about 50 Hz, whereas broadband sounds may extend to 100 kHz. According to Southall (2005) and Richardson et al. (1995), vessel noise typically falls within the range of 100–200 Hz.

In the frequency range of 20–500 Hz, distant shipping is the primary source of ambient noise (URI 2017). Spray and bubbles associated with breaking waves are the major contributions to ambient noise in the 500–100,000 Hz range. At frequencies greater than 100,000 Hz, "thermal noise" caused by the random motion of water molecules is the primary source. Ambient noise sources, especially noise from wave and tidal action, can cause coastal environments to have particularly high ambient noise levels.

Vessel noise can potentially mask vocalizations and other biologically important sounds (e.g., sounds of prey or predators) that marine mammals and fishes may rely on. Potential masking can vary depending on the ambient noise level within the environment, the received level and frequency of the vessel noise, and the received level and frequency of the sound of biological interest. For example, right whales were observed to shift the frequency content of their calls upward while reducing the rate of calling in areas of increased anthropogenic noise (Parks et al. 2007) as well as increasing the amplitude (intensity) of their calls (Parks et al. 2011; Parks et al. 2009). Right whales also had their communication space reduced by up to 84% in the presence of vessels (Clark et al. 2009). Although humpback whales did not change the frequency or duration of their vocalizations in the presence of ship noise, their source levels were lower than expected, potentially indicating some signal masking (Dunlop 2016).

5.1.3 Noise from HRG Surveys

Using physical criteria about various HRG sources, such as source level, transmission frequency, directionality, beamwidth, and pulse repetition rate, Ruppel et al. (2022) divided marine acoustic sources into four tiers based on impacts to marine mammals that could inform regulatory evaluation (Table 8). Ruppel et al. (2022) supported these tiers with behavioral evidence. Tier 4 includes most high resolution geophysical, oceanographic, and communication/tracking sources, which are considered unlikely to result in incidental take of marine mammals and therefore termed de minimis. The majority of acoustic sources under the Proposed Action fall into this de minimis category (Table 8).

HRG surveys may be vessel-based or AUV-based (see section 3.1.2) to deploy active sound sources (listed in Table 2 in section 3.1.1). These surveys may or may not make use of underwater transponder positioning (UTP) systems. UTP systems include an array of transponders placed temporarily on the seabed that communicate with AUVs to improve positioning accuracy. ADCP, pingers (locators), acoustic releases, seafloor/water column navigational/tracking acoustics for ROVs, AUVs, etc. are not likely to result in incidental take and are Tier 4 de minimus sources (Ruppel et al. 2022). These sources include the operating sounds for UTPs, AUVs, USBLs, ADCPs, acoustic releases, ROVs, and similar technology (Table 8).

For acoustic sources from vessel-based surveys that fall in Tier 3 (Table 8), PDC 3 (Appendix A) applies.

Using acoustic characteristics of HRG survey equipment operated from AUVs listed in the California 2024-2025 marine site characterization survey plans accepted to date, Level B disturbance distances (horizontal threshold ranges) were calculated using NOAA's Associated Level B Harassment Isopleth Calculator and are calculated to be 8.5 m or less from HRG devices on AUVs for marine mammals and 2.2 m or less for sea turtles. The impacts of noise to marine mammals and sea turtles from HRG sound sources operated from AUVs is minimal and therefore the use of HRG sound sources operated from AUVs does not require a specialized mitigation strategy and no additional conservation measures are recommended at this time.

Table 8. The ranked classification of active acoustic sources based on impacts to marine mammals, with the first three columns reproduced from Ruppel et al. (2022: Table 3). The other columns are for the activities from the Proposed Action.

Category (Ruppel et al. 2022)	Active Acoustic Sources: Short Descriptions (Ruppel at al. 2022)	Example Sources (Ruppel et al. 2022)	Proposed Action	Best Management Practices
Tier 1	*High-energy airgun surveys (includes GI guns)*	*airguns–- arrays larger than 12 airguns*	not applicable	not applicable
Tier 2	*Low/intermediate energy airgun surveys (includes GI guns)*	*airguns*	not applicable	not applicable
Tier 3	*HRG seismic sources (most)*	*Some sparkers, bubble guns, some boomers*	Medium (seismic) penetration sub-bottom profilers	PDC 3 applies to towed systems. PSOs required–- clearance and shut down zones
Tier 4	*De minimis sources (not likely to result in incidental take)*	*EK60/80), lowest powered sparkers, 3-plate boomers, ADCP, pingers (locators), acoustic releases, seafloor/water column navigational/tracking acoustics for ROVs, AUVs, etc.*	AUVs, UTPs, USBLs, ADCPs, acoustic releases, ROVs, and similar technology	not applicable

5.2 Vessel Interactions

5.2.1 Vessel Trips: Summarized

BOEM (2024) describes vessel use based on 10-hour and 24-hour days, with more vessel trips estimated as needed if trips are 10-hours. Here we used the maximum number of trips estimated in BOEM (2024), regardless of duration, so that a vessel trip represents one vessel moving in the Action Area for up to 24 hours.

Over a 5-year period per lease issued, we estimated up to 102 vessel trips for site assessment activities (Table 1), 340 for geophysical and geotechnical site characterization (Table 4), and 540 for biological surveys (Table 5), for a total of 982 vessel trips (Table 9). For two leases, this yields a total estimate of 1,964 vessel trips over the 5-year period of site assessment and site characterization. In terms of a daily average of vessels trips for these activities, this upper limit would average to 1.1 trips daily for 5 years ([1,964trips/5yrs÷(5yrs*365days) = 1.1 vessel trips per day]). Thus, about 2,000 vessel trips in a 5-year period, or an average 1.1 vessel trips per day for a 5-year period of activities, provide upper limits for assessing collision risks due to the Proposed Action in the context other vessel traffic (Figure 3).

Within the Action Area, all **vessels associated with the leases will be required to travel at 10 knots or less** for all activities (transiting, surveys, etc.; PDC 4).

Table 9. Summary of vessel trips estimated for a 5-year period following lease issuance (Total Trips are based on issuance of 2 leases).

Vessel Activity	Table for Details	Trips Per Lease	Total Trips
Site Assessment: Buoys	Table 1 in Section 2.5	102	204
HRG Surveys and Geotech	Table 4 in section 3.3	340	380
Biological Surveys	Table 5 in section 3.4	540	1,080
Total	**see rows above**	**982**	**1,964**

5.2.2 Vessel Strikes of Marine Mammals and Sea Turtles

Vessels strikes pose a threat to marine mammals and sea turtles. Most vessel strikes of marine mammals reported involve commercial vessels and occur over or near the continental shelf (Laist et al. 2001). Because commercial vessel operators are not required to report whale strikes, reporting rates are unknown and likely to be much lower than actual occurrences. Additionally, although the public is prohibited from harassing, harming, pursuing, wounding, killing, capturing, or collecting marine species protected by the ESA and MMPA, there are no national requirements for commercial vessels to mitigate for vessel strikes with protected species other than NOAA's Marine Life Viewing Guidelines (https://www.fisheries.noaa.gov/topic/marine-life-viewing-guidelines) and federal law that requires vessels to remain 100 yards away from humpback whales in Hawaii and Alaska waters, 200 yards from killer whales in Washington State inland waters, and 500 yards away from North Atlantic right whales anywhere in U.S. waters.

Vessel traffic within the U.S. West Coast EEZ poses ship strike threats to all large whale populations (Redfern et al. 2013; Moore et al. 2018). While vessel strikes can happen anywhere that vessels and whales co-occur, vessel strikes occur mainly in shipping lanes. Rockwood et al. (2017) found that 74% of blue whale, 82% of humpback whale, and 65% of fin whale known vessel strike mortalities of the U.S. West Coast occurred in shipping lanes associated with the ports of San Francisco and Los Angeles/Long Beach.

Of leatherback strandings documented in central California between 1981 and 2016, 11 strandings (7.3% of total) were determined to be the result of vessel strikes (NMFS unpublished data).

5.2.3 Vessel features: Moon pools

Moon pool usage presents a potential for marine mammals and sea turtles to become entrapped. Moon pools may be used offshore Oregon to deploy and/or retrieve equipment (e.g., ROVs, AUVs). Moon pools have been used for decades off the west coast and there is no known record of entrapment of protected species in the moon pools in the Pacific. MBARI regularly uses moon pools in launching ROVs and other instruments as it is safer for their staff and equipment. MBARI researchers and monitors have never had an animal trapped in their moon pool (MBARI staff, pers. comm.). With the limited occurrence of sea turtles in Oregon waters, as well as BOEM's BMPs described in Appendix A, there is a low probability of animals intersecting with moon pools.

5.3 Habitat Alteration

Disturbance to seafloor sediments may occur during geotechnical investigations, biological grab sampling, anchoring, and mooring buoys. As described in PDC 1 in A.1 of Appendix A, **all benthic areas will be cleared (i.e., appropriate seafloor data reviewed) before any bottom contact to ensure no sensitive or hard bottom habitats (e.g., Figure 4) are disturbed.** Section 11.5.2 in the EFH Assessment provides an estimated footprint for potential disturbance to soft sediments.

Collection of samples causes disturbance as sediment moves to fill the hole left by the removed core or grab, possibly exposing animals in the surrounding sediment to predators (Skilleter 1996). Sampling may also disrupt microbial assemblages in the sediments and breakdown biotic structures which help bind sediments (e.g., microbial mats). The distribution of these samples will occur throughout the leases, but the total spatial extent of sampling will be a small percentage compared to the overall area.

Disturbance may cause sediments and benthic organic material to be introduced into the water column and increase local turbidity levels. As a result, fish may be exposed to contaminants, change their feeding rates, become less able to avoid predators, and temporarily move away from disturbed areas. (Wilber and Clarke 2001; Utne-Palm 2002; Au et al. 2004). Sediment suspension and increased turbidity may smother fish feeding and respiratory organs and harm prey species on which the fishes depend (Airoldi 2003).

Biological response to these potential impacts is often a function of concentration and exposure duration (Newcombe and Jensen 1996). The proposed activities from the project are predicted to generate only minimal and short-term impacts to benthic habitats and cause a negligible increase in suspended materials over a short time frame. Therefore, proposed activities associated will have minimal adverse effects to EFH.

Indirect effects from buoy emplacement may preserve habitat integrity, as fishers may avoid these areas until buoys are decommissioned. The damage from bottom-contact gear would then be displaced to outside of the lease area.

5.4 Entanglement in ROV Cables and Metocean Buoy Moorings

Most entanglements are never observed, but those that are include many cases of entangled whales with unidentified gear (IWC 2016). There are reports of large whales (including humpback, right, and fin whales) interacting with anchor moorings of yachts and other vessels, towing small yachts from their moorings or becoming entangled in anchor chains, sometimes with lethal consequences (Richards 2012; Love 2013; Saez et al. 2021). Animals may swim into moorings accidentally or actively seek out anchor chains or boats as a surface to scratch against(Benjamins et al. 2014)

A total of 511 whale entanglements, 429 confirmed, along the U.S. West Coast have been reported from 1982-2017. The annual average of total entanglement reports received by NMFS for the same period was 14, with an average of 12 confirmed entanglement reports per year (Saez et al. 2021). There are no recorded events in the literature of ESA-listed species becoming entangled in ROV cables. The following gear types have been identified as involved in the entanglement of large whales off the U.S. West Coast between 1982 and 2017: netting, commercial and recreational fishing pots/traps, salmon troll line, steel cables, and one weather buoy (in 2014). Since 2000 (289 confirmed reports), pot/trap gear has become the most commonly identified gear type associated with entanglement reports (32 %).

Sea turtles have been documented to be entangled in a large variety of man-made items (Duncan et al. 2017; NMFS and USFWS 2008; Dodge et al. 2022). Sea turtle entanglements are an underestimate as not all entanglements are reported. In waters off the Northeast United States, the primary species entangled is the leatherback sea turtle, but loggerhead and green sea turtle entanglements also occur. Since the Sea Turtle Disentanglement Network was formed in 2002 and through 2014, there have been 275 entanglements in vertical lines (NMFS 2015). Turtles are usually entangled around the neck and/or front flippers. Sightings of leatherback sea turtles in the eastern North Pacific are most frequently encountered off the coast of central California (Benson et al. 2007). This species faces significant threats from bycatch in fisheries (entanglement and/or hooking) (Benson et al. 2020; Dodge et al. 2022). A leatherback was found dead, entangled in a 3/8” galvanized boat mooring chain, offshore Massachusetts (Dodge et al. 2022).

5.5 Accidental Release of Pollutants and Marine Debris

PDC 2 covers the release of marine debris.

Oil and other chemical spills are a specific type of ocean contamination that can have damaging effects on some marine mammal species directly through exposure to oil or chemicals and indirectly due to pollutants' impacts on prey and habitat quality (Engelhardt 1983; MMC 2010; Matkin et al. 2008). In the five-year period from 2013–2017 along the Pacific coast, there were 127 pinnipeds found stranded with a serious injury or mortality caused by oil or tar coating their body (Carretta et al. 2019a).

On a broader scale, ocean contamination from chemical pollutants introduced by industrial, urban, and agricultural use is also a concern for marine mammal conservation (Cossaboon et al. 2019; Desforges et al. 2016; Fair et al. 2010; Krahn et al. 2007; 2009; Moon et al. 2010; Ocean Alliance 2010). For example, the chemical components of pesticides used on land flow as runoff into the marine environment and can accumulate in the bodies of marine mammals and be transferred to their young through mother's milk (Fair et al. 2010).

The presence of these chemicals in marine mammals may put animals at risk for adverse health effects and reduced reproductive success, given toxicology studies and results from laboratory animals (Fair et al. 2010; Goddard-Codding et al. 2011; Krahn et al. 2007; 2009; Peterson et al. 2014; 2015). Desforges et al. (2016) suggested that exposure to chemical pollutants may act in an additive or synergistic manner with other stressors, resulting in significant population-level consequences. Although the general trend has been a decrease in chemical pollutants in the environment following their regulation, chemical pollutants remain important given their potential to impact marine mammals (Bonito et al. 2016; Jepson and Law 2016; Law et al. 2014).

Potential sources of chemical pollution related to the Proposed Action are from allisions with the metocean buoy and/or a spill during fuel transfer to the back-up diesel generator on the metocean buoy. Fuel transfer is unlikely given the buoys are powered by solar panels and diesel generators are for back-up power.

Most marine debris is thought to come from land-based sources, though ocean-based debris can be significant in some areas (e.g., Sheavly 2007; Jang et al. 2014). Ocean-based litter is generated by the intentional or unintentional discharge of debris directly into the ocean. Marine activities that generate ocean-based litter include commercial shipping, recreational and commercial fishing, aquaculture, research and military endeavors, and offshore drilling (Galgani et al. 2015; UN Environment & GRID-Arendal 2016). Most marine debris is made up of various forms of plastic that are highly persistent and often contain toxic chemicals or acquire them from the surrounding seawater. The fragmentation of plastics produces large numbers of microplastic particles that are easily taken up by a wide range of marine organisms (SCBD 2016).

Ocean litter has detrimental ecological, economic, and social impacts. Marine species, including seals, sea birds, sea turtles, whales, and dolphins can become entangled in debris, resulting in hindered movement, decreased feeding ability, injury, and death (Kühn et al. 2015; NOAA MDP 2014). Fish, crustaceans, shellfish, and zooplankton ingest microplastics, and some of these organisms consume less food and have decreased energy for growth as a result (Boerger et al. 2010; Browne et al. 2008; Cole et al. 2013; Murray and Cowie 2011; Watts et al. 2015). Furthermore, microplastics adsorb organic contaminants and trace metals from their surrounding environments (Holmes et al. 2012; Rochman et al. 2013).

There is a clear increase in the number of species, particularly marine mammals, known to be affected with 40% of the taxa known to ingest marine debris, mainly attributable to a review of the impacts of marine debris on cetaceans (Baulch and Perry 2014). The number of marine fish and seabirds affected by ingestion or entanglement has also risen. New records for plastic ingestion by fish have been reported in a range of habitats, including open ocean, deep-water and temperate pelagic and demersal (See Appendix 1a in Secretariat SCBD 2016).

6 BA: Marine Mammals and Sea Turtles—Species and Descriptions

6.1 List of Marine Mammals

Approximately 30species of marine mammal species occur in the Action Area: 8 baleen whale species, over 15 toothed whale and dolphin species, and 6 species of seals and sea lions (Table 10). Sea otters (*Enhydra lutris*) are also in the Action Area but fall under the jurisdiction of the U.S. Fish and Wildlife Service (USFWS). Although beaked whales are rarely sighted in the region, advances in acoustic monitoring have improved species detection and identification, using echolocation pulse features (McDonald et al. 2009; Zimmer et al. 2008). Recent studies have detected some beaked whale species in and around the Action Area (Simonis et al. 2020).

Detailed species descriptions, including state, habitat ranges, population trends, predator/ prey interactions, and species-specific threats are in Argonne (2019), H.T. Harvey and Associates (2020), US Navy (2022), and summarized below.

Table 10. Marine mammal species (MMPA stock or DPS) that may occur in the Action Area, ESA and MMPA status, occurrence (or seasonality), and critical habitat designation. Bolded species are ESA-listed or have critical habitat designation that overlaps the Action Area.

Common Name	Scientific Name	Stock (MMPA)/DPS	ESA/MMPA Status	Occurrence	Citations for ESA listing	Critical Habitat
Baleen Whales						
Blue whale	***Balaenoptera musculus***	Eastern North Pacific	**Endangered/ Depleted**	Late summer and fall	35 FR 18319; December 2, 1970. 2020 Recovery plan	N/A
Fin whale	***Balaenoptera physalus***	California, Oregon, and Washington	**Endangered/ Depleted**	Year round	35 FR 8491; June 2, 1970. 2010 Recovery plan	N/A
Bryde's whale	*Balaenoptera edeni*	Eastern Tropical Pacific	N/A	Occasional	N/A	N/A
Sei whale	***Balaenoptera borealis***	Eastern North Pacific	**Endangered/ Depleted**	Uncommon	35 FR 12024; December 2, 1970. 2011 Recovery plan	N/A
Minke whale	*Balaenoptera acutorostrata*	California, Oregon, and Washington	N/A	Occasional	N/A	N/A

Common Name	Scientific Name	Stock (MMPA)/DPS	ESA/MMPA Status	Occurrence	Citations for ESA listing	Critical Habitat
Humpback whale	***Megaptera novaeangliae***	Central America DPS	**Endangered/ Depleted**	Spring to fall	81 FR 62260; September 8, 2016. 1991 Recovery plan	**86 FR 21082, April 21, 2021**
Humpback whale	***Megaptera novaeangliae***	Mexico DPS	**Threatened/ Depleted**	Spring to fall	81 FR 62260; September 8, 2016. 1991 Recovery plan	**86 FR 21082, April 21, 2021**
Gray Whale	*Eschrichtius robustus*	Eastern North Pacific DPS	N/A	Oct-Jan and March-May	N/A	N/A
Gray Whale	***Eschrichtius robustus***	Western North Pacific DPS	**Endangered/ Depleted**	Unclear	59 FR 31094, June 16, 1994	N/A
North Pacific right whale	***Eubalaena japonica***	Eastern North Pacific	**Endangered/ Depleted**	Uncommon	73 FR 12024; April 7, 2008. 2013 Recovery plan	**73 FR 9000**
Toothed and Beaked Whales						
Sperm whale	***Physeter macrocephalus***	California, Oregon, and Washington	**Endangered/ Depleted**	Year round	35 FR 18319; December 2, 1970. 2010 Recovery plan	N/A
Killer whale	*Orcinus orca*	Eastern North Pacific Offshore	N/A	Sporadic	N/A	N/A
Killer whale	***Orcinus orca***	Eastern North Pacific Southern Resident	**Endangered/ Depleted**	April-Oct; limited sightings	79 FR 20802; April 14, 2014. 2008 Recovery plan	**86 FR 14668, August 2, 2021**
Dwarf sperm whale	*Kogia sima*	California, Oregon, and Washington	N/A	Uncommon	N/A	N/A
Pygmy sperm whale	*Kogia breviceps*	California, Oregon, and Washington	N/A	Uncommon	N/A	N/A

Common Name	Scientific Name	Stock (MMPA)/DPS	ESA/MMPA Status	Occurrence	Citations for ESA listing	Critical Habitat
Baird's beaked whale	*Berardius bairdii*	California, Oregon, and Washington	N/A	Summer/Fall	N/A	N/A
Cuvier's beaked whale	*Ziphius cavirostris*	California, Oregon, and Washington	N/A	Uncommon	N/A	N/A
Mesoplodont beaked whales	*Mesoplodon spp.*	California, Oregon, and Washington	N/A	Uncommon	N/A	N/A
Risso's dolphin	*Grampus griseus*	California, Oregon, and Washington	N/A	Year round	N/A	N/A
Northern right whale dolphin	*Lissodelphis borealis*	California, Oregon, and Washington	N/A	Year round	N/A	N/A
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	California, Oregon, and Washington	N/A	Year round	N/A	N/A
Bottlenose dolphin	*Tursiops truncatus*	CA coastal	N/A	Year round	N/A	N/A
Common bottlenose dolphin	*Tursiops truncatus truncatus*	CA/OR/WA offshore stock	N/A	Year round	N/A	N/A
Short-beaked common dolphin	*Delphinus delphis*	California, Oregon, and Washington	N/A	Year round	N/A	N/A
Long-beaked common dolphin	*Delphinus delphis bairdii*	California	N/A	Year round	N/A	N/A
Dall's porpoise	*Phocoenoides dalli*	California, Oregon, and Washington	N/A	Year round	N/A	N/A
Harbor porpoise	*Phocoena phocoena*	Northern Oregon/Washington Coast Stock	N/A	Year round	N/A	N/A
Harbor porpoise	*Phocoena phocoena*	Northern CA-Southern OR stock	N/A	Inshore year round	N/A	N/A
Sea Lions and Seals						
Steller sea lion	***Eumetopias jubatus***	Eastern DPS	Delisted (**critical habitat still in effect**)	Year round	N/A	**59 FR 0715;** https://www.fisheries.noaa.gov/action/designation-critical-habitat-steller-sea-lions
California sea lion	*Zalophus californianus*	U.S. Stock	N/A	Year round	N/A	N/A

Common Name	Scientific Name	Stock (MMPA)/DPS	ESA/MMPA Status	Occurrence	Citations for ESA listing	Critical Habitat
Northern fur seal	*Callorhinus ursinus*	California	N/A	Year round	N/A	N/A
Northern elephant seal	*Mirounga angustirostris*	California	N/A	Year round	N/A	N/A
Harbor seal	*Phoca vitulina richardsi*	California	N/A	Year round	N/A	N/A
Harbor seal	*Phoca vitulina richardii*	OR/WA Coast Stock	N/A	Year round	N/A	N/A
Guadalupe fur seal	***Arctocephalus townsendi***	Throughout its range	**Threatened/ Depleted**	Spring/ Summer, seasonal low numbers	N/A	N/A

6.2 List of Sea Turtles

Four ESA-listed species of sea turtles may occur in waters offshore Oregon (Table 11). Two of these are federally endangered and likely to occur in the Action Area: the leatherback sea turtle (*Dermochelys coriaceaI*) and loggerhead sea turtle (*Caretta caretta*; North Pacific Ocean Distinct Population Segment [DPS]). No known nesting habitat for sea turtles occurs in the Action Area. The green sea turtle (East Pacific DPS) is listed as threatened and occurs year-round in coastal southern California, but individuals rarely travel north of California, due to colder water temperatures (NMFS 2016c; Van Houtan et al. 2015). Similar to green sea turtles, olive ridley sea turtles (*Lepidochelys olivacea*) are unlikely to travel as far north as the Action Area.

Table 11. Sea turtle species that may occur in the Action Area, their ESA status, occurrence (or seasonality), and critical habitat (CH) designation. The proposed green sea turtle CH (not bolded) does not overlap the Action Area.

Common Name	Scientific Name	DPS	ESA Status	Occurrence	Citations for ESA listing	Critical Habitat
Leatherback sea turtle	***Dermochelys coriacea***	Throughout range	**Endangered**	June-Nov; limited sightings (gillnet restriction through Nov. 15th in central CA/southern OR).	35 FR 8491; June 3, 1970. 1998 Recovery plan	**77 FR 4169, January 26, 2012**
Loggerhead sea turtle	***Caretta caretta***	North Pacific Ocean DPS	**Endangered**	Uncommon	76 FR 58868; October 24, 2011. 1997 Recovery plan	N/A
Green sea turtle	***Chelonia mydas***	East Pacific DPS	**Threatened**	Extralimital	81 FR 20057; May 6, 2016. Recovery plan	Proposed 88 FR 46572, July 19, 2023
Olive ridley sea turtle	***Lepidochelys olivacea***	Mexico's Pacific coast breeding population	**Endangered**	Extralimital	43 FR 32800; August 27, 1978. 1998 Recovery plan	N/A
Olive ridley sea turtle	***Lepidochelys olivacea***	All other populations	**Threatened**	Extralimital	43 FR 32800; August 27, 1978. 1998 Recovery plan	N/A

6.3 Maps of Biologically Important Areas and Critical Habitat

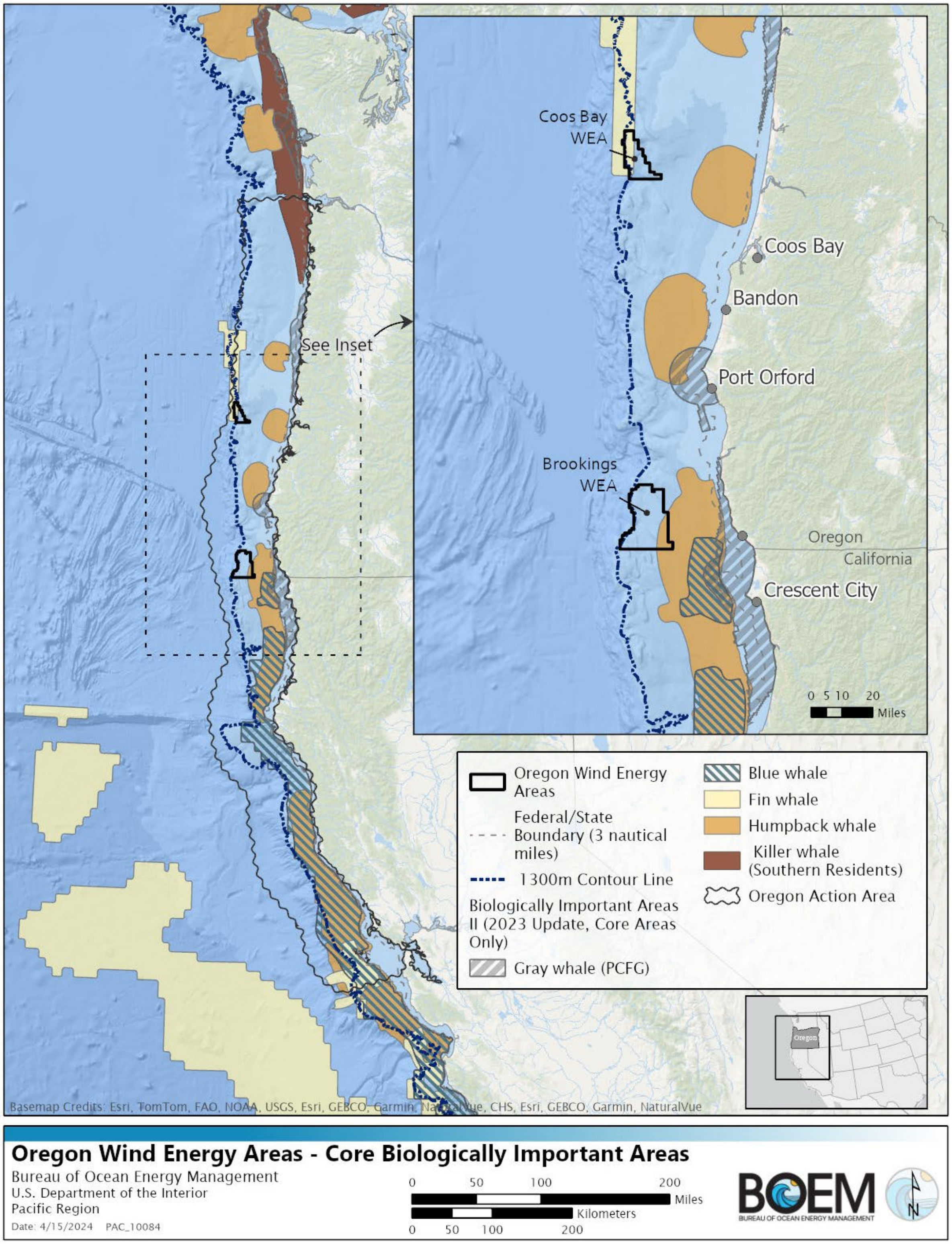

Figure 6. Core biologically important areas (BIAs) for four species of baleen whales and for killer whales (Calambokidis et al. 2024) relative to the Action Area and Coos Bay and Brookings WEAs.

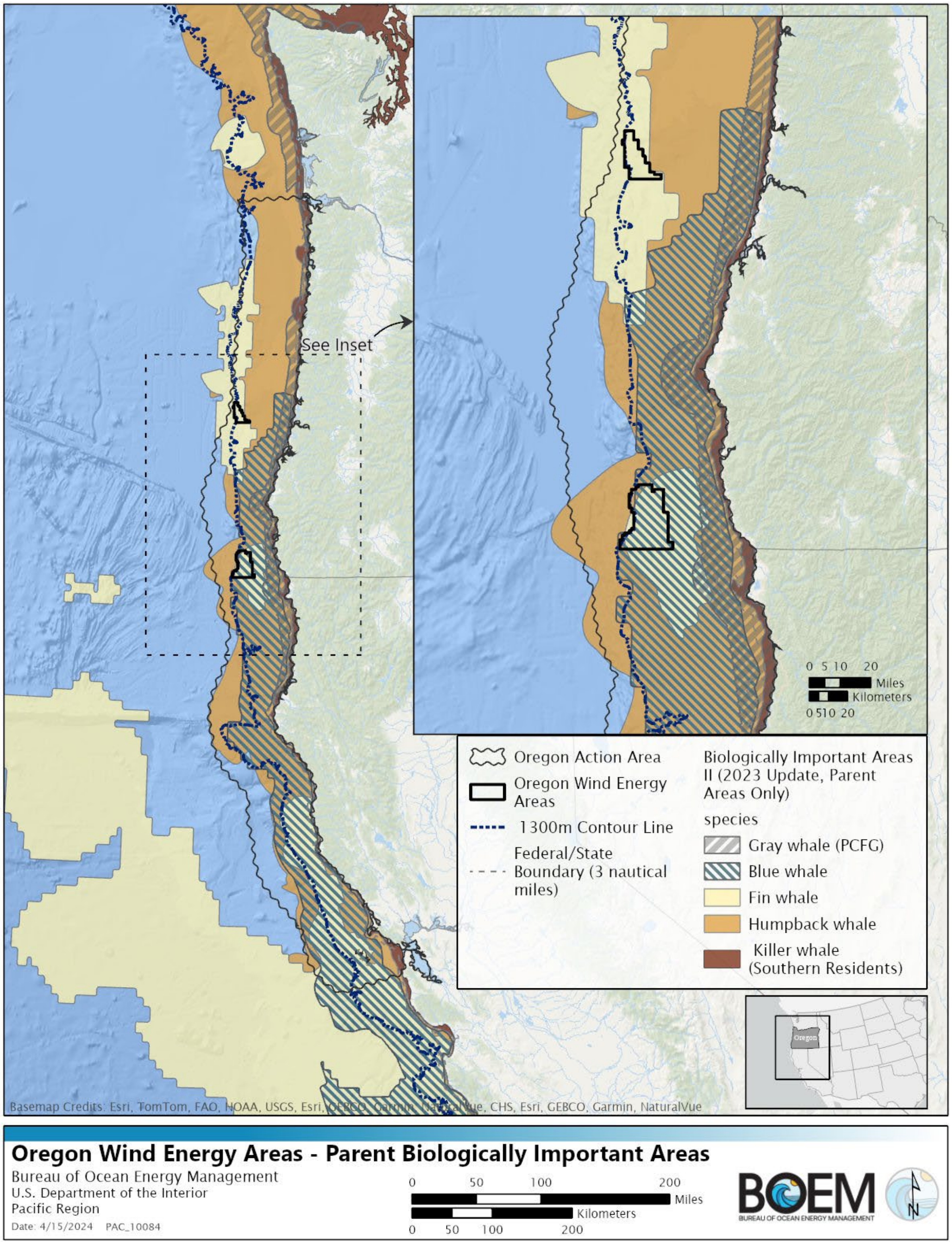

Figure 7. Parent biologically important areas (BIAs) for four species of baleen whales and for killer whales (Calambokidis et al. 2024) relative to the Action Area and Coos Bay and Brookings WEAs.

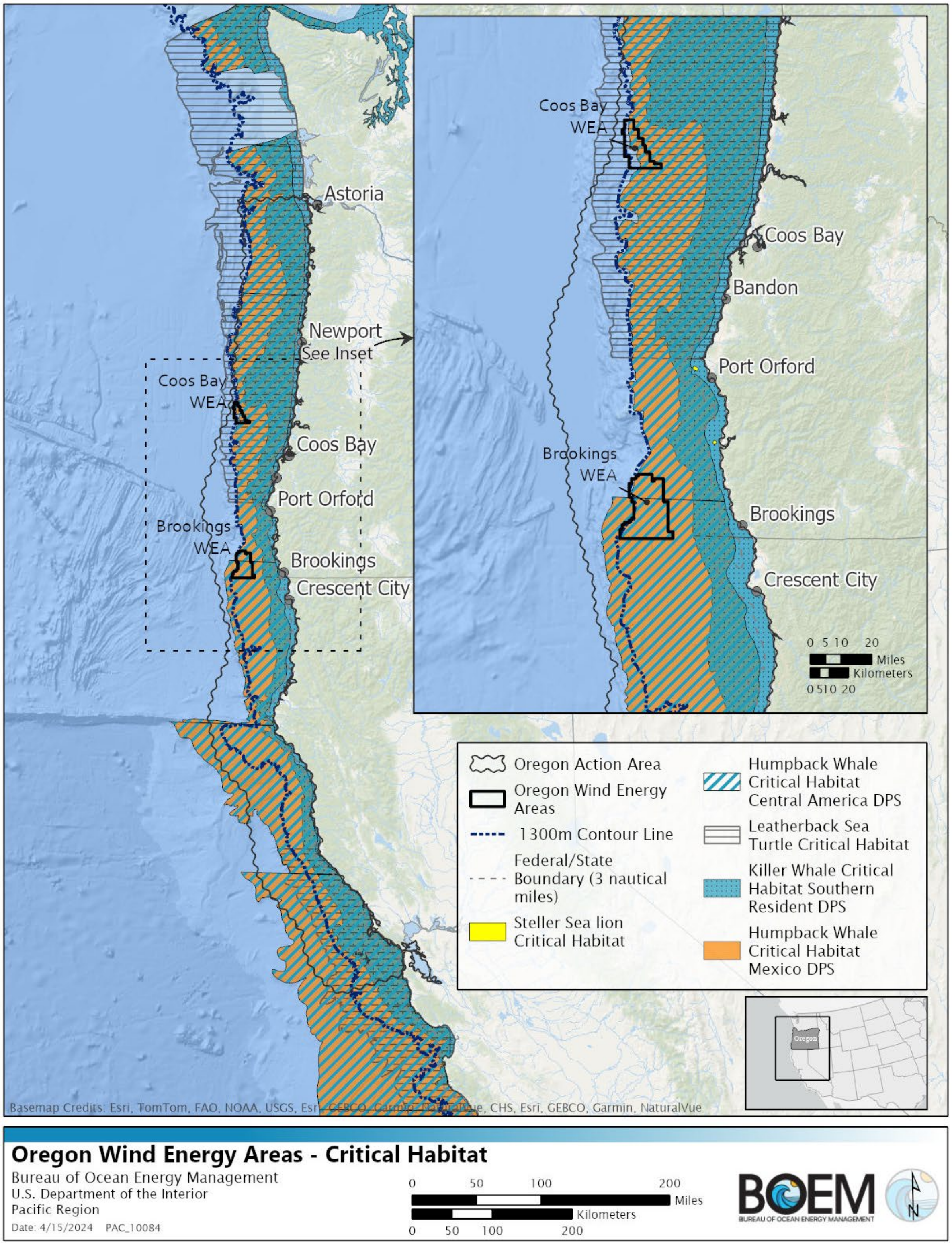

Figure 8. Critical habitat for the leatherback sea turtle, Steller sea lion, humpback whale, and south resident killer whale (Calambokidis et al. 2024; Carlton et al. 2024; Carretta et al. 2023) relative to the Action Area and WEAs.

6.4 Marine Mammals Likely to Occur in the Action Area

6.4.1 Blue whale (*Balaenoptera musculus*)

Blue whale populations were greatly reduced by commercial whaling in the early 1900s, and the species was federally listed as endangered in 1970 (35 FR 18319). Two blue whale stocks are recognized in the North Pacific Ocean; one is the Eastern North Pacific Stock (ENP) and the other is in the Central North Pacific Stock (CNP) (Carretta et al. 2020). Existing data shows that the eastern North Pacific blue whales range from the Costa Rica Dome to the Gulf of Alaska (Bailey et al. 2009; Calambokidis et al. 2009)

The seasonal migration of the ENP population has been confirmed by long-term acoustic monitoring (Burtenshaw et al. 2004) and by movements of photo-identified individuals between southern California and the Gulf of Alaska (Calambokidis 2009). Blue whales travel northward as summer progresses in response to northward progressing spring transition, and subsequent increases in primary productivity (Burtenshaw et al. 2004; Calambokidis 2009). Blue whale BIAs are described in Calambokidis et al. 2015 and updated in Calambokidis et al. 2024. Based on these updates, blue whale feeding parent BIAs overlap with the Brookings Wind Energy Area, but not the Coos Bay Wind Energy Area (Figure 7; Carlton et al. 2024, Fig. 3.45; Calambokidis et al. 2024, Figure 2 BC). Both the blue whale feeding core and parent BIAs overlap with the Action Area (Figure 6, Figure 7). Blue whales identified in the area off northern California are re-sighted most frequently off Point St. George (Calambokidis et al. 2004; Calambokidis 2007). They are most commonly sighted along the continental shelf break but also occur farther inshore, in transit or feeding on surface swarms of krill. Satellite-tagged blue whales provided information on “core areas of use”, indicating a high area of overlap for individuals at the western part of the Channel Islands, and near the Gulf of the Farallones, and the northern part of Cape Mendocino (Irvine et al. 2014). Irvine et al. (2014) found that although the satellite tracks were widely distributed, these whales tended to occupy the area off northern California during the latter part of the feeding season in late October–November. Based on a series of aerial and summer/fall shipboard surveys off CA, OR and WA from 1991–2018 sightings blue whale sightings in inshore and offshore waters off California in summer and fall (Becker et al. 2020).

The Eastern North Pacific population may have recently recovered from commercial whaling, which ended in 1971, despite the impacts of ship strikes, interactions with fishing gear, and increased levels of ambient sound in the Pacific Ocean (Barlow 1997, 2003, 2016; Calambokidis and Barlow 2013; Campbell et al. 2015; Carretta et al. 2020; International Whaling Commission 2016; Monnahan et al. 2015; Rockwood et al. 2017; Širović et al. 2015; Valdivia et al. 2019). The population appears near carrying capacity, and thus the rate of change of the population size has declined (Carretta et al. 2020; International Whaling Commission 2016; Monnahan et al. 2015). Based on NMFS systematic ship surveys from 1991 to 2014, the number of blue whales in the area (the combined Oregon/Washington stratum and the Northern California stratum) is estimated at 1,496 whales (Barlow 2016). The annual entanglement rate of blue whales (observed) during 2013-2017 is the sum of observed annual entanglements (1.35/yr), plus species probability assignments from unidentified whales (0.09/yr), totaling 1.44 blue whales annually (Carretta et al. 2020). Most observed blue whale ship strikes have been in southern California or off San Francisco, where the seasonal distribution of blue whales is in close proximity to shipping ports (Berman-Kowalewski et al. 2010). Using the moderate level of avoidance model from Rockwood et al. (2017), estimated ship strike deaths of blue whales are 18 annually. A comparison of average annual ship strikes observed over the period 2013-2017 (0.4/yr) versus estimated ship strikes (18/yr) indicates that the rate of detection for blue whale vessel strikes is approximately 2%. The observed and assigned annual incidental mortality and injury rate from ship strikes (0.4/yr) and commercial fisheries (≥ 1.44 /yr), totals 1.84 whales annually from 2013-2017. This exceeds the calculated potential biological removal of 1.23 for this stock of blue whales (Carretta et al. 2020).

No critical habitat is designated for blue whales in the North Pacific.

6.4.2 Fin whale (*Balaenoptera physalus*)

Fin whales prefer temperate and polar waters (Jefferson et al. 2015; Reeves et al. 2002). This species has been documented from 60° N in Alaska waters to tropical waters off Hawaii, in Canadian waters both offshore and inland including some fjords, and they have frequently been recorded in waters within the Southern California Bight (Campbell et al. 2015; Jefferson et al. 2014; Mate et al. 2016; 2017; Širović et al. 2016). As demonstrated by satellite tags and discovery tags, fin whales make long-range movements along the entire U.S. West Coast (Falcone et al. 2011; Mate et al. 2015b; 2016; 2017; 2018; Mate et al. 2009). Locations of breeding and calving grounds are largely unknown. The species is highly adaptable, following prey, typically off the continental shelf (Azzellino et al. 2008; Panigada et al. 2008). Survey and acoustic data indicate that fin whale distributions shift both seasonally as well as annually (Burnham et al. 2019; Calambokidis et al. 2015; Douglas et al. 2014; Jefferson et al. 2014).

During aerial surveys conducted within the 2,000 m isobath off southern Washington, Oregon, and Northern California in the spring, summer, and fall of 2011 and 2012, there were six sightings of 13 fin whales during winter and summer 2012 only in offshore waters over the continental slope (Adams et al. 2014). Sightings from systematic ship surveys out to 300 nmi off the U.S. West Coast and satellite tag data, habitat-based density models built with these data indicate that fin whales are more likely to be present seaward of the continental shelf in the offshore portion of the Action Area in late June to early December (Becker et al. 2020a). Because fin whale abundance appears lower in winter/spring in California (Dohl et al. 1983; Forney et al. 1995) and in Oregon (Green et al. 1992), it is likely that the distribution of this stock extends seasonally outside these coastal waters.

The fin whale is listed as endangered under the ESA, but there is no designated critical habitat for this species. Fin whale population structure in the Pacific Ocean is not well known. During the 20th century, more fin whales were taken by industrialized whaling than any other species (Rocha et al. 2014). NMFS recognizes three fin whale stocks: (1) the Northeast Pacific stock (Alaska); (2) the California, Oregon, and Washington stock, and (3) the Hawaii stock, all stocks are considered depleted under the MMPA and endangered under the ESA (Carretta et al. 2020). Analysis of genetic and acoustic data suggests that fin whales in the North Pacific interbreed and are a single population (Archer et al. 2019).

There has been a roughly 5-fold abundance increase between 1991 and 2014due largely to increases off northern California, Oregon, and Washington since 2005, while numbers off Central and Southern California have been stable (Nadeem et al. 2016). The best estimate of fin whale abundance in California, Oregon, and Washington waters out to 300 nmi is 9,029 (CV = 0.12) whales, based on a trend analysis of 1991-2014 line-transect data (Nadeem et al. 2016)

Total mean annual fishery-related serious injury and mortality was 0.67 fin whales during 2014-2018 (Carretta et al. 2020). Average observed annual mortality and serious injury due to ship strikes was 1.6 fin whales per year during 2014-2018. Documented ship strike deaths and serious injuries are derived from direct counts of whale carcasses and represent minimum impacts (Carretta et al. 2020). The most conservative estimate of ship strike deaths from Rockwood et al. (2017) is 43 whales annually. The ratio of documented ship strike deaths (1.8/yr) to estimated annual deaths (43) implies a carcass recovery/documentation rate of 4.1%. There is uncertainty regarding the estimated number of ship strike deaths, however, it is apparent that carcass recovery rates of fin whales are quite low.

Although no fin whale entanglements were observed 1990-2016 (Carretta et al. 2018a), some gillnet mortality may go unobserved, because whales swim away with a portion of the net (Carretta et al. 2020).

BIAs for fin whales, including parent and core areas (Figure 6, Figure 7), were recently delineated due to the availability of additional data (Calambokidis et al. 2024, Figure 6; Carlton et al. 2024, Fig. 3.44). Both the fin whale parent and core feeding BIAs overlap with the Coos Bay WEA and the fin whale parent feeding BIA overlaps with the Brookings WEA. Both the fin whale parent and core feeding BIAs overlap with the Action Area (Figure 6, Figure 7).

6.4.3 Sei whale (*Balaenoptera borealis*)

Sei whales have a worldwide distribution and are found primarily in cold temperate to subpolar latitudes across the North Pacific where there is steep bathymetric relief, such as the continental shelf break, canyons, or basins between banks and ledges (Best and Lockyer 2002; Burnham et al. 2019; Gregr and Trites 2001; Horwood 1987; Horwood 2009). Sei whales are migratory, spending the summer months feeding in the subpolar higher latitudes and returning to the lower latitudes to calve in the winter (Rone et al. 2017; Smultea 2014; Fulling et al. 2011; Olsen et al. 2009). In the winter in the Pacific, sei whales have been detected as far south as the Mariana Islands, Hawaii, and Southern California (Fulling et al. 2011; Smultea 2014). Analysis of sei whale genetic samples from around the Pacific suggests a single stock present in the Pacific (Baker et al. 2006; Huijser et al. 2018). For the MMPA stock assessment reports, sei whales within the Pacific U.S. EEZ are divided into two discrete areas: (1) California, Oregon and Washington waters and (2) waters around Hawaii. The Eastern North Pacific stock includes animals found within the U.S. west coast EEZ and in adjacent high seas waters; however, because comprehensive data on abundance, distribution, and human-caused impacts are lacking for high seas regions, the status of this stock is evaluated based on data from U.S. EEZ waters of the California Current (NMFS 2005).

Sei whales are rare in the California Current (Dohl et al. 1983; Barlow 2016; Forney et al. 1995; Green et al. 1992) but were the fourth most common whale taken by California coastal whalers in the 1950s-1960s (Rice 1974). Shipboard surveys off California, Oregon, and Washington from 1991-2014 sighted approximately 17 sei whales from 35° N to 45° N (Barlow 2016).

The sei whale is listed as an endangered under the ESA, but there is no designated critical habitat for this species (Carretta et al. 2020). A single Eastern North Pacific stock is recognized in the U.S. EEZ and that stock is considered depleted under the MMPA (Carretta et al. 2020). No data on trends in sei whale abundance exist for the eastern North Pacific. Although the population in the North Pacific is expected to have grown since being given protected status in 1976, the possible effects of continued unauthorized takes (Yablokov 1994), vessel strikes and gillnet mortality make this uncertain. Barlow (2016) noted that an increase in sei whale abundance observed in 2014 in the California Current is partly due to recovery of the population from commercial whaling but may also involve distributional shifts in the population. The best estimate of abundance for California, Oregon, and Washington waters is the unweighted geometric mean of the 2008 and 2014 estimates, or 519 (CV = 0.40) sei whales (Barlow 2016).

The California swordfish drift gillnet fishery is the most likely U.S. fishery to interact with sei whales from this stock, but no entanglements have been observed from 8,845 monitored fishing sets from 1990-2016 (Carretta et al. 2018a). The average observed annual mortality due to ship strikes is 0.2 sei whales per year for the period 2012-2016. Additional ship strike mortality probably goes unreported, because the whales may not have stranded or had obvious signs of trauma (Carretta et al. 2018a). Increasing levels of anthropogenic sound in the world's oceans is a habitat concern for whales, particularly for baleen whales that may communicate using low-frequency sound (Croll et al. 2002).

6.4.4 Humpback whale (*Megaptera novaeangliae*)

Humpback whales occur throughout the North Pacific, with multiple populations recognized based on low latitude winter breeding areas (Calambokidis et al. 2001; 2008, Barlow et al. 2011). Exchange of animals between breeding areas occurs rarely, based on photo-identification data of individual whales (Calambokidis et al. 2001; 2008). Photo-identification evidence also suggests strong site fidelity to feeding areas, but animals from multiple feeding areas converge on common winter breeding areas (Calambokidis et al. 2008).

Along the U.S. West Coast, NMFS currently recognizes one humpback whale stock that includes two separate feeding groups: (1) a California and Oregon feeding group of whales that includes whales from the endangered Central American and threatened Mexican DPSs defined under the ESA (NOAA 2016a), and (2) a northern Washington and southern British Columbia feeding group that primarily includes whales from the threatened Mexican DPS, but also small numbers of whales from the unlisted Hawaii and endangered Central American DPSs (Calambokidis et al. 2008, Barlow et al. 2011, Wade et al. 2016, Wade 2017; 2021). Very few photographic matches between these feeding groups are documented (Calambokidis et al. 2008).

Both core and parent BIAs for humpback whale feeding areas were identified off the U.S. west coast by Calambokidis et al. (2015) and updated by Calmbokidis et al. (2024). The Brookings WEA overlaps with the humpback parent and core BIA feeding areas and the Coos Bay WEA overlaps with the parent feeding BIA for fin whales (Carlton et al. 2024, Fig. 3.46) and both the core and parent humpback whale feeding BIAs overlap with the Action Area (Figure 6, Figure 7). Effective May 21, 2021, NMFS issued an updated final rule to designate critical habitat for the endangered Central America DPS, and the threatened Mexico DPS of humpback whales (*Megaptera novaeangliae*) (86 FR 21082). Critical habitat for these DPSs serve as feeding habitat and contain the essential biological feature of humpback whale prey. Critical habitat for the Central America DPS of humpback whales contains approximately 48,521 nmi^2 of marine habitat in the North Pacific Ocean within the portions of the California Current Ecosystem off the coasts of Washington, Oregon, and California. Specific areas designated as critical habitat for the Mexico DPS of humpback whales contain approximately 116,098 nmi^2 of marine habitat in the North Pacific Ocean, including areas within portions of the eastern Bering Sea, Gulf of Alaska, and California Current Ecosystem.

For the MMPA stock assessment reports, the California/Oregon/Washington Stock is defined to include humpback whales that feed off the west coast of the United States, including animals from both the California-Oregon and Washington-southern British Columbia feeding groups (Barlow et al. 2011; Calambokidis et al. 2008). Three other stocks are recognized in the Pacific region stock assessment reports: (1) Central North Pacific Stock (with feeding areas from Southeast Alaska to the Alaska Peninsula), (2) Western North Pacific Stock (with feeding areas from the Aleutian Islands, the Bering Sea, and Russia), and (3) American Samoa Stock in the South Pacific (with largely undocumented feeding areas as far south as the Antarctic Peninsula) (Carretta et al. 2020). The relationship of MMPA stocks to ESA DPSs is complex. Whales from three different DPSs (Central America, Mexico, and Hawaii) are included in the MMPA stock identified in this report as the "California/Oregon/Washington Stock" (COW). Nearly all Central American whales migrate to California and Oregon to feed, but the California/Oregon feeding area represents a mix of whales from Mexico and Central America (Wade 2021). Humpback whales expected to be present in the Action Area are expected to be part of the COW stock.

The COW stock is estimated to be increasing at 6-7% per year. Combining abundance estimates from both the California/Oregon and Washington/southern British Columbia feeding groups (2,374 + 526) yields an estimate of 2,900 animals (CV = 0.048) for the COW stock (Carretta et al. 2020).

From 2013-2017, mortality due to interactions with fisheries amounted to 17.3 whales per year (Carretta et al. 2020). Fourteen humpback whales (totaling eight deaths, 2.8 serious injuries, and two non-serious injuries) were reported struck by vessels between 2013 and 2017 (Carretta et al. 2019a). An encounter theory model estimated the number of annual ship strike deaths to be 22 humpback whales, though this includes only the period July–November when whales are most likely to be present in the U.S. West Coast EEZ and the time of year that overlaps with cetacean habitat models generated from line-transect surveys (Becker et al. 2016, Rockwood et al. 2017). A humpback whale was entangled in a research marine mooring buoy in 2014. The whale is estimated to have been entangled for three weeks and had substantial necrotic tissue around the caudal peduncle. Although the whale was fully disentangled, this animal was categorized as a serious injury because of the necrotic condition of the caudal peduncle and the possibility that the whale would lose its flukes due to the severity of the entanglement (Carretta et al. 2019a). Increasing levels of anthropogenic sound in the world's oceans (Andrew et al. 2002) has also been identified as a threat to humpback whales.

6.4.5 Gray whale (*Eschrichtius robustus*)

There are two north Pacific stocks of gray whales: the Western stock (WNP)and the Eastern stock (ENP) designated in the Pacific SAR (Carretta et al. 2020). Gray whales of the WNP stock primarily occur in shallow waters over the U.S. West Coast, Russian, and Asian continental shelves, while the ENP stock whales primarily occur in shallow waters over the continental shelf of the U.S. West Coast and Mexico. This species is one of the most coastal of the great whales (Jefferson et al. 2015; Jones and Swartz 2009). The WNP stock primarily feed in the Okhotsk Sea off Sakhalin Island, Russia, and in the southeastern Kamchatka Peninsula in the southwestern Bering Sea in nearshore waters generally less than 225 ft deep (Jones and Swartz 2009; Weller and Brownell 2012). The breeding grounds consist of subtropical lagoons in Baja California, Mexico, and suspected wintering areas in southeast Asia (Alter et al. 2009; Jones and Swartz 2009; Mate et al. 2015a; Urban-Ramirez et al. 2003; Weller et al. 2013). The ENP stock also feeds in nearshore waters in the Chukchi Sea, Bering Sea, Gulf of Alaska, the Pacific Northwest, and Northern California (Calambokidis et al. 2017; Lagerquist et al. 2018; Mate et al. 2010; 2013; 2015a; Weller et al. 2013). The main breeding grounds consist of subtropical lagoons in Baja California, Mexico (Alter et al. 2009; Jones and Swartz 2009; Urban-Ramirez et al. 2003).

Some gray whales make the longest annual migration of any mammal (15,000–20,000 km roundtrip; Guazzo et al. 2019). Gray whales migrate along the Pacific coast twice a year between October and July (Calambokidis et al. 2015). Although they generally remain mostly over the shelf during migration, some gray whales may be found in more offshore waters to the west of San Clemente Island and the Channel Islands (Calambokidis et al. 2015; Guazzo et al. 2019; Mate and Urban-Ramirez 2003; Schorr et al. 2019; Smultea 2014; Sumich and Show 2011). Recordings from a hydrophone array deployed offshore of central California (near Monterey) show that gray whales are acoustically active while migrating and that this acoustic behavior and their swimming behavior during migration changes on daily and seasonal time scales (Guazzo et al. 2017).

Information from tagging, photo-identification and genetic studies show that some whales identified in the Western North Pacific off Russia have been observed in the eastern North Pacific, including coastal waters of Canada, the U.S. and Mexico (Lang et al. 2014; Weller et al. 2012; Mate et al. 2015, Urbán et al. 2019). The number of whales documented moving between the Western and Eastern North Pacific represents 14% of gray whales identified off Sakhalin Island and Kamchatka according to Urban et al. (2019). Some whales that feed off Sakhalin Island in summer migrate east across the Pacific to the west coast of North America in winter, while others migrate south to waters off Japan and China (Weller et al. 2016). The current stock structure for gray whales in the Pacific has been in the process of being re-examined for a number of years and remains uncertain as of the most recent Pacific SAR (Carretta et al. 2020). Genetic data reveal mixed stock aggregations of gray whales in the North Pacific Ocean and indicate that current population structure is not reflected by the current eastern and western stock or DPS designations based on geography (Brüniche-Olsen et al. 2018; Carretta et al. 2020).

The WNP is endangered, with an estimated population size from photo-ID data for Sakhalin and Kamchatka in 2016 of 290 whales (90% percentile interval = 271–311) (Cooke 2017; Cooke et al. 2018). Their main wintering areas are in waters off Russia and Asia (Mate et al. 2015a; Moore and Weller 2013; Weller et al. 2012; 2013). Recent analysis of the data available for 2005 through 2016 estimates the combined Sakhalin Island and Kamchatka populations are increasing (Cooke 2019).

The ENP has recovered from whaling exploitation, is not considered depleted, and was delisted under the ESA in 1994 (Carretta et al. 2020; Swartz et al. 2006). The most recent estimate of abundance for the ENP population is from the 2015/2016 southbound survey and is 26,960 (CV=0.05) whales (Durban et al. 2017).

A few hundred gray whales that feed along the Pacific coast between southeastern Alaska and Northern California throughout the summer and fall are known as the Pacific Coast Feeding Group (PCFG) (Calambokidis et al. 2017; Carretta et al. 2017; Mate et al. 2013; Weller et al. 2013). The group has been identified as far north as Kodiak Island, Alaska (Gosho et al. 2011), and has generated uncertainty regarding the stock structure of the ENP (Carretta et al. 2017; Weller et al. 2012; 2013). Photo-identification, telemetry, and genetic studies suggest that the PCFG is demographically distinct from the ENP (Calambokidis et al. 2017; Frasier et al. 2011; Lagerquist et al. 2018; Mate et al. 2010). In 2012–2013, the Navy funded a satellite tracking study of PCFG gray whales (Mate 2013). Tags were attached to 11 gray whales near Crescent City, California in fall 2012. Good track histories were received from 9 of the 11 tags, which confirmed an exclusive nearshore (< 19 km) distribution and movement along the Northern California, Oregon, and Washington coasts (Mate 2013). Although the duration of the tags was limited, none of the PCFG whales moved south beyond Northern California.

Both stocks could be present in the Action Area during their northward and southward migration (Calambokidis et al. 2015; Carretta et al. 2019c; Cooke et al. 2015; Moore and Weller 2018; Sumich and Show 2011; Weller et al. 2012; 2013). During surveys of the northern feeding grounds, the largest number of WNP gray whales was observed in late-August and early-September (Meier et al. 2007), suggesting those few gray whales that may migrate down the U.S. west coast will not be in California waters in general during those months.

Gray whale BIAs, including parent and child migratory BIAs and parent and core feeding BIAs were identified along the U.S. West Coast (Calambokidis et al 2015; Calambokidis 2024 Figs. 7-10; Carlton et al. 2024, Figs. 3.39-3.42). Vessels transiting from Coos Bay, Crescent City, San Francisco Bay and Morro Bay are likely to intersect with gray whale migratory BIAs. Vessels surveying potential cable routes are also likely to intersect with small portions of the migratory BIAs. The gray whale BIAs do not overlap with the Oregon WEAs, but they do overlap with the Action Area (Figure 6, Figure 7). There has been no critical habitat designated for this species.

6.4.6 Sperm whale (*Physeter macrocephalus*)

Sperm whales consume a variety of squid and fish; females feed mostly on deep-living species of squid, whereas males often forage for bottom-dwelling fish (Whitehead 2003; Whitehead et al. 2008). Based on habitat models derived from line-transect survey data collected between 1991 and 2008 off the U.S. West Coast, sperm whales show an apparent preference for deep waters (Barlow et al. 2009; Becker et al. 2012; Becker et al. 2010; Forney et al. 2012). Sperm whales are distributed across the entire North Pacific and into the southern Bering Sea in summer, but the majority are thought to be south of 40°N in winter (Rice 1974; 1989; Miyashita et al. 1995). Sperm whales are found year-round in California waters (Dohl et al. 1983; Barlow 1995; Forney et al. 1995), but they reach peak abundance from April through mid-June and from the end of August through mid-November (Rice 1974). Sperm whales are seen off Washington and Oregon in every season except winter (Green et al. 1992). Of 176 sperm whales that were marked with Discovery tags off southern California in winter between 1962 and 1970, only three were recovered by whalers: one off northern California in June, one off Washington in June, and another far off British Columbia in April (Rice 1974).

Since 1978, there have been accounts of at least three other stranded sperm whales, including two in 2008, recorded by the Humboldt State University Vertebrate Museum. No sperm whales were reported from 30 surveys conducted off Eureka in fall 1991–2007 (Calambokidis 2009). Only two sperm whales were observed in low-elevation aerial surveys, both at depths of 656–6,561 ft (200–2,000 m) (Adams et al. 2014); satellite tracking has indicated their migration occurs along the continental shelf break, and passive acoustic monitoring has detected them in the Eel River Canyon.

The sperm whale has been listed as endangered since 1970 under the precursor to the ESA (NMFS 2009), but there is no designated critical habitat for this species in the North Pacific. Sperm whales within the Pacific U.S. EEZ are divided into three discrete, non-contiguous areas: California, Oregon and Washington (COW) waters, waters around Hawaii, and Alaska waters (Carretta et al. 2020). Sperm whales in the California Current have been identified as demographically independent from animals in Hawaii and the Eastern Tropical Pacific (Mesnick et al. 2011). The best estimate of sperm whale abundance in the California Current is the trend-based estimate corresponding to the most recent 2014 survey, or 1,997 (CV= 0.57) whales (Moore and Barlow 2014).

The fishery most likely to injure or kill sperm whales from this stock is the California thresher shark/swordfish drift gillnet fishery (Julian and Beeson 1998, Carretta et al. 2019a; 2019b), although sablefish hook and line fishery, entanglements in unknown fisheries, ingestion of marine debris and vessel strikes are also threats to this species (Carretta et al. 2020). For the 1991-2014 study period, conclusions about whether the population has increased or decreased are uncertain (Moore and Barlow 2017).

6.4.7 Southern resident killer whale (*Orcinus orca*)

The Eastern North Pacific Southern Resident stock of killer whales are composed of three matrilineal pods named J, K, and L (Bigg et al. 1990) and occur in the inland waterways of Puget Sound, Strait of Juan de Fuca, and southern Georgia Strait in spring, summer, and fall. Little is known about their fall, winter, and spring movements, but they have been reported in coastal waters off Oregon and Washington, especially in the area between Grays Harbor and the Columbia River (Ford et al. 2000, Hanson et al. 2017), and travel as far south as central California and as far north as the southeast Alaska. Although less is known about the whales' movements in outer coastal waters, satellite tagging, opportunistic sighting, and acoustic recording data suggest that Southern Residents spend nearly all of their time on the continental shelf, within 34 km (21.1 mi) of shore in water less than 200 m (656.2 ft) deep (Hanson et al. 2017). Details of their winter range from satellite-tagging reveal whales use the entire Salish Sea (northern end of the Strait of Georgia and Puget Sound) in addition to coastal waters from the central west coast of Vancouver Island, British Columbia to Point Reyes, California (Carretta et al. 2020). The J pod from this stock is commonly sighted in inshore waters in winter, while the other two pods, K and L, apparently spend more time offshore (Ford et al. 2000). Sample pollutant ratios from K and L pod whales were consistent with a hypothesis of time spent foraging in California waters (Krahn et al. 2009), which is consistent with sightings of K and L pods as far south as Monterey Bay. On the basis of available information, it is likely that pods K and L of will travel by and perhaps through the nearshore portions of the Action Area (e.g., to depths of 656 ft [200 m] at infrequent intervals in winter or spring). They could forage for migrating Chinook salmon at the Klamath River mouth, because of the abundance of prey. The two rivers closest to the Humboldt WEA, the Mad and Eel, have very few Chinook salmon in comparison, although Chinook salmon from the Sacramento River are regularly caught in nearshore fisheries in the Action Area (Bellinger et al. 2015).

Following the peak census count of 99 animals in 1995, the population size has declined approximately 1% annually and currently stands at 73 animals as of the 2019 census (Ford et al. 2000; Center for Whale Research 2019; 2020). A population viability analysis identified several risk factors to this population, including limitation of preferred Chinook salmon prey, anthropogenic noise and disturbance resulting in decreased foraging efficiency, vessel strikes and high levels of contaminants, including PCBs and DDT (Erbe 2002, Clark et al. 2009, Krahn et al. 2007; 2009, Lacy et al. 2017; Carretta et al. 2020).

The Southern Resident DPS was federally listed as endangered in 2005 (70 FR 69903). Critical habitat for this DPS (Figure 8) was designated in the summer core area in Haro Strait and waters around the San Juan Islands, Puget Sound, and the Strait of Juan de Fuca (79 FR 69054). In August 2021, additional critical habitat was designated along the U.S. West Coast from the Canadian border to Point Sur, California, including offshore of Humboldt County between depths of 6.1–200 m (20–656 ft) (86 FR 41668). BIA parent and core areas were delineated for Southern Resident Killer Whales (Calambokidis et al. 2024; Fig. 11). The BIAs overlap with the Action Area (Figure 6, Figure 7).

6.4.8 Steller sea lion (*Eumetopias jubatus*)

Steller sea lions' range along the north Pacific from northern Japan to California (Perrin et al. 2009), with centers of abundance and distribution in the Gulf of Alaska and Aleutian Islands (Muto et al. 2019). The Steller sea lion is a colonial breeder. They feed on a variety of fishes, bivalves, cephalopods, and gastropods. They may disperse long distances to find prey but are not known to migrate. Haul outs and rookeries usually consist of beaches, ledges, and rocky reefs (NMFS 2019). Steller sea lions do not dive deep, and they forage over the continental shelf at night, usually within 12 miles of the colony (Loughlin 2008). Individuals rarely come ashore on the mainland but haul out on islands and offshore rocks and even remain at sea during stormy weather (Kenyon and Rice 1961). Steller sea lions breed along the Humboldt County coast and their presence in the marine and coastal portions of the Action Area varies throughout the year. Two of the three largest breeding colonies in the region are on Sugarloaf Island off Cape Mendocino and on St. George Reef off Crescent City.

The Steller sea lion was federally listed as threatened in 1990 (NMFS 1990). In 1997, the eastern population (i.e., east of 144° W longitude) was listed as threatened, and the western population (i.e., west of 144° W longitude) was listed as endangered (NMFS 1997). The eastern DPS has since recovered and is no longer listed (78 FR 66139, 11/04/2013), increasing at the maximum theoretical net productivity rate for pinnipeds of 12 % (Muto et al. 2020b). The western DPS remains endangered. There is an exchange of sea lions across the stock boundary (144°W), especially due to the wide-ranging seasonal movements of juveniles and adult males (Baker et al. 2005; Jemison et al. 2013; 2018). The total count estimate of pups and non-pups for the U.S. portion of the eastern stock of Steller sea lions (excluding Canada) in 2017 is 43,201 and is considered to be a minimum population estimate (Johnson and Fritz 2014).

Critical habitat was designated in 1993, and includes Sugarloaf Island, Cape Mendocino, Southeast Farallon Island, and Año Nuevo Island in California (NMFS 1993). The Action Area overlaps with Stellar Sea Lion critical habitat (Figure 8). The Stellar Sea Lion critical habitat will not overlap with the Oregon WEAs; however, the eastern DPS includes sea lions originating from rookeries in southeast Alaska, British Columbia, Washington, Oregon, and California and therefore the range of the Eastern DPS of Stellar Sea Lions does overlap with the Oregon WEAs (https://www.fisheries.noaa.gov/species/steller-sea-lion#population). Mortality and serious injuries from commercial and recreational fisheries, marine debris, vessel strike, illegal shooting, explosives, disturbance at rookeries, Native subsistence harvest and incidental mortality currently impact Eastern U.S. Steller sea lions (Muto et al. 2020). A changing ocean environment, particularly warmer temperatures, may be resulting in increased California sea lion over Steller sea lion in the southern portion of the Steller sea lion's range (NMFS 2008).

6.4.9 Guadalupe fur seal (*Arctocephalus townsendii*)

The Guadalupe fur seal is a pelagic species for most of the year, occurring in the subtropical waters of southern California and Mexico. Breeding occurs almost entirely on Isla de Guadalupe, Mexico, from May to July (CMLPAI 2009; NMFS 2019a). In recent years, several Guadalupe fur seals have been consistently observed at San Miguel Island. In 1997, a pup was observed there but no other pups were observed until 2008. Breeding colonies may occur on San Miguel and San Nicolas Islands (Seal Conservation Society 2011). Guadalupe fur seals are solitary, non-social animals, but males may mate with up to 12 females during the breeding season (NMFS 2019a). They feed in deep waters on krill, squid, and small schooling fish (CMLPAI 2009). Unusual mortality events (UME), in the form of increased strandings of Guadalupe fur seals, have occurred along the entire coast of California, beginning in January 2015 at eight times higher than the historical average. Strandings have continued since 2015 at well above average rates in California. Additionally, Guadalupe fur seal strandings in Oregon and Washington became elevated in 2019. Along the U.S. West Coast, strandings occur almost annually in California waters and animals are increasingly observed in Oregon and Washington waters (Carretta et al. 2020). Most stranded animals were less than 2 years old, malnourished with secondary bacterial and parasitic infections (NMFS 2019b; Carretta et al. 2020). Guadalupe fur seals that stranded in central California and treated at rehabilitation centers were fitted with satellite tags and documented to travel as far north as Graham Island and Vancouver Island, British Columbia, Canada (Norris et al. 2015). Some satellite-tagged animals traveled far offshore outside the U.S. EEZ to areas 700 nmi west of the California / Oregon border. The population is considered to be a single stock because all are recent descendants from one breeding colony at Isla Guadalupe, Mexico (Carretta et al. 2020).

Current threats include incidental mortality and serious injury in commercial and unidentified fisheries, entanglement in marine debris and shootings (Carretta et al. 2020).

The Guadalupe fur seal was federally listed as endangered in 1967 and then re-listed as threatened in 1985 (NOAA 1985). The main reason for listing was a severe population decline due to hunting. No critical habitat has been designated for the Guadalupe fur seal. Since their listing, Guadalupe fur seals have significantly increased in numbers with an estimated annual rate of increase of 5.9% (range 4.1–7.7%) (García-Aguilar et al. 2018). The minimum population size of 31,019 animals is taken as the lower bound of the estimate provided by García-Aguilar et al. (2018) in Muto et al. (2020).

6.5 Marine Mammals Unlikely to Occur in the Action Area

6.5.1 North Pacific right whale (*Balaena japonica*)

The likelihood of a North Pacific right whale being present in the Action Area is low, as in recent years this species has only been routinely observed or acoustically detected in the Bering Sea (Brownell et al. 2001; Filatova et al. 2019; NMFS 2017; Shelden et al. 2005; Wade et al. 2011; 2010; Wright et al. 2019; 2018; Zerbini et al. 2015; 2010), with occasional sightings of individuals in the Gulf of Alaska (Matsuoka et al. 2014; Širović et al. 2015b; Wade et al. 2011), waters off British Columbia and the border with Washington State (Ford et al 2016; Širović et al 2015a; U.S. Department of the Navy 2015), and Southern California (Muto et al. 2018; WorldNow 2017). Occasional sightings of right whales have been made off California and off Baja California, Mexico; this includes two recent records from California in 2017, off La Jolla and in the Channel Islands (both of which were single whales) (Muto et al. 2021). The most recent estimated population for the eastern North Pacific right whale is between 26 and 31 individuals (Muto et al. 2020b). Although this estimate may be reflective of a Bering Sea subpopulation, the total eastern North Pacific population is unlikely to be much larger (Wade et al. 2010). There have been only four sightings, each of a single right whale, in Southern California waters over approximately the last 30 years (in 1988, 1990, 1992, and 2017) (Brownell et al. 2001; Carretta et al. 1994; NMFS 2017; WorldNow 2017). Sightings off California are rare (Brownell et al. 2001; NMFS 2017; Scammon 1874). Historically, during the period of U.S. West Coast whaling through the 1800s, right whales were considered uncommon to rare off California (Muto et al. 2020; Scammon 1874). However, right whales could have been severely depleted in their feeding grounds prior to 1854, when the first coastal whaling station was established in California. It remains possible that California and Mexico, and possibly offshore waters of Hawaii, were once the principal calving grounds for right whales from the Gulf of Alaska and Bering Sea (Muto et al. 2020). For the reasons presented above, the presence of North Pacific right whales is unlikely or rare in the Action Area. However, it will be important to monitor for North

Pacific right whales, in addition to other protected species, so that recommendations for mitigation can be updated if North Pacific right whales are detected in the Action Area.

6.6 Sea Turtles Likely to Occur in the Action Area

6.6.1 Leatherback sea turtle (*Dermochelys coriacea*)

The leatherback sea turtle is listed as a single, endangered population under the ESA (35 Federal Register 8491). However, USFWS and NMFS identified seven leatherback DPSs based on nesting locations and foraging distribution: Northwest Atlantic, Southwest Atlantic, Southeast Atlantic, Southwest Indian, Northeast Indian, West Pacific, and East Pacific (NMFS and USFWS 2020a). Only leatherbacks from the West Pacific DPS could occur in the Action Area, and none of the DPSs have been listed under the ESA. Their diet is primarily jellyfish, but they also consume other invertebrates, small fish, and plant material (NMFS 2016a; Nafis 2018).

Leatherbacks are mostly pelagic but occasionally enter shallower waters of bays and estuaries (NMFS 2016b). For fall aerial transects from Point Conception, California to the Oregon border over waters less than 302 ft (92 m) deep and within 21 mi (34 km) of shore, two to 28 leatherback sea turtles per year were reported per year 1990-2003 (Benson et al. 2007). None of the individuals reported from the northern coast were north of Cape Mendocino in Mendocino County. However, tagged leatherback sea turtles have been observed offshore of the northern California coast (Benson et al. 2011; TOPP 2019).

Leatherback nesting populations in the Pacific Ocean have declined by more than 80% since the 1980s. The International Union for Conservation of Nature has predicted a decline of 96% for the western Pacific subpopulation and a decline of nearly 100% for the eastern Pacific subpopulation by 2040 (NMFS 2016a; Sarti-Martinez et al. 1996). The number of leatherbacks foraging off the U.S. West Coast declined 6% annually from 1990 to 2017, representing an 80% decline in the foraging population over that period (Benson et al. 2020).

A total index of nesting female abundance of the West Pacific population was estimated to be 1,277 females. Leatherback turtles of the West Pacific DPS nest in tropical and subtropical latitudes primarily in Indonesia, Papua New Guinea, and Solomon Islands, and to a lesser extent in Vanuatu (Dutton et al. 2007; Benson et al. 2007a; Benson et al. 2007b; Benson et al. 2011). Oceanic currents help to structure the spatial and temporal distribution of juveniles which lead them to foraging and developmental habitats (e.g., the North Pacific Transition Zone); they undertake seasonal migrations seeking favorable oceanic habitats/temperatures and abundant foraging resources (Gaspar et al. 2012).

Critical habitat (Figure 8) has been designated to include the waters from Cape Flattery, Washington to Winchester Bay, Oregon, out to the 2,000 m isobath (NMFS 2012). In California, critical habitat extends from Point Arena to Point Arguello, inshore of the 1,000 m depth contour (NMFS 2012).

6.6.2 Loggerhead sea turtle (*Caretta caretta*)

In the eastern Pacific, loggerhead sea turtles are reported from Chile to Alaska. They are occasionally sited from the coasts of Washington and Oregon, but most records are of juveniles off the coast of California. Important eastern Pacific habitats for juveniles are the west coast of Mexico and the Baja Peninsula. Loggerhead sea turtles have been observed at scattered locations from Point Conception to the U.S./Mexico border (NMFS and USFWS 2020). Sightings in California tend to occur from July to September but can occur over most of the year during El Niño years when ocean temperatures rise.

The only known nesting areas in the North Pacific are found in southern Japan (NMFS 2017b). Despite long-term declines at nesting beaches in Japan, nesting populations in Japan appear to be gradually increasing or remaining stable (Chapman and Seminoff 2016; NMFS and USFWS 2007). Loggerheads do not nest within the Action Area.

The loggerhead sea turtle is primarily pelagic but occasionally enters bays, lagoons, salt marshes, estuaries, creeks, and rivers (NMFS and USFWS 2020). Loggerhead sea turtles consume whelks and conchs, but also sponges, crustaceans, jellyfish, worms, squid, barnacles, fish, and plants (NMFS 2017b; NMFS and USFWS 2020).

Loggerhead sea turtles in the North Pacific occur in areas where sea surface temperature ranges between 10 and 28.7°C and mean sea surface temperature ranges between 16.3 and 24°C (Eguchi et al. 2018). Below 15°C, loggerheads become lethargic and inactive. When temperatures fall to 10°C, they become cold-stunned (Mrosovsky 1980). Sea surface temperatures in the Action Area are generally cooler than temperatures preferred by loggerhead sea turtles. Occurrence of loggerheads would only be expected during summer and fall when water temperatures are more likely to be within their preferred range.

An aerial survey in 2015 from Point Conception to south of the U.S.-Mexico border recorded over 200 loggerheads, when sea surface temperatures were high and there was a strong El Niño. El Niño conditions in the eastern North Pacific coupled with other largescale ocean-atmosphere circulations in the western tropical Pacific resulted in anomalously warm sea surface temperatures in the region and affected the ranges of numerous marine species (Bond et al. 2015). A 2011 survey in the same region during a cold La Niña encountered no loggerheads.

Most records of loggerhead sightings, stranding events, and incidental bycatch on the U.S. West Coast have been juveniles in nearshore waters (Eguchi et al. 2018). In general, sea turtle sightings increase during the summer, peaking from July to September off Southern California and southwestern Baja California, with fewer loggerheads expected farther north (Eguchi et al. 2018).

In 2009, a status review conducted for the loggerhead identified nine DPSs within the global population (Conant et al. 2009). In2011, NMFS and USFWS listed five of these DPSs as endangered (North Pacific Ocean, South Pacific Ocean, North Indian Ocean, Northeast Atlantic Ocean, and Mediterranean Sea DPSs) and four as threatened (Southeast Indo-Pacific Ocean, Southwest Indian Ocean, Northwest Atlantic Ocean, and South Atlantic Ocean DPSs) (76 FR 58868). Only the North Pacific Ocean DPS occurs within the Action Area; however, mixing occurs between other populations in the Pacific and Indian Oceans, enabling a limited amount of gene flow with other DPSs (Gaos 2011). A 5-year review was conducted on the North Pacific DPS, and no changes were made to the listing status (NMFS and USFWS 2020b)

There is no critical habitat designated for loggerhead sea turtles within the Action Area.

6.7 Sea Turtles Unlikely to Occur in the Action Area

6.7.1 Green sea turtle (*Chelonia mydas*)

The green sea turtle occurs worldwide in surface waters that remain above 22°C (Van Houtan et al. 2015) and prefers shallow, protected waters (NMFS 2016c). It was first listed under the ESA in 1978, and NOAA has identified 11 DPSs of green sea turtles globally, one of which is the threatened East Pacific DPS (Seminoff et al. 2015). Green sea turtles have been sighted as far north as Alaska, but most commonly occur from southern California to northwestern Mexico (NMFS 2016c). Thus, while individuals from the East Pacific Ocean DPS could range into the Action Area, such movements are extralimital and unlikely.

NOAA has proposed marine critical habitat for the East Pacific DPS from the Santa Monica Bay south to San Diego [88 FR 46572]. However, there is no critical habitat designated or proposed for the green sea turtle in the Action Area.

6.7.2 Olive Ridley Sea Turtle (*Lepidochelys olivacea*)

The olive ridley has a global tropical distribution (National Marine Fisheries Service and U.S. Fish and Wildlife Service 2014). While they are uncommon in U.S. territorial waters (NMFS and USFWS 1998; 2014). the olive ridley is one of the most abundant species of sea turtles in the world. In the Pacific, large nesting populations occur in Mexico and Costa Rica, but the breeding populations in Mexico are listed as endangered, due to historic declines and threats from loss of nesting habitat and overharvest (NMFS and USFWS 2007c). California appears to be at the extreme northern range for the species, but individuals have been documented as far north as Alaska.

There is no critical habitat designated for olive ridley sea turtles in the Action Area.

7 BA: Fishes and Invertebrates—Species Lists and Descriptions

7.1 List of Fishes and Invertebrates

Thirty fish and invertebrate taxa are listed under the ESA as either threaten or endangered. Chinook salmon (9 Evolutionarily Separate Units (ESUs)), Coho salmon (4 ESUs), steelhead trout (11 Distinct Population Segments (DPSs)), chum salmon (2 ESUs), green sturgeon, eulachon, black abalone, and sunflower sea star are protected fish and invertebrate species expected to occur in or adjacent to the Action Area.

National Marine Fisheries Office of Protected Resources in Long Beach, CA provided technical input on the list of fish and invertebrate species considered here (Table 12).

Table 12. Species of fishes and invertebrates that may occur in the Action Area.

Chinook salmon (*Oncorhynchus tshawytscha*) - 9 ESUs				
Sacramento River winter-run Chinook salmon ESU	E / CH	50 CFR 224.101; 50 CFR 226.204	➤Also a NMFS Species in the Spotlight	https://www.fisheries.noaa.gov/species/chinook-salmon-protected#spotlight
Central Valley spring-run Chinook salmon ESU	T / CH	50 CFR 223.102; 50 CFR 226.204		
California Coastal Chinook salmon ESU	T / CH	50 CFR 223.102; 50 CFR 226.211		
Lower Columbia River Chinook salmon ESU	T / CH	50 CFR 223.102; 50 CFR 226.212		

Upper Columbia River Spring-run Chinook salmon ESU	E/CH	50 CFR 223.102; 50 CFR 226.212		
Snake River Fall Chinook salmon ESU	T / CH	50 CFR 223.102; 50 CFR 226.212		
Snake River Spring/Summer-Run Chinook ESU	T / CH	50 CFR 226.205		
Upper Willamette River Chinook salmon ESU	T / CH	50 CFR 223.102; 50 CFR 226.212		
Puget Sound Chinook salmon ESU	T / CH	50 CFR 226.212		
Coho salmon (*Oncorhynchus kisutch*) - 4 ESUs				
Central California Coast coho salmon ESU	E / CH	50 CFR 224.101; 50 CFR 226.210	➤Also a NMFS Species in the Spotlight	https://www.fisheries.noaa.gov/species/coho-salmon-protected#spotlight
Southern Oregon/Northern California Coast coho salmon ESU	T / CH	50 CFR 223.102: 50 CFR 226.210		
Lower Columbia River coho salmon ESU	T / CH	50 CFR 223.102; 50 CFR 226.212		
Oregon Coast coho salmon ESU	T / CH	50 CFR 223.102; 50 CFR 226.212		
Steelhead (*Oncorhynchus mykiss*) - 11 DPSs				
California Central Valley steelhead DPS	T / CH	50 CFR 223.102; 50 CFR 226.211		
Central California Coast steelhead DPS	T / CH	50 CFR 223.102; 50 CFR 226.211		
South-Central California Coast steelhead DPS	T/CH	50 CFR 223.102; 50 CFR 226.211		

Southern California steelhead DPS	E/CH	50 CFR 224.101; 50 CFR 226.211		
Northern California steelhead DPS	T / CH	50 CFR 223.102; 50 CFR 226.211		
Lower Columbia River steelhead DPS	T/CH	46 CFR 223.102; 50 CFR 226.212		
Middle Columbia River steelhead DPS	T/CH	47 CFR 223.102; 50 CFR 226.212		
Upper Columbia River steelhead DPS	E/CH	48 CFR 223.102; 50 CFR 226.212		
Puget Sound steelhead DPS	T/CH	49 CFR 223.102; 50 CFR 226.212		
Snake River steelhead DPS	T/CH	50 CFR 223.102; 50 CFR 226.212		
Upper Willamette River steelhead DPS	T/CH	50 CFR 223.102; 50 CFR 226.212		
Chum Salmon (*Oncorhynchus keta*) - 2 ESUs				
Columbia River chum salmon ESU	T/CH	50 CFR 226.212		
Hood Canal summer-run chum salmon ESU	T/CH	51 CFR 226.212		
Sturgeon (*Acipenser medirostris*)- 1 DPS				
North American Green Sturgeon Southern DPS	T / CH	50 CFR 223.102; 50 CFR 226.219		
Eulachon (*Thaleichthys pacificus*)- 1 DPS				
Pacific Eulachon Southern DPS	T / CH	50 CFR 223.102; 50 CFR 226.222		

Invertebrates				
Black abalone	E / CH	50 CFR 226.221		
Sunflower sea star	T/candidate			

7.2 Salmonids

7.2.1 Chinook Salmon (*Oncorhynchus tshawytscha*)

Chinook salmon are an anadromous fish species that are found in along the Pacific coast and inland from Ventura River in California to Point Hope, Alaska and in northeast Asia. On occasion they have been found further south. Like other Pacific salmon species, they are semelparous and spawning occurs in freshwater from August through February. Chinook salmon can spend up to a year in freshwater before migrating downstream to the ocean. They spend 2 to 8 years in the ocean before migrating back to natal freshwater rivers and streams to spawn.

Given this widespread geographic distribution, Chinook salmon have developed diverse and complex life history strategies. Chinook salmon can be categorized as either "stream-type" or "ocean-type" strategists. Stream-type Chinook salmon reside in freshwater for a year or more following emergence, whereas "ocean-type" Chinook salmon migrate to the ocean predominantly within their first year. In addition to differences in freshwater life histories, there appears to be differing ocean use patterns between these stream-type and ocean-type Chinook salmon. Stream-type populations appear to undertake extensive offshore ocean migrations while ocean-type Chinook salmon undertake distinct, coastally oriented, ocean migrations (Good et al. 2005).

Juvenile Chinook salmon exhibit a patchy distribution in U.S. West Coast waters; in pelagic trawl surveys conducted in summer and fall along Oregon and Washington, half of all juvenile salmonids were collected in about 5% of the surveys, and none were collected in about 40% of the surveys (Peterson et al. 2010). In general, salmonids are low in abundance in U.S. West Coast waters when compared to other fish, as evidenced by: (1) the low numbers of juvenile salmonids captured in directed pelagic surface/ subsurface research trawls relative to other nekton (Brodeur et al. 2004, Brodeur et al. 2005, Fisher et al. 2014, Peterson et al. 2010, Trudel et al. 2009), and (2) the low numbers of adult and subadult salmonids captured as bycatch in midwater trawls (e.g., commercial trawls for whiting, see Lomeli and Wakefield 2014).

Juvenile salmonids are pelagic and typically surface-oriented, most often found in the upper 20 m of the water column (Emmett et al. 2004, Walker et al. 2007, Beamish et al. 2000). Adult coho salmon tend to occur at shallower depths (< 40 m) than adult Chinook salmon (Walker et al. 2007). Juvenile Chinook salmon tend to occur closer inshore than other juvenile salmonid species, generally within the 100-meter isobath (Brodeur et al. 2004, Peterson et al. 2010), and occasionally being found in the surf zone (Marin Jarrin et al. 2009). Once in the ocean, Chinook salmon feed upon small crustaceans, other invertebrates as juveniles, and larval and juvenile fish as adults (Love 1996).

Within the Action Area nine evolutionary significant units (ESUs) may occur that are either threatened or endangered under the ESA.

Sacramento River Winter-Run Chinook ESU (Endangered). The listing status for this Chinook salmon ESU was determined to be endangered on January 4, 1994, (59 FR 440). Critical habitat was designated on June 16, 1993, and does not overlap with the Action Area. This ESU includes winter-run Chinook salmon spawning naturally in the Sacramento River and its tributaries, as well as winter-run Chinook salmon that are part of the conservation hatchery program at the Livingston Stone National Fish Hatchery.

Central Valley Spring-Run Chinook ESU (Threatened). The listing status for this Chinook salmon ESU was determined to be endangered on September 16, 1999 (FR 64 50394). Critical habitat was designated on September 2, 2005 (70 FR 52629) and does not overlap with the Action Area. This ESU includes naturally spawned spring-run Chinook salmon originating from the Sacramento River and its tributaries, and also spring-run Chinook salmon from the Feather River Hatchery Spring-run Chinook Salmon Program.

California Coastal Chinook ESU (Threatened). The listing status for this Chinook salmon ESU was determined to be threatened on September 16, 1999 (FR 64 50394). Critical habitat was designated on September 2, 2005 (70 FR 52488) and does not overlap with the Action Area. On June 28, 2005, NMFS confirmed the listing of California Coastal Chinook salmon as threatened under the ESA and also added seven artificially propagated populations from the following hatcheries or programs to the listing. This ESU includes all naturally spawned populations of Chinook salmon from rivers and streams south of the Klamath River (Humboldt County, CA.) to the Russian River (Sonoma County, CA).

Lower Columbia River Chinook (Threatened). The listing status for this Chinook salmon ESU was determined to be threatened on May 24, 1999 (64 FR 14308) and June 28, 2005 (70 FR 37159); updated April 14, 2014 (79 FR 20802). Critical habitat was designated on September 2, 2005 (70 FR 52629) and does not overlap with the Action Area. This ESU includes all includes naturally spawned Chinook salmon originating from the Columbia River and its tributaries downstream of a transitional point east of the Hood and White Salmon Rivers, and any such fish originating from the Willamette River and its tributaries below Willamette Falls. This ESU also includes Chinook salmon from several artificial propagation programs.

Upper Columbia River Spring-run Chinook ESU (Endangered). The listing status for this Chinook salmon ESU was determined to be endangered on March 24, 1999 (64 FR 14308) and June 28, 2005 (70 FR 37159); updated April 14, 2014 (79 FR 20802). Critical habitat was designated on September 2, 2005 (70 FR 52629) and does not overlap with the Action Area. This ESU includes naturally spawned spring-run Chinook salmon originating from Columbia River tributaries upstream of the Rock Island Dam and downstream of Chief Joseph Dam (excluding the Okanogan River subbasin). This ESU also includes Chinook salmon from several artificial propagation programs.

Snake River Fall Chinook ESU (Threatened). The listing status for this Chinook salmon ESU was determined to be threatened on April 22, 1992 (57 FR 14653) and June 28, 2005 (70 FR 37159); updated April 14, 2014 (79 FR 20802). Critical habitat was designated on December 28,1993 (58 FR 68543) and does not overlap with the Action Area. This ESU includes all naturally spawned fall-run Chinook salmon originating from the mainstem Snake River below Hells Canyon Dam and from the Tucannon River, Grande Ronde River, Imnaha River, Salmon River, and Clearwater River subbasins. This ESU also includes Chinook salmon from several artificial propagation programs.

Snake River Spring/Summer Run* Chinook *ESU (Threatened). The listing status for this Chinook salmon ESU was determined to be threatened on April 22, 1992 (57 FR 14653) and June 28, 2005 (70 FR 37159); updated April 14, 2014 (79 FR 20802). Critical habitat was designated on October 25, 1999 (64 FR 57399) and does not overlap with the Action Area. This ESU includes all naturally spawned spring/summer-run Chinook salmon originating from the mainstem Snake River and the Tucannon River, Grande Ronde River, Imnaha River, and Salmon River sub-basins. This ESU also includes Chinook salmon from several artificial propagation programs.

Upper Willamette River Chinook ESU (Threatened). The listing status for this Chinook salmon ESU was determined to be threatened on March 24, 1999 (64 FR 14308) and June 28, 2005 (70 FR 37159); updated April 14, 2014 (79 FR 20802). Critical habitat was designated on September 2, 2005 (70 FR 52629) and does not overlap with the Action Area. This ESU includes naturally spawned spring-run Chinook salmon originating from the Clackamas River and from the Willamette River and its tributaries above Willamette Falls. This DPS also includes Chinook salmon from several artificial propagation programs.

Puget Sound Chinook ESU (Threatened). The listing status for this Chinook salmon ESU was determined to be threatened on March 24, 1999 (64 FR 14308) and June 28, 2005 (70 FR 37159); updated April 14, 2014 (79 FR 20802). Critical habitat was designated on September 2, 2005 (70 FR 52629) and does not overlap with the Action Area. This ESU includes naturally spawned Chinook salmon originating from rivers flowing into Puget Sound from the Elwha River (inclusive) eastward, including rivers in Hood Canal, South Sound, North Sound and the Strait of Georgia. This ESU also includes Chinook salmon from several artificial propagation programs.

7.2.2 Coho Salmon (*Oncorhynchus kisutch*)

Coho salmon are found in the North Pacific Ocean and inland from Monterey Bay, California to Point Hope, Alaska and north Asia. They are semelparous and spawning takes place in freshwater from September through late January. Coho salmon typically exhibit a three-year life history, divided between 18 months in freshwater and 18 months in saltwater phases. In freshwater, coho salmon spawn and rear in small streams with stable gravels and complex habitat features, such as backwater pools, beaver dams, and side channels. Marine survival and growth of coho salmon are linked to food availability, environmental conditions, and stressors present in the nearshore environment. Juvenile coho salmon disperse from their natal streams to coastal waters; their ocean distribution changes with time, with juveniles typically moving northward or farther offshore (Brodeur et al. 2004). Ocean dispersal rates for yearling Columbia River coho salmon averaged between 3.2 and 6.6 km/d (Fisher et al. 2014). Juvenile salmonids are pelagic and typically surface-oriented, most often found in the upper 20 meters of the water column (Emmett et al. 2004, Walker et al. 2007, Beamish et al. 2000). Adult coho salmon tend to occur at shallower depths (< 40 meters) than adult Chinook salmon (Walker et al. 2007).

In general, juvenile salmonids are low in abundance in U.S. West Coast waters when compared to other fish, as evidenced by the low numbers of juvenile salmonids captured in directed pelagic surface/subsurface research trawls relative to other nekton (Brodeur et al. 2004, Brodeur et al. 2005, Fisher et al. 2014, Peterson et al. 2010). Juvenile coho salmon exhibit a patchy distribution in U.S. West Coast waters; in pelagic trawl surveys conducted in summer and fall along Oregon and Washington, half of all juvenile salmonids were collected in about 5% of the surveys, and none were collected in about 40% of the surveys (Peterson et al. 2010). Juvenile coho salmon occur in coastal waters, usually further offshore than juvenile Chinook salmon (Brodeur et al. 2004, Peterson et al. 2010). While in the ocean, coho salmon primarily feed upon fish and planktonic invertebrates (Love 1996).

Within the Action Area four ESUs may occur that are either threatened or endangered under the ESA.

Central California Coast Coho ESU (Endangered). The listing status for this coho salmon ESU was determined to be threatened under the ESA on October 31, 1996 (64 FR 56138); NMFS re-classified the ESU as endangered on June 28, 2005 (70 FR 37160). Critical habitat was designated on May 5, 1999 (64 FR 24049) and does not overlap with the Action Area. This ESU includes naturally spawned coho salmon originating from rivers south of Punta Gorda, California, up to and including Aptos Creek, as well as such coho salmon originating from tributaries to San Francisco Bay. Coho salmon from three artificial propagation programs are included in this ESU.

Southern Oregon/Northern CA Coast Coho ESU (Threatened). The listing status for this coho salmon ESU was determined to be threatened under the ESA on May 6, 1997 (62 FR 24588). The listing was revisited and confirmed as threatened on June 28, 2005. Critical habitat was designated on May 5, 1999 (64 FR 24049) and does not overlap with the Action Area. This ESU includes naturally spawned coho salmon originating from coastal streams and rivers between Cape Blanco, Oregon, and Punta Gorda, California. Coho salmon that originate from three artificial propagation programs are also included.

Lower Columbia River Coho ESU (Threatened). The listing status for this coho salmon ESU was determined to be threatened under the ESA on June 28, 2005 (70 FR 37159); updated April 14, 2014 (79 FR 20802). Critical habitat was designated on February 24, 2016 (81 FR 9251) and does not overlap with the Action Area. This ESU includes naturally spawned coho salmon originating from the Columbia River and its tributaries downstream from the Big White Salmon and Hood Rivers (inclusive) and any such fish originating from the Willamette River and its tributaries below Willamette Falls. Coho salmon that originate from a number of artificial propagation programs are also included.

Oregon Coast Coho ESU (Threatened). The listing status for this coho salmon ESU was determined to be threatened on August 10, 1998 (63 FR 42587) and June 20, 2011 (76 FR 35755); updated April 14, 2014 (79 FR 20802). Critical habitat was designated on February 11, 2008 (73 FR 7815) and does not overlap with the Action Area. This ESU includes naturally spawned coho salmon originating from coastal rivers south of the Columbia River and north of Cape Blanco. This ESU also includes coho salmon from the Cow Creek Hatchery Program.

7.2.3 Steelhead trout (*Oncorhynchus mykiss irideus*)

Steelhead originally ranged from northern Mexico to southeastern Alaska and inland. They are iteroparous and spawning takes place in the spring. Juveniles typically spend 2 years in freshwater before migrating downstream the ocean. While in the ocean, steelhead feed upon insects, mollusks, crustaceans, fish eggs, and other small fishes (Love 1996).

Steelhead are rainbow trout that exhibit an anadromous life history pattern. By migrating to the ocean, steelhead grow to much larger sizes than their resident rainbow trout cohorts. Anadromous steelhead and resident rainbow trout can be considered to be from the same population, as anadromous parents can produce resident offspring and resident parents can produce anadromous offspring. This adaptive life history makes steelhead flexible to changing habitat conditions. Also, unlike other Pacific salmonids, they can spawn more than one time.

After emergence, young steelhead rear in freshwater streams for 1 to 4 years before out migrating to the ocean. After reaching the ocean in the spring, juvenile steelhead tend to move offshore quickly rather than use nearshore waters like other salmon. For example, Daly et al. (2014) captured tagged juvenile steelhead that migrated greater than 55 km offshore of the Columbia River within 3 days. While as sea, steelhead are found in pelagic waters of the Gulf of Alaska principally within 10 meters from the surface, though they sometimes travel to greater depths (Light et al. 1989).

Within the Action Area eleven DPSs may occur that are either threatened or endangered under the ESA.

Southern California Coastal DPS (Endangered). The listing status for this steelhead DPS was determined to be endangered on August 18, 1997 (62 FR 43937) and January 5, 2006 (71 FR 833); range extension on May 1, 2002 (67 FR 21586); updated April 14, 2014 (79 FR 20802). Critical habitat was designated on September 2, 2005, and does not overlap with the Action Area. The Southern California Coast Steelhead DPS is comprised of a suite of anadromous steelhead populations that inhabit coastal stream networks from the Santa Maria River system south to the U.S. border with Mexico.

Northern California DPS (Threatened). The ESA listing status for this steelhead DPS was threatened on June 07, 2000 (65 FR 36074) and January 5, 2006 (71 FR 833); updated April 14, 2014 (79 FR 20802). Critical habitat was designated on September 2, 2005 (70 FR 52629) and does not overlap with the Action Area. This DPS includes naturally spawned anadromous steelhead originating below natural and manmade impassable barriers in California coastal river basins from Redwood Creek to and including the Gualala River.

California Central Valley DPS (Threatened). The ESA listing status for this steelhead DPS was threatened on March 19, 1998 (63 FR 13347); reaffirmed January 5, 2006 (71 FR 833). Critical habitat was designated September 2, 2005 (70 FR 52629) and does not overlap with the Action Area. This DPS includes naturally spawned anadromous populations originating below natural and manmade impassable barriers from the Sacramento and San Joaquin Rivers and their tributaries; excludes such fish originating from San Francisco and San Pablo Bays and their tributaries. Steelhead from the following artificial propagation programs are also included within the DPS: Coleman National Fish Hatchery Program, Feather River Fish Hatchery Program, and Mokelumne River Hatchery Program.

Central California Coast DPS (Threatened). The ESA listing status for this steelhead DPS was threatened on August 18, 1997 (62 FR 43937) and January 5, 2006 (71 FR 834); updated April 14, 2014 (79 FR 20802). Critical habitat was designated September 2, 2005 (70 FR 52629) and does not overlap with the Action Area. This DPS includes naturally spawned anadromous populations originating below natural and manmade impassable barriers from the Russian River to and including Aptos Creek, and all drainages of San Francisco and San Pablo Bays eastward to Chipps Island at the confluence of the Sacramento and San Joaquin Rivers. Steelhead from the following artificial propagation programs are also included within the DPS: Don Clausen Fish Hatchery Program and Kingfisher Flat Hatchery Program (Monterey Bay Salmon and Trout Project).

South-Central California Coast DPS (Threatened). The ESA listing status for this steelhead DPS was threatened on August 18, 1997 (62 FR 43937) and January 5, 2006 (71 FR 833); updated April 14, 2014 (79 FR 20802). Critical habitat was designated September 2, 2005 (70 FR 52629) and does not occur withing the Action Area. This DPS includes naturally spawned anadromous steelhead originating below natural and manmade impassable barriers from the Pajaro River to (but not including) the Santa Maria River.

Lower Columbia River Steelhead DPS (Threatened). The ESA listing status for this steelhead DPS was threatened on March 19, 1998 (63 FR 13347) and January 5, 2006 (71 FR 834); updated April 14, 2014 (79 FR 20802). Critical habitat was designated September 2, 2005 (70 FR 52629) and does not occur withing the Action Area. This DPS includes naturally spawned anadromous *O. mykiss* (steelhead) originating below natural and manmade impassable barriers from rivers between the Cowlitz and Wind Rivers (inclusive) and the Willamette and Hood Rivers (inclusive); excludes such fish originating from the upper Willamette River basin above Willamette Falls. This DPS also includes fish from a number of artificial propagation programs.

Middle Columbia River Steelhead DPS (Threatened). The ESA listing status for this steelhead DPS was threatened on March 25, 1999 (64 FR 14517) and January 5, 2006 (71 FR 833); updated April 14, 2014 (79 FR 20802). Critical habitat was designated September 2, 2005 (70 FR 52629) and does not occur withing the Action Area. This DPS includes naturally spawned anadromous *O. mykiss* (steelhead) originating below natural and manmade impassable barriers from the Columbia River and its tributaries upstream of the Wind and Hood Rivers (exclusive) to and including the Yakima River; excludes such fish originating from the Snake River basin. This DPS also includes fish from a number of artificial propagation programs.

Upper Columbia River Steelhead DPS (Endangered). The ESA listing status for this steelhead DPS was endangered on August 18, 1997 (62 FR 43937); reclassified to threatened on January 5, 2006 (71 FR 833) and August 24, 2009 (74 FR 42605); updated April 14, 2014 (79 FR 20802). Critical habitat was designated September 2, 2005 (70 FR 52629) and does not occur withing the Action Area. This DPS includes naturally spawned anadromous *O. mykiss* (steelhead) originating below natural and manmade impassable barriers from the Columbia River and its tributaries upstream of the Yakima River to the U.S.-Canada border. This DPS also includes fish from a number of artificial propagation programs.

Puget Sound Steelhead DPS (Threatened). The ESA listing status for this steelhead DPS was threatened on May 11, 2007 (72 FR 26722); updated April 14, 2014 (79 FR 20802). Critical habitat was designated February 24, 2016 (81 FR 9252) and does not occur withing the Action Area. This DPS includes naturally spawned anadromous *O. mykiss* (steelhead) originating below natural and manmade impassable barriers from rivers flowing into Puget Sound from the Elwha River (inclusive) eastward, including rivers in Hood Canal, South Sound, North Sound and the Strait of Georgia. This DPS also includes fish from a number of artificial propagation programs.

Snake River Steelhead DPS (Threatened). The ESA listing status for this steelhead DPS was threatened on August 18, 1997 (62 FR 43937) and January 5, 2006 (71 FR 833); updated April 14, 2014 (79 FR 20802). Critical habitat was designated September 2, 2005 (70 FR 52629) and does not occur withing the Action Area. This DPS includes all naturally spawned anadromous *O. mykiss* (steelhead) originating below natural and manmade impassable barriers from the Snake River basin. This DPS also includes fish from a number of artificial propagation programs.

Upper Willamette River Steelhead DPS (Threatened). The ESA listing status for this steelhead DPS was threatened on March 25, 1999 (64 FR 14517) and January 5, 2006 (71 FR 833); updated April 14, 2014 (79 FR 20802). Critical habitat was designated September 2, 2005 (70 FR 52629) and does not occur withing the Action Area. This DPS includes naturally spawned anadromous winter-run steelhead originating below natural and manmade impassable barriers from the Willamette River and its tributaries upstream of Willamette Falls, to and including the Calapooia River.

7.2.4 Chum Salmon (*Oncorhynchus keta*)

Chum salmon are found are found throughout the North Pacific Ocean and range from the Arctic coast of Canada and throughout the northern coastal regions of North America and Asia. In the United States, chum salmon are found throughout Alaska and as far south as Yaquina Bay, Oregon, on the West Coast.

They are anadromous—they hatch in freshwater streams and rivers then migrate out to the saltwater environment of the ocean to feed and grow. Chum salmon do not reside in fresh water for an extended period and young chum salmon (fry) typically migrate directly to estuarine and marine waters soon after they are born. As they grow larger, they migrate offshore across the North Pacific Ocean. As they approach sexual maturity, they migrate back into coastal waters and return to the fresh water area where they were born to spawn, typically spawn between the ages of 3 and 6. They spawn from late summer to March, with peak spawning concentrated in early winter when the river flows are high. They usually nest in areas in the lowermost reaches of rivers and streams, within 60 miles of the ocean. Young chum salmon feed on insects as they migrate downriver and on insects and marine invertebrates in estuaries and near-shore marine habitats. Adults eat copepods, fishes, mollusks, squid, and tunicates.

Within the Action Area two ESUs may occur that are threatened under the ESA.

Columbia River Chum ESU (Threatened). The listing status for this coho salmon ESU was determined to be threatened March 25, 1999 (64 FR 14508) and June 28, 2005 (70 FR 37159); updated April 14, 2014 (79 FR 20802). Critical habitat was designated on September 2, 2005 (70 FR 52629) and does not overlap with the Action Area. This ESU naturally spawned chum salmon originating from the Columbia River and its tributaries in Washington and Oregon. Coho salmon that originate from three artificial propagation programs are also included. This ESU also includes fish from a number of artificial propagation programs.

Hood Canal Summer-run Chum ESU (Threatened). The listing status for this coho salmon ESU was determined to be threatened on March 25, 1999 (64 FR 14508) and June 28, 2005 (70 FR 37159); updated April 14, 2014 (79 FR 20802). Critical habitat was designated on September 2, 2005 (70 FR 52629) and does not overlap with the Action Area. This ESU includes naturally spawned summer-run chum salmon originating from Hood Canal and its tributaries as well as from Olympic Peninsula rivers between Hood Canal and Dungeness Bay (inclusive). This ESU also includes fish from a number of artificial propagation programs.i

7.3 Other Anadromous Fish: Green Sturgeon and Eulachon

7.3.1 Green Sturgeon (*Acipenser medirostris*), Southern DPS (Threatened).

The North American green sturgeon occurs in the nearshore Eastern Pacific Ocean from Alaska to Mexico (Huff et al. 2012). Green sturgeon are long-lived, late-maturing, iteroparous, anadromous species that spawn infrequently in natal streams, and spend substantial portions of their lives in marine waters. NMFS has identified two DPSs of green sturgeon: northern and southern (Israel et al. 2009). In 2006, NMFS determined that the Southern DPS of green sturgeon warranted listing as a threatened species under the ESA (71 FR 17757). Green sturgeon have been observed in large concentrations in the summer and autumn within coastal bays and estuaries along the west coast of the U.S., including the Columbia River estuary, Willapa Bay, Grays Harbor, San Francisco Bay and Monterey Bay (Huff et al. 2012; Lindley et al. 2011; Lindley et al. 2008; Moser and Lindley 2007). Maximum recorded depth for green sturgeon has been 167 m (Love et al. 2021).

On October 9, 2009, NMFS designated critical habitat for the Southern DPS of green sturgeon (74 FR 52300). Critical habitat is designated in coastal U.S. marine waters within 110 m (60 fathoms) depth from Monterey Bay, California (including Monterey Bay), north to Cape Flattery, Washington, including the Strait of Juan de Fuca, Washington, to its United States boundary; the Sacramento River, lower Feather River, and lower Yuba River in California; the Sacramento-San Joaquin Delta and Suisun, San Pablo, and San Francisco bays in California; the lower Columbia River estuary; and certain coastal bays and estuaries in California (Humboldt Bay), Oregon (Coos Bay, Winchester Bay, Yaquina Bay, and Nehalem Bay), and Washington (Willapa Bay and Grays Harbor).

7.3.2 Eulachon (*Thaleichthys pacificus*) Southern DPS (Threatened).

The eulachon is a small, cold-water species of anadromous fish, occupying the eastern Pacific Ocean in nearshore waters to depths of about 300 m (1,000 ft) from California to the Bering Sea. Eulachon return to their natal rivers to spawn. The Southern DPS was first listed as threatened by NMFS on March 18, 2010 (75 FR 13012). On October 20, 2011, NMFS designated critical habitat for Southern DPS eulachon (76 FR 65324), which does not overlap with the Action Area. Southern DPS eulachon are those that spawn in rivers south of the Nass River in British Columbia to the Mad River in California (NMFS 2016).

7.4 Invertebrates

7.4.1 Sunflower Sea Star *(Pycnopodia helianthoides*) (Candidate species for Threatened Status)

The sunflower sea star was proposed to be listed as threatened under the ESA on March 16, 2023 (88 FR 16212). The species is a large, fast moving, many-armed sea star, native to the eastern Pacific Ocean from Baja California, Mexico to the Aleutian Islands, Alaska. The species is most abundant in the waters off eastern Alaska and British Columbia. Between 2013 and 2017, sea star wasting syndrome (SSWS) killed an estimated 90% of the population (Lowry et al. 2022).

The sunflower sea star has no clear associations with specific habitat types or features and is considered a habitat generalist (Gravem et al. 2021). Sunflower sea stars occupy a wide range of benthic substrates including mud, sand, shell, gravel, and rocky bottoms while roaming in search of prey (Konar et al. 2019; Lambert et al. 2000). The diet of adult sunflower sea stars generally consists of benthic and mobile epibenthic invertebrates, including sea urchins, snails, crab, sea cucumbers, and other sea stars (Mauzey et al. 1968; Shivji et al. 1983), and appears to be driven largely by prey availability. They occur in the low intertidal and subtidal zones to a depth of 435 m but are most common at depths less than 25 m and rare in waters deeper than 120 m (Lambert 2000; Hemery et al. 2016; Gravem et al. 2021). The Northwest Fisheries Science Center (NWFSC) conducts West Coast Groundfish Bottom Trawl Surveys annually (Keller et al. 2017) and records the numbers of *P. helianthoides* captured as bycatch during these surveys. The survey follows a depth-stratified random sampling design, spans 32-48.5 degrees latitude, and covers 36-1285 m in depth. NWFSC notes that sunflower sea star density was not particularly high in the trawl survey compared to shallower dive surveys (i.e. less than 36 m). Recently, during seven years of trawling (2015-2021), only seven sunflower sea stars were recorded (Lowry et al., 2022, Appendix A) across an area that was essentially the entire U.S. West Coast. These data indicate that the probability of encountering this species during surveys in the lease areas or cable corridors is extremely low.

Threats to the sunflower sea star were broadly grouped into the five ESA Section 4(a)(1) categories of: 1) present or threatened destruction, modification, or curtailment of habitat or range; 2) overutilization for commercial, recreational, scientific, or educational purposes; 3) competition, disease, or predation; 4) adequacy of existing regulatory mechanisms; and 5) other natural or manmade factors affecting continued existence (Lowry et al. 2022).

7.5 Species Excluded from Analysis

7.5.1 Black Abalone (*Haliotis cracherodii*) Endangered

The black abalone (*Haliotis cracherodii*) was listed as endangered under the ESA in 2009, and critical habitat was designated by NMFS in 2011 (Endangered and Threatened Wildlife and Plants: Final Rulemaking to Designate Critical Habitat for Black Abalone,76 Federal Register 66806–66844 [October 27, 2011]). The distribution of black abalone ranges from approximately Point Arena, Mendocino County, California, south to Bahia Tortugas and Isla Guadalupe in Mexico (Butler et al. 2009). The majority of black abalone live on rocky substrates in the high to low intertidal zone, and it is rarely found deeper than 6 m of water (Butler et al. 2009). Project activities are not expected to overlap with the species' depth range or its critical habitat and are thus excluded from further analysis.

8 BA: Marine Mammals and Sea Turtles—Assessment of ESA-Listed Species and Critical Habitat

The potential IPFs for marine mammals and sea turtles associated with the Proposed Action include noise from HRG and geotechnical surveys, vessel noise, the potential for collision with project-related vessels and potential entanglement in mooring systems associated with the installation of a metocean buoy, as well as accidental release of pollutants and marine debris.

Lessees incorporate best management practices into their plans. These have been developed through years of conventional energy operations and refined through BOEM's renewable energy program and consultations with NMFS, including vessel strike avoidance measures, visual monitoring, and shutdown and reporting. These measures, which will minimize or eliminate potential effects from site characterization surveys and site assessment activities to protected marine mammal and sea turtle species, are found in Appendix A.

8.1 Noise Impacts

8.1.1 High-Resolution Geophysical (HRG) Surveys

Source levels and frequencies of HRG equipment were measured under controlled conditions and represent the best available information for HRG sources (Crocker and Fratantonio 2016). Using 19 HRG source levels (excluding side-scan sonars operating at frequencies greater than 180 kHz, and other equipment that is unlikely to be used for data collection/site characterization surveys associated with offshore renewable energy) with NOAA's sound exposure spreadsheet tool, injury (PTS) exposure distance ranges were calculated for ESA-listed species (Table 13). To provide the maximum impact scenarios, the highest power levels and most sensitive frequency setting for each hearing group was used. A geometric spreading model, together with calculations of absorption of high frequency acoustic energy in sea water, when appropriate, was used to estimate injury and disturbance distances for listed marine mammals. The spreadsheet and geometric spreading models do not consider the tow depth and directionality of the sources; therefore, these are likely overestimates of actual injury and disturbance distances. All sources were analyzed at a tow speed of 2.315 meters per second (m/s) (4.5 kn).

The disturbance distances depend on the equipment and the species present. The range of disturbance distances for all ESA-listed marine mammal and sea turtle species expected to occur in the Action Area is from 40–502 m (131–1,647 ft), with sparkers producing the upper limit of this range (Table 14). Visual monitoring requirements of a 500 m (1,640 ft) exclusion zone for ESA-listed large whales will ensure that any potential impacts to these species from noise generated by HRG survey equipment will be reduced to insignificant levels.

The largest possible disturbance distance for sea turtles is 90 m from a HRG vessel. In a scenario where a vessel is approaching a turtle at 90 m, it will reach the turtle in 39 seconds at a speed of 4.5 kn. Subsequently, a vessel could pass a turtle and be beyond the 90 m disturbance distance in another 39 sec. Therefore, the largest potential disturbance time is likely to be no longer than 78 seconds along any given survey line. BOEM believes that these brief, periodic disturbances will have discountable effects on sea turtles.

The purpose of the clearance zone is to monitor for behavioral disturbance when ESA-listed species are within the survey area and to watch for any animals heading toward the exclusion zone. For any animals sighted within the clearance zone, a shut-down would not be required unless adverse responses are observed or animals are in distress (e.g., an injured or entangled animal). The purpose of the exclusion zones for all listed marine mammal species is to avoid or minimize the number of exposures by means of monitoring and HRG equipment shut-down provisions when listed marine mammals are sighted within the exclusion distance. A description of the PDCs and associated BMPs for PSOs, including clearance zones, exclusion zones, shut-downs, and ramp-up requirements can be found in Appendix A. Harm from periodic behavioral reactions to HRG survey noise is not expected to occur for any ESA-listed species with the implementation of the proposed PDCs.

Disturbance distances to ESA-listed marine mammal and sea turtle species are conservative, as explained above, and any behavioral effects will be intermittent and short in duration and are expected to result in **discountable to insignificant** effects.

Table 13. PTS Exposure Distances (in meters) for marine mammal hearing groups from mobile HRG sources towed at 4.5 knots for a) impulsive and b) non-impulsive sources.

a) mobile, impulsive, intermittent sources

HRG Source	Highest Source Level (dB re 1 µPa)	Low Frequency (e.g., Baleen Whales)[1]	Mid-Frequency (e.g., Dolphins, Sperm Whales)[1]	High Frequency (e.g., Porpoise)	Phocids (True Seals)	Otariids (Sea Lions, Fur Seals)	Sea Turtles	Fishes
Boomers, Bubble Guns (4.3 kHz)	176 dB SEL, 207 dB RMS, 216 peak	0.3	0	5	0.2	0	0	3.2
Sparkers (2.7 kHz)	188 dB SEL, 214 dB RMS, 115 peak	12.7	0.2	47.3	6.4	0.1	0	9/0
CHIRP Sub-Bottom Profilers (5.7 kHz)	193 dB SEL, 209 dB RMS, 214 peak	1.2	0.3	35.2	0.9	0	NA	NA

b) mobile, non-impulsive, intermittent sources

HRG Source	Highest Source Level (dB re 1 µPa)	Low Frequency (e.g., Baleen Whales)[1]	Mid-Frequency (e.g., Dolphins, Sperm Whales)[1]	High Frequency (e.g., Porpoise)	Phocids (True Seals)	Otariids (Sea Lions, Fur Seals)	Sea Turtles	Fishes
Multibeam echosounder (100 kHz)	185 dB SEL, 224 dB RMS, 228 peak	0	0.5	251.4*	0	0	NA	NA
Multibeam echosounder (>200 kHz)	182 dB SEL, 218 dB RMS, 223 peak	NA	NA	NA	NA	NA	NA	NA
Side-scan sonar (>200 kHz)	184 dB SEL, 220 dB RMS, 226 peak	NA	NA	NA	NA	NA	NA	NA

[1] PTS exposure distances for listed marine mammals were calculated with NOAA's sound exposure spreadsheet tool using sound source characteristics for HRG sources in Crocker and Fratantonio (2016).

* This range is conservative as it assumes full power, an omnidirectional source, and does not consider absorption over distance.

NA = not applicable due to the sound source being out of the hearing range for the group.

RMS = root mean square   SEL = sound exposure level

Table 14. Maximum disturbance distances (in meters) for marine mammal hearing groups from mobile HRG sources towed at 4.5 knots for a) impulsive and b) non-impulsive sources.

a) mobile, impulsive, intermittent sources

HRG Source	Low Frequency (e.g., Baleen Whales)[1]	Mid-Frequency (e.g., Dolphins and Sperm Whales)[1]	High Frequency (e.g., Porpoise)	Phocids (True Seals)	Otariids (Sea Lions and Fur Seals)	Sea Turtles	Fishes
Boomers, Bubble Guns (4.3 kHz)	224	224	224	224	224	40	708
Sparkers (2.7 kHz)	502	502	502	502	502	90	1,585
CHIRP Sub-Bottom Profilers (5.7 kHz)	282	282	282	282	282	50	NA

b) mobile, non-impulsive, intermittent sources

HRG Sources	Low Frequency (e.g., Baleen Whales)[1]	Mid-Frequency (e.g., Dolphins and Sperm Whales)[1]	High Frequency (e.g., Porpoise)	Phocids (True Seals)	Otariids (Sea Lions and Fur Seals)	Sea Turtles	Fishes
Multibeam echosounder (100 kHz)		370	370	NA	NA	NA	NA
Multibeam echosounder (>200 kHz)	NA	NA	NA	NA	NA	NA	NA
Side-scan sonar (>200 kHz)	NA	NA	NA	NA	NA	NA	NA

[1] Disturbance distances for listed marine mammals were calculated with NOAA's Associated Level B Harassment Isopleth Calculator using sound source characteristics for HRG sources in Crocker and Fratantonio (2016).

NA = not applicable due to the sound source being out of the hearing range for the group.

8.1.2 Geotechnical Surveys

Geotechnical surveys (vibracores, piston cores, gravity cores) related to offshore renewable energy activities are typically numerous, but very brief, sampling activities that introduce relatively low levels of sound into the environment. General vessel noise is produced from vessel engines and dynamic positioning to keep the vessel stationary while equipment is deployed, and sampling conducted. Recent analyses of the potential impacts to protected species exposed to noise generated during geotechnical survey activities determined that effects to protected species from exposure to this noise source are extremely unlikely to occur (Anderson 2021).

8.1.3 Vessel Noise

The vessels used for the Proposed Action will produce low-frequency, broadband underwater sound below 1 kHz (for larger vessels), and higher-frequency sound between 1 kHz to 50 kHz (for smaller vessels), although the exact level of sound produced varies by vessel type.

The general frequency range for vessel noise (10 to 1,000 Hz; MMS 2007) overlaps with the generalized hearing range for blue, fin, sei, humpback (7 Hz to 35 kHz) and sperm whales (150 Hz to 160 kHz) and would therefore be audible. Vessels without ducted propeller thrusters would produce levels of noise of 150 to 170 dB re 1 μPa-1 meter at frequencies below 1,000 Hz, while the expected sound-source level for vessels with ducted propeller thrusters level is 177 dB (RMS) at 1 meter (BOEM 2015, Rudd et al. 2015). For ROVs, source levels may be as high as 160 dB (BOEM 2021). Given that the noise associated with the operation of project vessels is below the thresholds that could result in injury, no injury is expected.

In the open ocean, ambient noise levels are between about 60 and 80 dB re 1 μPa in the band between 10 Hz and 10 kHz due to a combination of natural (e.g., wind) and anthropogenic sources (Urick 1983), while inshore noise levels, especially around busy ports, can exceed 120 dB re 1 μPa. When the noise level is above the sound of interest, and in a similar frequency band, masking could occur. This analysis assumes that any sound that is above ambient noise levels and within an animal's hearing range may potentially cause masking. However, the degree of masking increases with increasing noise levels; a noise that is just detectable over ambient levels is unlikely to cause any substantial masking.

Vessel noise has the potential to disturb marine mammals and elicit an alerting, avoidance, or other behavioral reaction. These reactions are anticipated to be short-term, likely lasting the amount of time the vessel and the whale are in close proximity (Magalhães et al. 2002; Richardson et al. 1995; Watkins 1981), and not consequential to the animals. Additionally, short-term masking could occur. Masking by passing ships or other sound sources transiting the Action Area would be short term and intermittent, and therefore unlikely to result in any substantial costs or consequences to individual animals or populations. Areas with increased levels of ambient noise from anthropogenic noise sources such as areas around busy shipping lanes and near harbors and ports may cause sustained levels of masking for marine mammals, which could reduce an animal's ability to find prey, find mates, socialize, avoid predators, or navigate (Anderson 2021).

Based on the best available information, ESA-listed whales are either not likely to respond to vessel noise or are not likely to measurably respond in ways that would significantly disrupt normal behavior patterns that include, but are not limited to, breeding, feeding, or sheltering. Therefore, the effects of vessel noise on ESA-listed whales are insignificant (i.e., so minor that the effect cannot be meaningfully evaluated or detected) (Anderson 2021).

Per Anderson (2021) ESA-listed turtles could be exposed to a range of vessel noises within their hearing abilities. Depending on the context of exposure, potential responses of leatherback and loggerhead sea turtles to vessel noise disturbance would include startle responses, avoidance, or other behavioral reactions, and physiological stress responses. Very little research exists on sea turtle responses to vessel noise disturbance. Currently, there is nothing in the available literature specifically aimed at studying and quantifying sea turtle response to vessel noise. However, a study examining vessel strike risk to green sea turtles suggested that sea turtles may habituate to vessel sound and may be more likely to respond to the sight of a vessel rather than the sound of a vessel, although both may play a role in prompting reactions (Hazel et al. 2007). Regardless of the specific stressor associated with vessels to which turtles are responding, they only appear to show responses (avoidance behavior) at approximately 10 m or closer (Hazel et al. 2007).

Therefore, the noise from vessels is not likely to affect sea turtles from further distances, and disturbance may only occur if a sea turtle hears a vessel nearby or sees it as it approaches. These responses appear limited to non-injurious, minor changes in behavior based on the limited information available on sea turtle response to vessel noise.

For these reasons, vessel noise is expected to cause minimal disturbance to sea turtles. If a sea turtle detects a vessel and avoids it or has a stress response from the noise disturbance, these responses are expected to be temporary and only endure while the vessel transits through the area where the sea turtle encountered it. Therefore, sea turtle responses to vessel noise disturbance are considered insignificant (i.e., so minor that the effect cannot be meaningfully evaluated), and a sea turtle would be expected to return to normal behaviors and stress levels shortly after the vessel passes by.

8.2 Vessel Collisions: Monitoring, Reporting, and Avoiding

BOEM and BSEE monitor for any takes that have occurred as a result of vessel strikes by requiring any operator of a vessel immediately report the striking of any ESA-listed marine animal (see PDC 7). BOEM's BMPs for PDC 4 (Minimize Vessel Interactions with ESA-listed Species) requires operators to implement measures to minimize the risk of vessel strikes to protected species and report observations of injured or dead protected species. This BMP will be required for every applicable permit and plan that has associated vessel traffic that is approved by BOEM or BSEE. BOEM's BMP states that Lessees will have qualified PSOs on board, or dedicated crew on watch to monitor a vessel strike avoidance zone for protected species. Section A.4.1, 2d-2g has BMPs for vessel speed reductions when a marine mammal or sea turtle is seen. Crews must immediately report sightings of an injured or dead marine mammal or sea turtle to the West Coast Stranding Hotline, regardless of whether the injury or death was caused by their vessel. If the operator's vessel collided with a protected species, BOEM and BSEE must be notified within 24 hours of the strike (PDC 4 & PDC 7 apply).

Lessees will also be directed to NMFS' Marine Life Viewing Guidelines, which highlight the importance of these measures for avoiding impacts to mother/calf pairs (https://www.fisheries.noaa.gov/topic/marine-life-viewing-guidelines#guidelines-&-distances). Additionally, wherever available, Lessees will ensure all vessel operators check for daily information regarding protected species sighting locations. These media may include, but are not limited to: Channel 16 broadcasts, whalesafe.com, and the Whale/Ocean Alert App.

The range of the West Pacific DPS of leatherback sea turtles overlaps with high-density vessel traffic areas, and it is possible that the vast majority of vessel strikes are undocumented. However, information on vessel strikes for other locations is not available (NMFS and USFWS 2020a). Additionally, vessel strikes (e.g., hull impacts and propeller lacerations) likely injure or kill loggerheads. However, few vessel strikes are documented, and no estimate of the frequency of occurrence if available. Therefore, the effect on the DPS is unknown (NMFS and USFWS 2020b).

Rockwood et al (2017) recommend types of enhanced conservation measures to decrease ship strike mortality. The potential for effects to all ESA-listed species from vessel traffic associated with data collection activities are expected to be reduced to **discountable levels** with the implementation of the BMP for vessel operations (see Appendix A). Similar activities have taken place since at least 2012 in association with BOEM's renewable energy program in the Atlantic OCS, and there have been no reports of any vessel strikes of marine mammals and sea turtles.

8.3 Entanglement or Entrapment in Cables, Moorings, Moon Pools, or Other Potential Hazards

Reviews of entanglements of large whales and sea turtles have led to recommendations to reduce the risk of entangling animals (IWC 2016; NMFS 2015), some of which are practicable for marine industries in general. General recommendations to reduce entanglement risks include reduced number of buoy lines, no floating line at the surface which have a high risk of interacting with turtles and whales that spend a good deal of time at the surface of the water. Other recommendations include reducing the amount of slack in line. Use sinking lines, rubber-coated lines, sheaths, chains, acoustic releases, weak links, and other potential solutions to lower entanglement risk. Weak links may not be feasible if there is a risk of the data buoy being lost, but they may be feasible on ancillary lines that will not affect the integrity of the buoy mooring. However, there are several best practices available that can reduce risks on all mooring types. BOEM's BMPs to use the best available technologies to reduce entanglement risks greatly reduce the risk of entanglement.

There are no recorded events of ESA-listed species becoming entangled in ROV cables; however, to minimize this risk, BOEM requires protected species observers to monitor a clearance zone (600 m for ESA-listed species) for 30 minutes before any ROVs are deployed to make sure no ROVs are deployed around ESA-listed species.

PNNL deployed two LiDAR metocean buoys – one in the Humboldt WEA and one in the Morro Bay WEA (PNNL 2019). Including the multiple metocean buoys deployed along the NE Atlantic coast associated with site assessment activities, no incidents of entanglement have been reported to date. BOEM continues to work with lessees and requires the use of the best available mooring systems, using the shortest practicable line lengths, anchors, chain, cable, or coated rope systems, to prevent or reduce to discountable levels any potential entanglement of marine mammals and sea turtles. BOEM reviews each buoy design to ensure that reasonable low-risk mooring designs are used. Potential impacts on ESA-listed species from entanglement related to buoy deployment and operation are thus expected to be **discountable**.

Lost or derelict fishing gear may become entangled in the metocean buoy lines and present an entanglement risk to protected species. Approximately 12 metocean buoys will be deployed as part of the Proposed Action. From 1982–2017, direct entanglements in fishing gear were most attributed to unidentifiable gear, netting and pot/traps (Saez et al. 2021). Changes in gillnet fishing regulations helped address the 1980's increase which was primarily gray whales entangled with gillnets (Saez et al. 2021). Considering the general inshore deployment (~200 ft water depth) and weight of pot traps, it is unlikely that these will be moved in such a way as to become entangled in 6 offshore metocean buoy lines and present an entanglement risk to protected species. Risk of secondary entanglement related to buoy deployment and operation are thus expected to be **discountable**.

Any potential displacement of fishing effort as a result of leasing and site characterization and site assessment activities are described in (BOEM 2022), and are expected to be limited in spatial scope, considering existing fishing grounds, and short-term. Entanglement impacts to marine mammals and sea turtles, as a result of displaced fishing effort, are expected to be **discountable**.

Moon pool usage presents a potential for marine mammals and sea turtles to become entrapped. Moon pools may be used offshore Oregon to deploy and/or retrieve equipment (e.g., ROVs, AUVs). There is no known record of entrapment of protected species in the moon pools in the Pacific. The limited occurrence of sea turtles in Oregon waters, as well as BOEM's BMPs described in Appendix A, reduce the potential impact from moon pools to **discountable** levels.

8.4 Accidental Release of Pollutants and Marine Debris

A spill of petroleum product could occur as a result of hull damage from allisions with a met buoy, collisions between vessels, accidents during the maintenance or transfer of offshore equipment and/or crew, or due to natural events (i.e., strong waves or storms). From 2000 to 2009, the average spill size for vessels other than tank ships and tank barges was 88 gallons (USCG 2011); should a spill from a vessel associated with the Proposed Action occur, BOEM anticipates that the volume would be similar. Diesel fuel is lighter than water and may float on the water's surface or be dispersed into the water column by waves. Diesel would be expected to dissipate very rapidly, evaporate, and biodegrade within a few days (MMS 2007). The NOAA's Automated Data Inquiry for Oil Spills (an oil weathering model) was used to predict dissipation of a maximum spill of 2,500 barrels, a spill far greater than what is assumed as a non-routine event during the Proposed Action. Results of the modelling analysis showed that dissipation of spilled diesel fuel is rapid. The amount of time it took to reach diesel fuel concentrations of less than 0.05% varied between 0.5 and 2.5 days, depending on ambient wind (TetraTech Inc. 2015), suggesting that 88 gallons would reach similar concentrations much faster and limit the environmental impact of such a spill.

Vessels are expected to comply with USCG requirements relating to prevention and control of oil spills, and most equipment on the met and buoys would be powered by batteries charged by small wind turbines and solar panels. BOEM expects that each of the vessels involved with site characterization and site assessment activities would minimize the potential for a release of oils and/or chemicals in accordance with 33 CFR Parts 151, 154, and 155, which contain guidelines for implementation and enforcement of vessel response plans, facility response plans, and shipboard oil pollution emergency plans. Based on the size of the spill, it would be expected to dissipate very rapidly and would then evaporate and biodegrade within a day or two (at most), limiting the potential impacts to a localized area for a short duration and result in **discountable** effects to ESA-listed marine mammal and sea turtle species.

Records of interactions between anthropogenic marine debris and wildlife have been increasing rapidly in recent decades and is a cumulative source of impacts on ESA-listed species and other marine life. In the marine environment alone, the number of species reported to be affected by debris increased by more than 159% during 1995–2015 (Fossi et al. 2018). Sea turtles are reported to be ingesting large amounts of debris worldwide (Schuyler et al. 2013). Lessees are prohibited from deliberately discharging containers and other similar materials (i.e., trash and debris) into the marine environment (30 C.F.R. 250.300(a) and (b)(6)) and are required to make durable identification markings on equipment, tools, containers (especially drums), and other material (30 C.F.R. 250.300(c)). The intentional jettisoning of trash has been the subject of strict laws such as MARPOL, Annex V and the Marine Plastic Pollution Research and Control Act, and regulations imposed by various agencies including USCG and EPA. As a BMP to reduce the anthropogenic impact of marine debris, BSEE NTL 2015-G03 "Marine Trash and Debris Awareness and Elimination" provides guidance to prevent intentional and/or accidental introduction of debris into the marine environment. BOEM also requires that operators ensure that all offshore employees and those contractors actively engaged in their offshore operations complete awareness training that includes viewing a training video or slide show (specific options are outlined in the NTL. With continued training and awareness, marine debris is not expected to be a significant concern from the Proposed Action and the effects to ESA-listed marine mammal and sea turtle species will be **discountable**.

8.5 Critical Habitat Impacts and Determinations

Effective May 21, 2021, NMFS issued an updated final rule to designate critical habitat for the endangered Central America DPS, and the threatened Mexico DPS of **humpback whales** (*Megaptera novaeangliae*) (86 FR 21082). Critical habitat for these DPSs serve as feeding habitat and contain the essential biological feature of humpback whale prey. Critical habitat for the Central America DPS of humpback whales contains approximately 48,521 square nautical miles (nmi^2) of marine habitat in the North Pacific Ocean within the portions of the California Current Ecosystem off the coasts of Washington, Oregon, and California. Specific areas designated as critical habitat for the Mexico DPS of humpback whales contain approximately 116,098 nmi^2 of marine habitat in the North Pacific Ocean, including areas within portions of the eastern Bering Sea, Gulf of Alaska, and California Current Ecosystem. The nearshore boundary of the endangered Central America DPS of humpback whales is defined by the 50-m isobath. The offshore boundary is defined by the 1,200-m isobath relative to MLLW; except, in areas off Oregon south of 42 degrees 10 minutes, the offshore boundary is defined by the 2,000-m isobath (NMFS Office Of Protected Resources 2024: Humpback Whale (Central America DPS) from 2010-06-15 to 2010-08-15. NOAA National Centers for Environmental Information, https://www.fisheries.noaa.gov/inport/item/65375). Both Oregon WEAs have large areas of overlap with humpback whale critical habitat (Figure 8). Any displacement of prey species as a result of vessel transits and surveys conducted as part of the Proposed Action are anticipated to be short-term and temporary and are **not anticipated to destroy or adversely modify** critical habitat.

Critical habitat for the endangered **Southern Resident DPS of killer whales** was designated in the summer core area in Haro Strait and waters around the San Juan Islands, Puget Sound, and the Strait of Juan de Fuca (79 FR 69054). In August 2021, NOAA Fisheries revised the critical habitat designation for Southern Resident killer whales (SRKW; *Orcinus orca*). The final rule maintains the previously designated critical habitat in inland waters of Washington and expands it to include certain coastal waters off Washington, Oregon, and California. The revision adds to critical habitat approximately 15,910 square miles of marine waters between the 6.1-meter and 200-meter depth contours from the U.S.-Canada border to Point Sur, California(86 FR 41668; https://www.fisheries.noaa.gov/west-coast/endangered-species-conservation/critical-habitat-southern-resident-killer-whales). Any displacement of prey species or individuals as a result of limited vessel transits, to and from the WEAs to their respective and/or alternative ports, conducted as part of the Proposed Action, are anticipated to be short-term and temporary and are **not anticipated to destroy or adversely modify** critical habitat.

Critical habitat (feeding) for **leatherback sea turtles** stretches along the California coast from Point Arena to Point Arguello east of the 3,000-meter depth contour, and from Cape Flattery, Washington to Cape Blanco, Oregon east of the 2,000-m depth contour. During the critical habitat review, it was determined that the oceanographic features of the general area off Morro Bay produce prey of sufficient condition, distribution, abundance, and density to provide for foraging that is essential to the conservation of leatherback sea turtles, i.e., “high” conservation value (NMFS 2012). Displacement of prey species or individuals as a result of limited vessel surveys and transits conducted as part of the Proposed Action, are anticipated to be short-term and temporary and are **not anticipated to destroy or adversely modify** critical habitat.

9 BA: Fishes and Invertebrates—Assessment of ESA-Listed Species and Critical Habitat

This section discusses potential effects of the identified impact-producing factors (IPFs) that may affect listed fish and invertebrate species. BOEM has identified two potential IPFs generated by activities associated with site characterization and assessment: noise and habitat alteration/turbidity. A summary description of each impacting source are the resulting effects to ESA-listed species are discussed below.

9.1 Noise

Being a dense medium, water transmits sound faster and for longer distances than air transmits sound. Aquatic organisms may use this phenomenon to quickly glean information about their environment over relatively large areas. Fishes possess two mechanoreception sensory systems to detect sound in their environment. The first is the lateral line system (LLS) which is a series of pore-receptors along the body of a fish. The LLS detects vibration and pressure gradients in the water within a few body lengths of the organism. The lateral line detects particle motion at low frequencies from below 1 hertz (Hz) up to at least 400 Hz (Hastings & Popper 2005; Higgs & Radford 2013).

The second hearing organ fish possess is an inner ear (Popper & Hawkins 2019). For most species, the inner ear contains three dense otoliths (small calcareous bones) that sit atop many delicate hair cells, comparable to the hair cells found in the mammalian ear. Sound waves in water pass through the fish's body, which has a composition similar to water, but will differentially affect the heavier otoliths. This causes a change in the relative motion between the otoliths and the surrounding body tissues and can be detected by the hair cells and sensed by the nervous system.

Some fishes possess additional morphological adaptations or specializations that can enhance their sensitivity to sound pressure, such as an anatomical extension that connects a gas-filled swim bladder to the auditory system (Astrup 1999; Popper & Fay 2010; Popper & Hawkins 2019). The swim bladder can enhance sound detection by converting acoustic pressure into localized particle motion, which may then be detected by the inner ear (Radford et al. 2012). Fishes with a swim bladder generally have better sensitivity to sound and can detect higher frequencies than fishes without a swim bladder (Popper & Fay 2010; Popper et al. 2014). In addition, structures such as gas-filled bubbles near the ear or swim bladder also increase sensitivity and allow for high-frequency hearing capabilities and better sound pressure detection.

Many fishes use sound to (1) find food, habitat, and mates; (2) provide orientation cues for migration; (2) communicate during territorial defense, aggression, mating, and as a method of indicating alarm; and (3) detect and avoid predators (Popper and Hawkins 2019). Anthropogenic noise may mask, disrupt, or distract organisms that use sound as a source of information for these important activities. Noise at very high energy levels may affect fish directly by increasing stress levels, causing temporary or permanent loss of hearing, damage to body tissues, or increased mortality rates (Popper and Hawkins 2019).

Most native fishes on the Pacific Coast are hearing generalists and are most sensitive to particle motion. Hearing generalist species include salmonids and green sturgeon because, although they possess a swim bladder, they lack the accessory organs that connect the swim bladder to the inner ear, and this makes them less able to detect sound pressure waves. Eulachon do not possess a swim bladder (Gustafson et al. 2022), which makes them comparatively insensitive to noise impacts. Although particle motion may be the more relevant exposure metric for many fish species, there are few data available that measure it due to a lack of standard measurement methodology and experience with particle motion detectors (Popper et al 2014). Historically, studies that have investigated hearing in fishes and the consequences of anthropogenic noise have been carried out with sound pressure metrics. In these instances, particle motion can be inferred from pressure measurements (Nedelec et al. 2016). Further discussion regarding noise impacts to fishes from HRG surveys is found in Section 4.1 Acoustic Impacts.

Because invertebrate species lack gas-filled structures within their bodies, they may be less sensitive to anthropogenic noise sources compared to fishes, although many taxa appear to have morphological structures (e.g., hair cells) that can be sensitive to particle motion (Popper & Hawkins 2018). A recent review indicates that some invertebrates change their behavior when exposed to chronic shipping noise (Murchy et al. 2019). Much more research needs to be done to determine if such behavior changes translate into population-level effects. The low levels of expected anthropogenic noise are not known to permanently alter characteristics of pelagic or benthic habitats. Due to the shallow distribution of the sunflower sea star, it will be minimally exposed to noise from HRG surveys, buoy installation and retrieval, and geological and/or biological collections. Therefore, project activities are expected to have no detectable adverse effects to the sunflower sea star.

Noise produced by project activities result from the operation of marine vessels and from survey and biological collection. Adverse effects related to noise exposure, if any, are expected to last for the duration of the activities that are producing the noise and are not expected to have long-lasting consequences. For fish species capable of sensing the introduced noise, they may alter their behavior and leave the affected area. Project activities are likely to have temporary, largely undetectable effects to the populations of listed fish species due to the minimal influence project activities may have across larger spatial and temporal scales.

9.2 Habitat Alteration and Turbidity

Project activities that may alter habitats or increase turbidity in the Action Areas include geotechnical and biological sampling, and buoy emplacement, operation, and retrieval.

Geotechnical sampling (gravity cores, piston cores, vibracores, deep borings, cone penetration tests, etc.) and biological grab sampling may damage benthic habitats by permanently removing small amounts of sediments from the seabed. Animals within or on top of these samples will likely be killed. Collection of samples causes nearby disturbance as sediment moves to fill the hole left by the removed core or grab, possibly exposing animals in the surrounding sediment to predators (Skilleter 1996). Sampling may also disrupt microbial assemblages in the sediments and breakdown biotic structures which help bind sediments together (e.g., microbial mats; Skilleter 1996). Recovery rates of sampled areas to baseline conditions are mostly unknown but may exceed several weeks (Skilleter 1996). The distribution of these samples will occur throughout the leases, but the total spatial extent of sampling will be a very small percentage compared to the overall Action Area

Habitat disturbance may cause sediments and benthic organic material to be introduced into the water column and may also increase local turbidity levels. Direct effects from sediment suspension and increased turbidity on fish populations may include exposure to contaminants, changes in feeding rates, reduction in predator-avoidance ability, or smothering of feeding and respiratory organs (Wilber and Clarke 2001; Utne-Palm 2002; Au et al. 2004). To avoid these consequences, fishes may choose to relocate until water clarity returns to levels approximating pre-disturbance conditions. Indirect effects on fish populations from sediment suspension and increased turbidity may occur by harming the populations of prey species on which the fishes depend (Airoldi 2003). Biological response to these potential impacts is often a function of concentration and exposure duration (Newcombe and Jensen 1996). The proposed activities from the project are predicted to generate only minimal and short-term impacts to benthic habitats and cause a negligible increase in suspended materials over a short time frame. The offshore location of the WEAs suggests that terrestrial-based pollutants are not likely to be found in large concentrations within disturbed sediments. Salmon, green sturgeon, eulachon, and sunflower sea star are not likely to occur in the deep benthic habitats of the Action Area where benthic disturbance is most likely to occur. Impacts are expected to be short-term and temporary; therefore, populations of listed fish species are **not likely to be adversely affected** by the proposed benthic sampling activities.

PNNL (2019) assessed potential effects from a data-collecting metocean buoy within the Morro Bay WEA. The consequences to ESA-listed species from buoy emplacement, operations, and retrieval from the proposed project is expected to be similar to those described in PNNL (2019). A buoy system may also function as a small de facto artificial reef, providing a minor amount of additional hard substrate within the WEAs from the anchor, mooring lines, and buoy structure. The environment effects are expected to be similar to that produced by marine debris and generate local increases in biomass and species diversity (Caselle et al. 2002). Indirect effects from buoy emplacement may preserve habitat integrity of the seabed as fishers, especially trawlers, may avoid these areas until buoys are decommissioned. The damage from bottom-contact trawls would then be displaced to outside of the local buoy area. The spatial extent of environmental consequences from buoys will be a small percentage compared to the overall Action Area. Salmon, green sturgeon eulachon, and sunflower sea star are not likely to occur in the deep benthic habitats where habitat alteration due to metocean buoy deployment may occur. Therefore, no effects are expected to populations of listed fish species from these activities.

This analysis is consistent with the findings by NOAA in their Deep Seabed Mining Regulations for Exploration Licenses (15 CFR Part 970, Subpart G Environmental Effects) promulgated under the authority of 30 U.S.C. 1401 et seq. Activities identified to have no significant impact and require no further environmental assessment include: (1) Gravity and magnetometric observations and measurements; (2) Bottom and sub-bottom acoustic profiling or imaging without the use of explosives; (3) Mineral sampling of a limited nature such as those using either core, grab or basket samplers; (4) Water and biotic sampling, if the sampling does not adversely affect shellfish beds, marine mammals, or an endangered species, or if permitted by the National Marine Fisheries Service or another Federal agency; (5) Meteorological observations and measurements, including the setting of instruments; (6) Hydrographic and oceanographic observations and measurements, including the setting of instruments; (7) Sampling by box core, small diameter core or grab sampler, to determine seabed geological or geotechnical properties; (8) Television and still photographic observation and measurements; (9) Shipboard mineral assaying and analysis; and (10) Positioning systems, including bottom transponders and surface and subsurface buoys filed in Notices to Mariners (15 CFR§ 970.701(a)).

9.3 Critical Habitat Impacts and Determinations

Critical habitat for listed **green sturgeon** overlaps with the Action Area. Any displacement of prey species or individuals as a result of vessel transits, conducted as part of the Proposed Action, are anticipated to be short-term and temporary and are **not anticipated to destroy or adversely modify** critical habitat.

10 BA: Cumulative Effects and Conclusions for ESA-Listed Species

10.1 Cumulative Effects

In addition to commercial vessel traffic levels and current commercial fishing activities, aquaculture operations, and Department of Defense operations throughout the Pacific (Argonne 2019).

ESA-listed protected species experience a variety of anthropogenic impacts, including collisions with vessels (ship strikes), entanglement with fishing gear, noise from human activities, pollution, disturbance of marine and coastal environments, climate change, effects on benthic habitat, waste discharge, and accidental fuel leaks or spills. Many marine mammals migrate long distances and are affected by these factors over very broad geographical scales. Potential effects associated with the Proposed Action are expected to be relatively minor. Vessel trips associated with the Proposed Action will not significantly increase vessel traffic in the Action Area. Vessels generally move slowly while surveying or remain stationary. Vessels may transit at **no more than 10 knots** between surveys and departing/returning from ports and offshore areas within the Action Area (Appendix A: PDC 4). The Proposed Action would result in a minor incremental contribution to cumulative impacts. Adherence to BOEM's BMPs (Appendix A) regarding vessel strike avoidance measures and exclusion zones to minimize acoustic impacts would reduce the potential for cumulative impacts on listed marine mammals. Based on the analysis in this BA, BOEM has determined that the incremental contribution to cumulative impacts on marine mammals from the Proposed Action will be discountable.

Leatherback and loggerhead sea turtles are ESA-listed as threatened or endangered and are all highly migratory species that could occur within the Action Area. The most likely impacts on sea turtles as a result of the Proposed Action are minor disturbance at very close ranges through noise exposure, effects of vessel impacts, and the physical placement of metocean buoys. Based on this analysis that considers the low numbers of sightings of leatherbacks and loggerheads in the Action Area, as well as the adherence to BOEM's BMPs regarding vessel strike avoidance measures, marine debris training, mooring BMPs, and measures to reduce exposure to non-injurious sound, BOEM has determined that the incremental contribution to cumulative impacts on leatherback and loggerhead sea turtles from the Proposed Action will be discountable.

Marine fishes are ESA-listed as threatened or endangered and are all migratory species that could occur within the Action Area. The most likely impacts on marine fishes from the Proposed Action are minor disturbance at very close ranges through noise exposure and habitat disturbance. Based on this analysis, as well as the adherence to the BMPs described in Appendix A, BOEM has determined that the incremental contribution to cumulative impacts to marine fishes from the Proposed Action will be discountable.

The sunflower sea star is proposed to be listed as threatened under the ESA. It is a relatively sedentary species that will be primarily found in shallower waters within the Action Area. Most bottom disturbing activities will occur within the lease areas which are deeper than the sunflower sea star's preferred depth range. However, sampling within proposed cable corridors will overlap with its distribution. There are no likely impacts as a result of the Proposed Action since there is minimal overlap in habitat, and noise impacts would not likely to be detectable by the sea star. Based on this analysis, as well as the adherence to the BMPs described in Appendix A, BOEM has determined that the incremental contribution to cumulative impacts to the sunflower sea star from the Proposed Action will be discountable.

10.2 Conclusions for ESA-listed Species

Due to the nature of the proposed activities, as well as the PDCs and BMPs employed as part of the Proposed Action (Appendix A), BOEM has determined that the impacts to protected species and critical habitat from site characterization surveys and site assessment activities will be **negligible and not likely to adversely affect** ESA-listed protected species or associated critical habitat. See Table 15 for a summary of effect determinations for the activities in the Proposed Action.

Table 15. Summary analysis of effects from the Proposed Action on ESA-listed species covered in this BA for a) installation of data collection devices; b) HRG and geotechnical surveys; and c) vessel operations. NLAA = Not Likely to Adversely Affect; NE = No Effect.

a) Installation of metocean buoys, wave gliders, and other data collection devices

Route of Effect	Potential Effect	BMP	Whales	Sea Turtles	Pinnipeds	Fishes	Sunflower Sea Star
Habitat alteration/ turbidity	Foraging/prey availability	N	NE	NLAA	NLAA	NLAA	NLAA
Physical presence of moorings/buoys	Entanglement	Y	NLAA	NLAA	NLAA	NE	NE
Accidental release of pollutants from generators and fuel storage	Water Quality	N	NLAA	NLAA	NLAA	NLAA	NE
Marine debris	Ingestion, entanglement	Y	NLAA	NLAA	NLAA	NE	NE

b) HRG and geotechnical surveys

Route of Effect	Potential Effect	BMP	Whales	Sea Turtles	Pinnipeds	Fishes	Sunflower Sea Star
Noise from HRG surveys	Disturbance	Y	NLAA	NLAA	NLAA	NLAA	NE
Habitat alteration/ turbidity from geotechnical surveys	No effect	N	NE	NE	NLAA	NLAA	NLAA
Noise	Disturbance	Y	NLAA	NLAA	NLAA	NLAA	NE
Side-scan sonar (≥ 200 kHz)	No effect	N	NE	NE	NE	NE	NE

c) Vessel operations

Route of Effect	Potential Effect	BMP	Whales	Sea Turtles	Pinnipeds	Fishes	Sunflower Sea Star
Strikes	Injury	Y	NLAA	NLAA	NLAA	NE	NE
Moon pools	Injury	Y	NLAA	NLAA	NLAA	NE	NE
Noise from vessel transit and operation	Disturbance	N	NLAA	NLAA	NLAA	NLAA	NE
Noise from engines and thrusters	Disturbance	Y	NLAA	NLAA	NLAA	NLAA	NE
Impingement	No Effect	N	NE	NE	NE	NE	NE

11 Essential Fish Habitat (EFH) Assessment

Prepared by the Bureau of Ocean Energy Management for the National Marine Fisheries Service in Accordance with the Magnuson-Stevens Fishery Conservation and Management Act, as Amended in 1996.

11.1 Purpose

Under Section 305 (b) (2) of the Magnuson Fishery Conservation and Management Act (16 U.S.C. 1801 et seq.) as amended by the Sustainable Fisheries Act on October 11, 1996, Federal agencies are required to consult with the Secretary of Commerce on any actions that may adversely affect Essential Fish Habitat (EFH). The Department of Commerce published an interim final rule (50 CFR Part 600) in the Federal Register (December 19, 1997, Volume 62, Number 244) that detailed the procedures under which Federal agencies would fulfill their consultation requirements. As set forth in the regulations, EFH Assessments must include: 1) a description of the Proposed Action; 2) an analysis of the effects, including cumulative effects, of the action on EFH, the managed species, and associated species by life history stage; 3) the Federal agency's views regarding the effects of the action on EFH; and 4) proposed mitigation if applicable.

11.2 Project Description

This EFH assessment covers lease issuance, site characterization, and site assessment for the Brookings and Coos Bay Wind Energy Areas (WEAs). Details and maps of the Action Areas are provided in the introduction section (section 1) of this document.

11.3 Managed Species

The Pacific Fishery Management Council (PFMC) manages or monitors (as ecosystem component species) numerous fishes and invertebrates under four Fishery Management Plans (FMPs): 1) Coastal Pelagic Fishery Management Plan; 2) Highly Migratory Species Fishery Management Plan; 3) Pacific Groundfish Fishery Management Plan; and 4) Pacific Salmon Fishery Management Plan (Table 16) (PFMC 2022a,b; PFMC 2023a,b). In addition to species identified under these four FMPS, a suite of shared ecosystem component species is also monitored.

Table 16. Fish and invertebrate species managed or monitored by the Pacific Fishery Management Council. Species distributions that overlap with the WEAs and nearby Action Area = X; species distributions that potentially overlap within the WEAs and nearby Action Area = ?; species distributions that do not overlap with the WEA or nearby Action Area = *. Distribution data obtained from Love et al. (2021).

Common Name	Scientific Species Name or Family	Coos Bay WEA	Brookings WEA
Coastal Pelagic Species FMP			
Pacific sardine	*Sardinops sagax*	X	X
Pacific (chub) mackerel	*Scomber japonicus*	X	X
Northern anchovy	*Engraulis mordax*	X	X
Market squid	*Doryteuthis opalescens*	X	X
Jack mackerel	*Trachurus symmetricus*	X	X
All endemic krill and euphausiid species		X	X
Pacific herring (ecs)	*Clupea pallasii pallasii*	X	X

Common Name	Scientific Species Name or Family	Coos Bay WEA	Brookings WEA
Jacksmelt (ecs)	*Atherinopsis californiensis*	X	X
Highly Migratory Species FMP			
North Pacific albacore	*Thunnus alalunga*	X	X
Yellowfin tuna	*Thunnus albacares*	X	X
Bigeye tuna	*Thunnus obesus*	X	X
Skipjack tuna	*Katsuwonus pelamis*	X	X
Pacific bluefin tuna	*Thunnus orientalis*	X	X
Common thresher shark	*Alopias vulpinus*	X	X
Shortfin mako	*Isurus oxyrinchus*	X	X
Blue shark	*Prionace glauca*	X	X
Striped marlin	*Kajikia (Tetrapturus) audax*	X	X
Swordfish	*Xiphias gladius*	X	X
Dorado	*Coryphaena hippurus*	X	X
Bigeye thresher shark (ecs)	*Alopias superciliosus*	*	*
Common mola (ecs)	*Mola mola*	X	X
Escolar (ecs)	*Lepidocybium flavobrunneum*	?	?
Lancetfishes (ecs)	*Alepisauridae*	X	X
Louvar (ecs)	*Luvarus imperialis*	X	X
Pelagic stingray (ecs)	*Pteroplatytrygon (Dasyetis) violacea*	X	X
Pelagic thresher shark (ecs)	*Alopias pelagicus*	*	*
Wahoo (ecs)	*Acanthocybium solandri*	*	*
Pacific Groundfish FMP			
Big skate	*Raja binoculata*	X	X
Leopard shark	*Triakis semifasciata*	X	X
Longnose skate	*Raja rhina*	X	X
Spiny dogfish	*Squalus suckleyi*	X	X
Cabezon	*Scorpaenichthys marmoratus*	X	X
Kelp greenling	*Hexagrammos decagrammus*	X	X
Lingcod	*Ophiodon elongatus*	X	X
Pacific cod	*Gadus macrocephalus*	X	X
Pacific whiting (hake)	*Merluccius productus*	X	X
Sablefish	*Anoplopoma fimbria*	X	X
Aurora rockfish	*Sebastes aurora*	X	X
Bank rockfish	*Sebastes rufus*	X	X
Black rockfish	*Sebastes melanops*	X	X
Black-and-yellow rockfish	*Sebastes chrysomelas*	X	X
Blackgill rockfish	*Sebastes melanostomus*	X	X
Blackspotted rockfish	*Sebastes melanostictus*	X	X
Blue rockfish	*Sebastes mystinus*	X	X
Bocaccio	*Sebastes paucispinis*	X	X
Bronzespotted rockfish	*Sebastes gilli*	X	X
Brown rockfish	*Sebastes auriculatus*	X	X
Calico rockfish	*Sebastes dallii*	*	*
California scorpionfish	*Scorpaena guttata*	*	*
Canary rockfish	*Sebastes pinniger*	X	X
Chameleon rockfish	*Sebastes phillipsi*	X	X
Chilipepper rockfish	*Sebastes goodei*	X	X
China rockfish	*Sebastes nebulosus*	X	X
Copper rockfish	*Sebastes caurinus*	X	X
Cowcod	*Sebastes levis*	X	X

Common Name	Scientific Species Name or Family	Coos Bay WEA	Brookings WEA
Darkblotched rockfish	*Sebastes crameri*	X	X
Deacon rockfish	*Sebastes diaconus*	X	X
Dusky rockfish	*Sebastes ciliatus*	*	*
Dwarf-red rockfish	*Sebastes rufinanus*	*	*
Flag rockfish	*Sebastes rubrivinctus*	X	X
Freckled rockfish	*Sebastes lentiginosus*	*	*
Gopher rockfish	*Sebastes carnatus*	X	X
Grass rockfish	*Sebastes rastrelliger*	X	X
Greenblotched rockfish	*Sebastes rosenblatti*	*	*
Greenspotted rockfish	*Sebastes chlorostictus*	X	X
Greenstriped rockfish	*Sebastes elongatus*	X	X
Halfbanded rockfish	*Sebastes semicinctus*	X	X
Harlequin rockfish	*Sebastes variegatus*	*	*
Honeycomb rockfish	*Sebastes umbrosus*	*	*
Kelp rockfish	*Sebastes atrovirens*	*	*
Longspine thornyhead	*Sebastolobus altivelis*	X	X
Mexican rockfish	*Sebastes macdonaldi*	*	*
Olive rockfish	*Sebastes serranoides*	X	X
Pink rockfish	*Sebastes eos*	X	X
Pinkrose rockfish	*Sebastes simulator*	*	*
Pygmy rockfish	*Sebastes wilsoni*	X	X
Pacific ocean perch	*Sebastes alutus*	X	X
Quillback rockfish	*Sebastes maliger*	X	X
Redbanded rockfish	*Sebastes babcocki*	X	X
Redstripe rockfish	*Sebastes proriger*	X	X
Rosethorn rockfish	*Sebastes helvomaculatus*	X	X
Rosy rockfish	*Sebastes rosaceus*	X	X
Rougheye rockfish	*Sebastes aleutianus*	X	X
Sharpchin rockfish	*Sebastes zacentrus*	X	X
Shortraker rockfish	*Sebastes borealis*	X	X
Shortspine thornyhead	*Sebastolobus alascanus*	X	X
Silvergray rockfish	*Sebastes brevispinis*	X	X
Speckled rockfish	*Sebastes ovalis*	X	X
Splitnose rockfish	*Sebastes diploproa*	X	X
Squarespot rockfish	*Sebastes hopkinsi*	X	X
Sunset rockfish	*Sebastes crocotulus*	X	X
Starry rockfish	*Sebastes constellatus*	*	*
Stripetail rockfish	*Sebastes Saxicola*	X	X
Swordspine rockfish	*Sebastes ensifer*	X	X
Tiger rockfish	*Sebastes nigrocinctus*	X	X
Treefish	*Sebastes serriceps*	*	*
Vermilion rockfish	*Sebastes miniatus*	X	X
Widow rockfish	*Sebastes entomelas*	X	X
Yelloweye rockfish	*Sebastes ruberrimus*	X	X
Yellowmouth rockfish	*Sebastes reedi*	X	X
Yellowtail rockfish	*Sebastes flavidus*	X	X
Arrowtooth flounder (turbot)	*Atheresthes stomias*	X	X
Butter sole	*Isopsetta isolepis*	X	X
Curlfin sole	*Pleuronichthys decurrens*	X	X
Dover sole	*Microstomus pacificus*	X	X
English sole	*Parophrys vetulus*	X	X

Common Name	Scientific Species Name or Family	Coos Bay WEA	Brookings WEA
Flathead sole	*Hippoglossoides elassodon*	X	X
Pacific sanddab	*Citharichthys sordidus*	X	X
Petrale sole	*Eopsetta jordani*	X	X
Rex sole	*Glyptocephalus zachirus*	X	X
Rock sole	*Lepidopsetta bilineata*	X	X
Sand sole	*Psettichthys melanostictus*	X	X
Starry flounder	*Platichthys stellatus*	X	X
Shortbelly rockfish	*Sebastes jordani (ecs)*	X	X
Aleutian skate	*Bathyraja aleutica (ecs)*	X	X
Bering/sandpaper skate	*Bathyraja interrupta (ecs)*	*	*
California skate	*Beringraja (Raja) inornata (ecs)*	X	X
Roughtail/black skate	*Bathyraja trachura (ecs)*	X	X
Endemic softnose skates	*Arhynchobatidae (ecs)*	X	X
Pacific grenadier	*Coryphaenoides acrolepis (ecs)*	X	X
Giant grenadier	*Coryphaenoides (Albatrossia) pectoralis (ecs)*	X	X
Endemic grenadiers	*Macrouridae (ecs)*	X	X
Fine scale codling/Pacific flatnose	*Antimora microlepis (ecs)*	X	X
Spotted ratfish	*Hydrolagus colliei (ecs)*	X	X
Soupfin shark	*Galeorhinus galeus (zyopterus) (ecs)*	X	X
Pacific Salmon FMP			
Chinook Salmon	*Oncorhynchus tshawytscha*	X	X
Chum Salmon	*Oncorhynchus keta*	X	X
Coho Salmon	*Oncorhynchus kisutch*	X	X
Sockeye Salmon	*Oncorhynchus nerka*	X	X
Steelhead Trout	*Oncorhynchus mykiss*	X	X
Pink Salmon	*Oncorhynchus gorbuscha*	X	X
Shared Ecosystem Component Species			
Round herring	*Etrumeus (teres) acuminatus*	X	X
Thread herring	*Opisthonema libertate, O. medirastre*	*	*
Endemic mesopelagic fish species	*Myctophidae, Bathylagidae, Paralepididae, and Gonostomatidae*	X	X
Pacific sand lance	*Ammodytes personatus*	X	X
Pacific saury	*Cololabis saira*	X	X
Endemic silversides	*Atherinopsidae*	X	X
Endemic smelts	*Osmeridae*	X	X
Endemic squid species	Cranchiidae, Gonatidae, Histioteuthidae, Octopoteuthidae, Ommastrephidae except (*Dosidicus gigas*), Onychoteuthidae, and Thysanoteuthidae	X	X

The marine environment in the Coos Bay and Brookings WEAs and nearby regions are rich in fish species due to the high productivity of the California Current System and the wide variety of habitats located therein. The vast majority of the species managed by the Council can be found within the Action Area during their life cycle (Love 1996). The PFMC has identified EFH and habitat areas of particular concern (HAPCs) for each of the four FMPs (PFMC 2022a,b; PFMC 2023a,b). EFH and HAPCs will be present within the Action Area and therefore this analysis will be broad in scope and will discuss the effects of the identified impact-producing factors on a wide range of prey, habitats, and managed or monitored species.

11.4 Potential Impacting-Producing Factors

BOEM identified two potential impact-producing factors generated by activities associated with site characterization and assessment: noise and habitat alteration/turbidity. A summary description of each impacting source is included in the following section.

11.5 Effects on EFH

11.5.1 Noise

Being a dense medium, water transmits sound faster and for longer distances than air transmits sound. Aquatic organisms may use this phenomenon to quickly glean information about their environment over relatively large areas. Fishes possess two mechanoreception sensory systems to detect sound in their environment. The first is the lateral line system (LLS) which is a series of pore-receptors along the body of a fish. The LLS detects vibration and pressure gradients in the water within a few body lengths of the organism. The lateral line detects particle motion at low frequencies from below 1 hertz (Hz) up to at least 400 Hz (Hastings & Popper 2005; Higgs & Radford 2013).

The second hearing organ fish possess is an inner ear (Popper & Hawkins 2019). For most species, the inner ear contains three dense otoliths (small calcareous bones) that sit atop many delicate hair cells, comparable to the hair cells found in the mammalian ear. Sound waves in water pass through the fish's body, which has a composition similar to water, but will differentially affect the heavier otoliths. This causes a change in the relative motion between the otoliths and the surrounding body tissues and can be detected by the hair cells and sensed by the nervous system.

Some fishes possess additional morphological adaptations or specializations that can enhance their sensitivity to sound pressure, such as an anatomical extension that connects a gas-filled swim bladder to the auditory system (Astrup 1999; Popper & Fay 2010; Popper & Hawkins 2019). The swim bladder can enhance sound detection by converting acoustic pressure into localized particle motion, which may then be detected by the inner ear (Radford et al. 2012). Fishes with a swim bladder generally have better sensitivity to sound and can detect higher frequencies than fishes without a swim bladder (Popper & Fay 2010; Popper et al. 2014). In addition, structures such as gas-filled bubbles near the ear or swim bladder also increase sensitivity and allow for high-frequency hearing capabilities and better sound pressure detection.

Many fishes use sound to (1) find food, habitat, and mates; (2) provide orientation cues for migration; (2) communicate during territorial defense, aggression, mating, and as a method of indicating alarm; and (3) detect and avoid predators (Popper and Hawkins 2019). Anthropogenic noise may mask, disrupt, or distract organisms that use sound as a source of information for these important activities. Noise at very high levels may affect fish directly by increasing stress levels, causing temporary or permanent loss of hearing, damage to body tissues, or increased mortality rates (Popper and Hawkins 2019). Fishes residing in environments where there is little light, such as the deep sea, may have a greater reliance on sound to sense their environments (Marshall 1966; Deng et al. 2011). Eggs and larval fish stages may be less sensitive due to their immature or undeveloped sensory organs (Kunc et al. 2016). Most native fishes on the Pacific Coast are hearing generalists, although some species managed under the Coastal Pelagic

Species FMP (e.g., Pacific sardine, northern anchovy) would be considered hearing specialists (Hastings & Popper 2005).

Although particle motion may be the more relevant exposure metric for many fish species, there are few data available that measure it due to a lack of standard measurement methodology and experience with particle motion detectors (Popper et al. 2014). Historically, studies that have investigated hearing in fishes and the consequences of anthropogenic noise were carried out with sound pressure metrics. In these instances, particle motion can be inferred from pressure measurements (Nedelec et al. 2016). In this analysis, impact assessment is expected to be conservative.

Noise produced by project activities (described in section 2 and 3) result from the operation of marine vessels and from surveys and biological collections. Adverse effects from noise, if any, are expected to last for the duration of the activities that are producing the noise and are not expected to have long-lasting consequences. For fish species capable of sensing the introduced noise, they may alter their behavior and leave the affected area (e.g., the pelagic fish species within each FMP) or move closer to the seabed (e.g., demersal fishes within the Pacific Groundfish FMP). Adults may have greater sensitivity to noise impacts compared to larvae and eggs given their better developed hearing systems. No population-level effects are expected due to the minimal influence project activities may have across larger spatial and temporal scales. Project activities are likely to have temporary, minimally adverse impacts to managed species.

Because invertebrate species lack gas-filled structures within their bodies, they may be less sensitive to anthropogenic noise sources compared to fishes, although many taxa appear to have morphological structures (e.g., hair cells) that can be sensitive to particle motion (Popper & Hawkins 2018). A recent review indicates that some invertebrates change their behavior when exposed to chronic shipping noise (Murchy et al. 2019). Much more research needs to be done to determine if such behavior changes translate into population-level effects. The low levels of expected anthropogenic noise are not known to permanently alter characteristics of pelagic or benthic habitats. Therefore, project activities are expected to have no or minimally adverse effects to EFH (including HPACs) or to the invertebrate prey base of managed species.

11.5.2 Habitat Alteration and Turbidity

Project activities that may alter habitats or increase turbidity in the Action Areas include geotechnical and biological sampling, and buoy emplacement, operation, and retrieval.

Geotechnical sampling (gravity cores, piston cores, vibracores, deep borings, cone penetration tests, etc.) and biological grab sampling may damage benthic habitats by permanently removing small amounts of sediments from the seabed. Animals within or on top of these samples will likely be killed. Collection of samples causes nearby disturbance as sediment moves to fill the hole left by the removed core or grab, possibly exposing animals in the surrounding sediment to predators (Skilleter 1996). Sampling may also disrupt microbial assemblages in the sediments and breakdown biotic structures which help bind sediments together (e.g., microbial mats; Skilleter 1996). Recovery rates of sampled areas to baseline conditions are mostly unknown, but may exceed several weeks (Skilleter 1996). The distribution of these samples will occur throughout the leases, but the total spatial extent of sampling will be a very small percentage compared to the overall Action Area so only minimally adverse effects to EFH are expected.

PNNL (2019) assessed potential effects from a data-collecting buoy within the Morro Bay WEA and determined that minimal and temporary adverse effects to EFH were expected. The consequences to EFH from buoy emplacement, operations, and retrieval from the proposed project is expected to be similar to those described in PNNL (2019). A buoy system may also function as a small de facto artificial reef, providing a minor amount of additional hard substrate within the WEAs from the anchor, mooring lines, and buoy structure. The environment effects are expected to be similar to that produced by marine debris and generate local increases in biomass and species diversity (Caselle et al. 2002). Indirect effects from buoy emplacement may preserve habitat integrity of the seabed as fishers, especially trawlers, may avoid these areas until buoys are decommissioned. The damage from bottom-contact trawls would then be displaced to outside of the local buoy area. The spatial extent of environmental consequences from buoys will be a small percentage compared to the overall Action Area so only minimal effects to managed species and EFH are expected.

Habitat disturbance may cause sediments and benthic organic material to be introduced into the water column and may also increase local turbidity levels. Direct effects from sediment suspension and increased turbidity on fish populations may include exposure to contaminants, changes in feeding rates, reduction in predator-avoidance ability, or smothering of feeding and respiratory organs (Wilber and Clarke 2001; Utne-Palm 2002; Au et al. 2004). To avoid these consequences, fishes may choose to relocate until water clarity returns to levels approximating pre-disturbance conditions. Indirect effects on fish populations from sediment suspension and increased turbidity may occur by harming the populations of prey species on which the fishes depend (Airoldi 2003). Biological response to these potential impacts is often a function of concentration and exposure duration (Newcombe and Jensen 1996).

To estimate the footprint of disturbance to soft sediments from the Proposed Action, here we assume that each contact disturbs up to 10 m^2, although most contacts are expected disturb areas less than half that size with some less than 1 m^2. The majority of seafloor contacts are the proposed potential number of geotechnical samples, at 100 samples per lease issued. Additional seafloor disturbance per lease could come from up to 6 met buoys and up to 10 ADCP moorings per lease, for a total of 116 contacts. Here we have increased and rounded up from 116 contacts to 150 to avoid an underestimate: 150 contacts X 10 m^2 = 1,500 m^2. We also include potential UTP (or similar technology) contacts; based on a representative survey plan, the estimated footprint for UTP contacts is a maximum 64 m^2 per lease. The estimated total footprint per lease is: 1,500 m^2 + 64 m^2 = 1,564 m^2 sediment disturbance per lease issued. This yields a total of 3,128 m^2.

This analysis is consistent with the findings by NOAA in their Deep Seabed Mining Regulations for Exploration Licenses (15 CFR Part 970, Subpart G Environmental Effects) promulgated under the authority of 30 U.S.C. 1401 et seq. Activities identified to have no significant impact and require no further environmental assessment include: (1) Gravity and magnetometric observations and measurements; (2) Bottom and sub-bottom acoustic profiling or imaging without the use of explosives; (3) Mineral sampling of a limited nature such as those using either core, grab or basket samplers; (4) Water and biotic sampling, if the sampling does not adversely affect shellfish beds, marine mammals, or an endangered species, or if permitted by the National Marine Fisheries Service or another Federal agency; (5) Meteorological observations and measurements, including the setting of instruments; (6) Hydrographic and oceanographic observations and measurements, including the setting of instruments; (7) Sampling by box core, small diameter core or grab sampler, to determine seabed geological or geotechnical properties; (8) Television and still photographic observation and measurements; (9) Shipboard mineral assaying and analysis; and (10) Positioning systems, including bottom transponders and surface and subsurface buoys filed in Notices to Mariners (15 CFR§ 970.701(a)).

BOEM concludes that the proposed activities from the project are predicted to generate only minimal and short-term impacts to benthic habitats and cause a negligible increase in suspended materials over a short time frame. The offshore location of the WEAs suggests that terrestrial-based pollutants are not likely to be found in large concentrations within disturbed sediments. Therefore, proposed activities associated will have minimal adverse effects to managed species and EFH.

11.6 Cumulative Analysis

This section describes the projects and activities considered in the cumulative analysis for the proposed site characterization and site assessment. Possible sources of cumulative impacts specific to managed species and EFH are those that degrade the environment via anthropogenic noise or habitat alteration/increased turbidity.

Sources of cumulative impacts include commercial fishing marine vessel traffic, and non-point sources of ocean discharges. Climate change activities are also addressed. Potential cumulative impacts are discussed below.

11.6.1 Federal and State Offshore Energy Projects

The PacWave South Hydrokinetic Project, a 20-megawatt open ocean marine hydrokinetic testing infrastructure designed to test and validate marine hydrokinetic devices is located approximately six nautical miles off the coast of Newport, Oregon and overlaps with the Action Area. The consequences of these foreseeable activities associated with PacWave South are expected to produce no or minimally adverse consequences to managed fish species and EFH (OSU 2019). Activities associated with site assessment and site characterization of Federal offshore wind energy leases are foreseeable in Central and Northern California, and some of these activities many overlap with the Action Area. The consequences of these foreseeable activities are expected to produce no or minimally adverse consequences to managed fish species and EFH (BOEM 2022).

Foreseeable ongoing oil and gas operations are not expected to spatially overlap with the Action Area or include notable changes in baseline activities that may affect noise, habitats, or turbidity (M. Mitchell, Department of the Interior, Bureau of Safety and Environmental Enforcement, personal communication). Environmental consequences of foreseeable decommissioning (removal) of oil and gas platforms have been reviewed and it is unlikely that future decommissioning activities that produce impacts to managed fish species and EFH will temporarily overlap with project activities (BSEE, BOEM, and USACOE) 2023. Overall, Federal offshore energy project activities are only expected to produce an incrementally small increase in noise, habitat changes and turbidity within the regional environment, and most of these effects will be temporary in duration.

11.6.2 Non-Energy Projects and Activities

Commercial Fishing. Commercial fishing activity is ubiquitous along the Pacific Coast (Miller et al. 2017), and is the most widespread human exploitative activity in the marine environment, generating significant impacts to habitats and populations (Jennings & Kaiser 1998). Bottom trawling has notable noise consequences to benthic environments (Daly et al. 2019). Proposed activities analyzed in this document would only incrementally add to the impacts relative to fishing, and those impacts would be temporary.

Marine Vessel Traffic. Commercial shipping has seen rapid growth in recent years and is expected to increase (Kaplan & Solomon 2016). Noise from this shipping traffic can vary considerably according to regulatory and economic events (McKenna et al. 2012), but it is an ongoing activity that occurs throughout the year. The proposed activities analyzed in this document are only expected to produce a temporary increase in anthropogenic sound in the Action Area.

Nonpoint Source (NPS) Discharges. Turbidity can increase in marine environments from terrestrial runoff, especially during storm events. The nearest nonpoint sources of pollution are rivers and creeks which empty into the ocean along the mainland coast. Because water flow rate varies seasonally, most of the pollution enters the ocean in the winter months and, given the distance of the WEAs from the coast, turbidity plumes from NPS discharges may not overlap with the WEAs, but may temporarily overlap with surveys of the potential cable corridors. The proposed activities analyzed in this document are only expected to produce a temporary and incrementally small increase in turbidity within the Action Area.

11.6.3 Climate Change Conditions

Climate change conditions may have significant impacts to marine life stemming from large shifts in ocean temperature, circulation, stratification, nutrient input, oxygen content, and ocean acidification (Doney et al. 2012; Penn & Deutsch 2022). In the short term, the minimally adverse consequences from project activities analyzed in this document shall incrementally and temporarily increase the negative pressures faced by marine life and habitats. In the long term, a societal shift to renewable energy resources will lessen the degree and speed of climate change conditions and improve environmental conditions overall.

11.6.4 Cumulative Conclusion

The impacts from additional noise from project activities would be temporary and incremental and not generate population-level consequences to managed species or lasting negative effects to EFH. The short-term impact from habitat alteration/turbidity from the proposed activities would only contribute an incremental and temporary impact to managed species and EFH.

11.7 EFH Conservation Recommendations and Mitigation

Although project activities are expected to generate temporary and minimal adverse effects to EFH, BOEM proposes the following two conservation measures to further minimize impacts to EFH. These two measures will be project design criteria and serve to protect rocky reefs, a habitat of particular concern for Pacific Groundfish EFH that may be present in either the Coos Bay or Brookings WEAs or the potential cable corridors to shore.

11.7.1 PDC 1: Hard Bottom Avoidance: Metocean Buoy Anchoring and Prohibition of Trawling

11.7.1.1 Hard Bottom Avoidance and Anchoring Plan

Lessees and their contractors shall avoid intentional contact within hard substrate, rock outcroppings, seamounts, or deep-sea coral/sponge habitat and include a buffer that fully protects these habitats from bottom contact during the deployment of metocean buoy moorings, benthic sampling, or geotechnical sampling. As part of any site assessment plan (SAP), the lessee shall submit to BOEM the details of how these activities will avoid contact with hard bottom. The Plan shall describe how the lessee will avoid placing vessel anchors on sensitive ocean floor habitats and shall include the following information: 1) Detailed maps showing proposed anchoring sites that are located at least 12 m (40 ft) from hard substrate and other anthropogenic features (e.g., power cables), if present; 2) A description of the navigation equipment that would be used to ensure anchors are accurately set; and 3) Anchor handling procedures that would be followed to prevent or minimize anchor dragging, such as placing and removing all anchors vertically.

11.7.1.2 Prohibition of Bottom Trawling During Project Activities

Lessees will characterize site-specific parameters within the WEAs to inform their site assessment plan and to generally describe local conditions, including biological attributes. Lessees and their contractors may employ a range of methods to accomplish these goals (BOEM 2022), but may not employ bottom trawling methodology to conduct these activities.

11.8 EFH Conclusion

Project activities are expected to have temporary and minimally adverse impacts to managed species and EFH. Two proposed conservation recommendations, (1) Hard Bottom Avoidance and Metocean Buoy Anchoring Plan, and (2) Prohibition of Bottom Trawling during Project Activities, will further reduce the level of expected effects.

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Appendix A: Project Design Criteria and Best Management Practices

This appendix describes Project Design Criteria (PDC) and Best Management Practices (BMPs) for minimizing effects to threatened and endangered species and Essential Fish Habitat for Site Characterization and Site Assessment Activities to Support Offshore Wind Development. In BOEM's Draft Environmental Assessment for Oregon (https://www.boem.gov/renewable-energy/state-activities/commercial-wind-lease-issuance-pacific-outer-continental-shelf), Appendix D "Typical Best Management Practices for Operations on the Pacific Outer Continental Shelf" contains BMPs that overlap with the ones described here.

In line with BOEM's regulatory authorities, the following PDCs and BMPs apply in Federal waters.

Any survey monitoring plan must meet the following minimum requirements specified below, except when complying with these requirements would put the safety of the vessel or crew at risk.

A.1 PDC 1: Hard Bottom Avoidance: Metocean Buoy Anchoring and Prohibition of Trawling

The practice of trawling risks bycatch of protected fish species and disturbance of benthic habitats; thus, PDC 1 includes the prohibition of trawling. The BMPs for PDC 1 cover practices for met buoy anchoring: to protect rocky reefs and reduce adverse effects associated with habitat alteration to minimally adverse levels. Furthermore, all benthic areas will be cleared (i.e., appropriate seafloor data reviewed) before any bottom contact to ensure no sensitive or hard bottom habitats are disturbed.

A.1.1 BMPs:

1. Lessees and their contractors shall avoid intentional contact within hard substrate, rock outcroppings, seamounts, or deep-sea coral/sponge habitat and include a buffer that protects these habitats from bottom contact during the deployment of metocean buoy moorings, benthic sampling, or geotechnical sampling. As part of any site assessment plan (SAP), the lessee shall submit to BOEM the details of how these activities will avoid contact with hard bottom. The Plan shall describe how the lessee will avoid placing vessel anchors on sensitive ocean floor habitats and shall include the following information:1) Detailed maps showing proposed anchoring sites that are located at least 12 m (40 ft) from hard substrate and other anthropogenic features (e.g., power cables), if present; 2) A description of the navigation equipment that would be used to ensure anchors are accurately set; and 3) Anchor handling procedures that would be followed to prevent or minimize anchor dragging, such as placing and removing all anchors vertically.

2. Lessees will characterize site-specific parameters within the WEAs to inform their site assessment plan and to generally describe local conditions, including biological attributes. Lessees and their contractors may employ a range of methods to accomplish these goals but may not employ bottom trawling methodology to conduct these activities.

A.2 PDC 2: Marine Debris Awareness and Prevention

"Marine debris" is defined 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 or an authorized representative of the Lessee (collectively, the "Lessee") while conducting activities on the OCS in connection with a lease, grant, or approval issued by the Department of the Interior (DOI). The Lessee must practice trash and debris reduction and handling practices to reduce the amount of offshore trash that could potentially be lost into the marine environment. These trash management practices include substituting paper and ceramic cups and dishes for those made of Styrofoam or other extruded polystyrene foam, recycling offshore trash, and transporting and storing supplies and materials in bulk containers when feasible and have resulted in a reduction of accidental loss of trash and debris. Vessel operators will comply with pollution regulations outlined in 33 CFR 151.51-77.

To understand the type and amount of marine debris generated, and to minimize the risk of entanglement in and/or ingestion of marine debris by protected species, lessees must implement the following BMPS.

A.2.1 BMPs:

1. Training: All vessel operators, employees, and contractors performing OCS survey activities on behalf of the Lessee (collectively, "Lessee Representatives") must complete marine trash and debris awareness training annually. The training consists of two parts: (1) viewing a marine trash and 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 trash and debris training videos, training slide packs, and other marine debris related educational material 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 OCS survey activities must continue to develop and use a marine trash and 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:
    - **a.** Viewing of either a video or slide show by the personnel specified above;
    - **b.** An explanation from management personnel that emphasizes their commitment to the requirements;
    - **c.** Attendance measures (initial and annual); and
    - **d.** Recordkeeping and availability of records for inspection by DOI.

    By January 31 of each year, the Lessee must submit to DOI an annual report signed by the Lessee that describes its marine trash and debris awareness training process and certifies that the training process has been followed for the previous calendar year. The Lessee must send the reports via email to *marinedebris@bsee.gov*.

2. Marking: Materials, equipment, tools, containers, and other items used in OCS activities which are of such shape or configuration that they are likely to snag or damage fishing devices, and

could be lost or discarded overboard, must be clearly marked with the vessel or facility identification and properly secured to prevent loss overboard. 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.

3. Recovery: Lessees must recover marine trash and debris that is lost or discarded in the marine environment while performing OCS activities when such incident is likely to: (a) cause undue harm or damage to natural resources, including their physical, atmospheric, and biological components, with particular attention to those that could result in the entanglement of or ingestion by marine protected species; or (b) significantly interfere with OCS uses (e.g., are likely to snag or damage fishing equipment, or present a hazard to navigation). Lessees must notify DOI when recovery activities are (i) not possible because conditions are unsafe; or (ii) not practicable because the marine trash and debris released is not likely to result in any of the conditions listed in (a) or (b) above. The lessee must recover the marine trash and 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 trash and debris. If the marine trash and 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. Recovery of the marine trash and debris should be completed immediately, but no later than 30 days from the date in which the incident occurred. If the Lessee is not able to recover the marine trash or debris within 48 hours (See BMP 4. Reporting), the Lessee must submit a recovery plan to DOI explaining the recovery activities to recover the marine trash or debris ("Recovery Plan"). The Recovery Plan must be submitted no later than 10 calendar days from the date in which the incident occurred. Unless otherwise objected 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. The Lessee must enact steps to prevent similar incidents and must submit a description of these actions to BOEM and BSEE within 30 days from the date in which the incident occurred.

4. Reporting: The Lessee must report all marine trash and debris lost or discarded to DOI (using the email address listed on DOI's most recent incident reporting guidance). This report applies to all marine trash and debris lost or discarded, and must be made monthly, no later than the fifth day of the following month. The report must 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) and composition (e.g., plastic, aluminum, steel, wood, paper, hazardous substances, or defined pollutants);
- **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 0.5 m when operating a magnetometer or gradiometer, side-scan sonar, or sub-bottom profile 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.

In addition to the foregoing, the Lessee must submit a report within 48 hours of the incident ("48-hour Report") if the marine trash or debris could (a) cause undue harm or damage to natural resources, including their physical, atmospheric, and biological components, with particular attention to those that could result in the ingestion by or entanglement of marine protected species; or (b) significantly interfere with OCS uses (e.g., are likely to snag or damage fishing equipment, or present a hazard to navigation). The information in the 48-hour Report would be the same as that listed above, but just for the incident that triggered the 48-hour Report. The Lessee must report to DOI if the object is recovered and, as applicable, any substantial variation in the activities described in the Recovery Plan that were required during the recovery efforts.

Information on decommissioning obligations including unrecovered marine trash and debris is provided in 30 CFR § 285.902. The Lessee is not required to submit a report for those months in which no marine trash and debris was lost or discarded.

A.3 PDC 3: Minimize Interactions With ESA-listed Species During Geophysical Survey Operations

To avoid injury of ESA-listed species (marine mammals and sea turtles) and minimize any potential disturbance, the following measures will be implemented for all vessels operating impulsive survey equipment that emits sound at frequency ranges < 180 kHz (within the functional hearing range of marine mammals). The Clearance Zone is defined as the area around the sound source that needs to be visually cleared of ESA-listed species for 30 minutes before the sound source is turned on. The Clearance Zone is equivalent to a minimum visibility zone for survey operations to begin (*See* BMP 6). The Shutdown Zone is defined as the area around the sound source that must be monitored for possible shutdown upon detection of ESA-listed whale species within or entering that zone. For both the Clearance and Shutdown Zones, these are minimum visibility distances and for situational awareness PSOs should observe beyond this area when possible. **This applies to all sound sources on towed systems that emit sound at frequency ranges < 180 kHz (within the functional hearing range of marine mammals).**

A.3.1 BMPs:

1. For situational awareness a Clearance Zone extending at least (600 m in all directions) must be established around all vessels operating sources <180 kHz.
   a. The Clearance Zone must be monitored by approved third-party PSOs at all times and any observed ESA-listed species must be recorded (see reporting requirements below).
   b. For monitoring around the autonomous surface vessel (ASV) where remote PSO monitoring must occur from the mother vessel, a dual thermal/HD camera must be

installed on the mother vessel facing forward and angled in a direction so as to provide a field of view ahead of the vessel and around the ASV. PSOs must be able to monitor the real-time output of the camera on hand-held computer tablets. Images from the cameras must be able to be captured and reviewed to assist in verifying species identification. A monitor must also be installed in the bridge displaying the real-time images from the thermal/HD camera installed on the front of the ASV itself, providing a further forward view of the craft. In addition, night-vision goggles with thermal clip-ons and a hand-held spotlight must be provided and used such that PSOs can focus observations in any direction around the mother vessel and/or the ASV.

2. To minimize exposure to noise that could be disturbing, Shutdown Zones (500 m for ESA-listed whales visible at the surface) must be established around the sources operating at < 180 kHz being towed from the vessel.

   a. The Shutdown Zones must be monitored by third-party PSOs at all times when noise-producing equipment (< 180 kHz) is being operated and all observed ESA-listed species must be recorded (see reporting requirements below).

   b. If an ESA-listed whale species is detected within or entering the respective Shutdown Zone, any noise-producing equipment operating below 180 kHz must be shut off until the minimum separation distance from the source is re-established and the measures in (5) are carried out.

      i. A PSO must notify the survey crew that a shutdown of all active boomer, sparker, and bubble gun acoustic sources < 180 kHz is immediately required. The vessel operator and crew must comply immediately with any call for a shutdown by the PSO. Any disagreement or discussion must occur only after shutdown.

   c. If a Shutdown Zone cannot be adequately monitored for ESA-listed whale species presence (i.e., a PSO determines conditions, including at night or other low-visibility conditions, are such that ESA-listed species cannot be reliably sighted within the Shutdown Zone(s)), no equipment operating at < 180 kHz can be deployed until such time that the Shutdown Zone can be reliably monitored.

3. Before any noise-producing survey equipment (operating at < 180 kHz) is deployed, the Clearance Zone (600 m for all ESA-listed species) must be monitored for 30 minutes of pre-clearance observation.

   a. If any ESA-listed species is observed within the Clearance Zone during the 30-minute pre-clearance period, the 30-minute clock must be paused. If the PSO confirms the animal has exited the zone and headed away from the survey vessel, the 30-minute clock that was paused may resume. The pre-clearance clock will reset to 30 minutes if the animal dives or visual contact is otherwise lost.

4. When technically feasible, a "ramp up" of the electromechanical survey equipment must occur at the start or re-start of geophysical survey activities. A ramp up must begin with the power of the smallest acoustic equipment for the geophysical survey at its lowest power output. When technically feasible the power will then be gradually turned up and other acoustic sources added in a way such that the source level would increase gradually.

5. Following a shutdown for any reason, ramp up of the equipment may begin immediately only if: (a) the shutdown is less than 30 minutes, (b) visual monitoring of the Shutdown Zone(s) continued throughout the shutdown, (c) the animal(s) causing the shutdown was visually followed and confirmed by PSOs to be outside of the Shutdown Zone(s) (500 m for ESA-listed whale species, and heading away from the vessel, and (d) the Shutdown Zone(s) remains clear of all ESA-listed whale species. If all (a, b, c, and d) the conditions are not met, the Clearance Zone (600 m for all ESA-listed species) must be monitored for 30 minutes of pre-clearance observation before noise-producing equipment can be turned back on.
6. In order for geophysical surveys to be conducted at night or during low-visibility conditions, PSOs must be able to effectively monitor the Clearance and Shutdown Zone(s). No geophysical surveys may occur if the Shutdown Zone(s) cannot be reliably monitored for the presence of ESA-listed whale species to ensure avoidance of impact to those species.
    a. An Alternative Monitoring Plan (AMP) must be submitted to BOEM (or the federal agency authorizing, funding, or permitting the survey) detailing the monitoring methodology that will be used during nighttime and low visibility conditions and an explanation of how it will be effective at ensuring that the Shutdown Zone(s) can be maintained during nighttime and low-visibility survey operations. The plan must be submitted 60 days before survey operations are set to begin.
    b. The plan must include technologies that have the technical feasibility to detect all ESA-listed whales out to 600 m and leatherback sea turtles out to 100 m.
    c. PSOs should be trained and experienced with the proposed alternative monitoring technology.
    d. The AMP must describe how calibration will be performed, for example, by including observations of known objects at set distances and under various lighting conditions. This calibration should be performed during mobilization and periodically throughout the survey operation.
    e. PSOs shall make nighttime observations from a platform with no visual barriers, due to the potential for the reflectivity from bridge windows or other structures to interfere with the use of the night vision optics.

7. At times when multiple survey vessels are operating within a lease area, adjacent lease areas, or exploratory cable routes, a minimum separation distance (to be determined on a survey specific basis, dependent on equipment being used) must be maintained between survey vessels to ensure that sound sources do not overlap.

8. Any visual observations of ESA-listed species by crew or project personnel must be communicated to PSOs on-duty.

9. During good conditions (e.g., daylight hours; Beaufort scale 3 or less) when survey equipment is not operating, to the maximum extent practicable, PSOs must conduct observations for protected species for comparison of sighting rates and behavior with and without use of active geophysical survey equipment. Any observed ESA-listed species must be recorded regardless of any mitigation actions required.

A.4 PDC 4: Minimize Vessel Interactions with ESA-listed Species

All vessels associated with survey activities (transiting [i.e., traveling between a port and the survey site] or actively surveying) must comply with the vessel strike avoidance measures specified below and travel at speeds of 10 knots or less within the Action Area. The only exception is when the safety of the vessel or crew necessitates deviation from these requirements. If any such incidents occur, they must be reported as outlined below under Reporting Requirements (PDC 7). The Vessel Strike Avoidance Zone is defined as 500 m or greater from any sighted ESA-listed marine mammal species or other unidentified large marine mammal and 100 m from any sea turtle visible at the surface.

A.4.1 BMPs:

1. Vessel captain and crew must maintain a vigilant watch for all protected species and slow down, stop their vessel, or alter course, as appropriate and regardless of vessel size, to avoid striking any ESA-listed species. The presence of a single individual at the surface may indicate the presence of submerged animals in the vicinity; therefore, precautionary measures should always be exercised. If pinnipeds or small delphinids of the following genera: *Delphinus*, *Lagenorhynchus*, *Tursiops*, and *Phocoena* are visually detected approaching the vessel (i.e., to bow ride) or towed equipment, vessel strike avoidance and shutdown is not required.

2. Anytime a survey vessel is underway (transiting or surveying), the vessel must maintain a 500 m minimum separation distance and a PSO or trained crew member must monitor a Vessel Strike Avoidance Zone (500 m or greater from any sighted ESA-listed whale species or other unidentified large marine mammal, or 100 m from any sea turtle visible at the surface) to ensure detection of that animal in time to take necessary measures to avoid striking the animal (see PDC 3). I For monitoring around the autonomous surface vessels, regardless of the equipment it may be operating, a dual thermal/HD camera must be installed on the mother vessel facing forward and angled in a direction so as to provide a field of view ahead of the vessel and around the ASV. A dedicated operator must be able to monitor the real-time output of the camera on hand-held computer tablets. Images from the cameras must be able to be captured and reviewed to assist in verifying species identification. A monitor must also be installed in the bridge displaying the real-time images from the thermal/HD camera installed on the front of the ASV itself, providing a further forward view of the craft.

   a. Survey plans must include identification of vessel strike avoidance measures, including procedures for equipment shut down and retrieval, communication between PSOs/crew lookouts, equipment operators, and the captain, and other measures necessary to avoid vessel strike while maintaining vessel and crew safety. If any circumstances are anticipated that may preclude the implementation of this PDC, they must be clearly identified in the survey plan and alternative procedures outlined in the plan to ensure minimum distances are maintained and vessel strikes can be avoided.

   b. All vessel crew members must be briefed in the identification of protected species that may occur in the survey area and in regulations and best practices for avoiding vessel collisions. Reference materials must be available aboard all project vessels for identification of ESA-listed species. The expectation and process for reporting of protected species sighted during surveys must be clearly communicated and posted in highly visible locations aboard all project vessels, so that there is an expectation for reporting to the designated vessel contact (such as the lookout or the vessel captain), as well as a communication channel and process for crew members to do so.

c. The Vessel Strike Avoidance Zone(s) are a minimum and must be maintained around all surface vessels at all times.

d. If a large whale is identified within 500 m of the forward path of any vessel, the vessel operator must steer a course away from the whale at 10 knots (18.5 km/hr) or less until the 500 m minimum separation distance has been established. Vessels may also shift to idle if feasible.

e. If a large whale is sighted within 200 m of the forward path of a vessel, the vessel operator must reduce speed and shift the engine to neutral. Engines must not be engaged until the whale has moved outside of the vessel's path and beyond 500 m from the vessel. If stationary, the vessel must not engage engines until the large whale has moved beyond 500 m from the vessel.

f. If a sea turtle is sighted within the operating vessel's forward path, the vessel operator must slow down to 4 knots (unless unsafe to do so) and steer away as possible. The vessel may resume normal operations once the vessel has passed the individual.

g. During times of year when sea turtles are known to occur in the survey area, vessels must avoid transiting through areas of visible jellyfish aggregations. In the event that operational safety prevents avoidance of such areas, vessels must slow to 4 knots while transiting through such areas.

3. To monitor the Vessel Strike Avoidance Zone, a PSO or trained crew member must be posted during all times a vessel is underway (transiting or surveying) to monitor for ESA-listed species in all directions.

a. Visual observers monitoring the vessel strike avoidance zone can be either PSOs or trained crew members. If the trained lookout is a vessel crew member, this must be their designated role and primary responsibility while the vessel is transiting. Any designated crew lookouts must receive training on protected species identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements. All observations must be recorded per reporting requirements.

b. Regardless of monitoring duties, all crew members responsible for navigation duties must receive site-specific training on ESA-listed species sighting/reporting and vessel strike avoidance measures.

4. Vessels underway must not divert their course to approach any ESA-listed species.

5. Lessees are directed to NMFS' Marine Life Viewing Guidelines, which highlight the importance of these measures for avoiding impacts to mother/calf pairs: https://www.fisheries.noaa.gov/topic/marine-life-viewing-guidelines

6. Wherever available, Lessees will ensure all vessel operators check for daily information regarding protected species sighting locations. These media may include, but are not limited to: Channel 16 broadcasts, https://whalesafe.com/ and the Whale/Ocean Alert App.

7. Use of a Moon Pool: During times of year when sea turtles are known to occur in the survey area and there is an intention to utilize a moon pool for the required activities, the following BMPs need to be followed:
   a. *Closure of the Hull Door*
      i. Should the moon pool have a hull door that can be closed, the operator(s) should keep the doors closed as much as reasonably practicable when no activity is occurring within the moon pool, unless the safety of crew or vessel require otherwise. This will prevent protected species from entering the confined area during periods of non-activity.
      ii. Should the moon pool have a hull door that can be closed then prior to and following closure, the moon pool must be monitored continuously by a dedicated crew observer with no other tasks to ensure that no individual protected species is present in the moon pool area. If visibility is not clear to the hull door from above (e.g., turbidity or low light), 30 minutes of monitoring is required prior to hull door closure.
      iii. If a protected species is observed in the moon pool prior to closure of the hull door, the hull door must not be closed, to the extent practicable. If the observed animal leaves the moon pool, the operator may commence closure. If the observed animal remains in the moon pool, contact BSEE prior to closure of the hull doors according to reporting requirements (see *below* under *Protected Species within an Enclosed Moon Pool Reporting)*.
   b. *Movement of the vessel (no hull door) and equipment deployment/retrieval*
      i. Prior to movement of the vessel and/or deployment/retrieval of equipment, the moon pool must be monitored continuously for a minimum of 30 minutes, by a dedicated crew observer with no other tasks, to ensure no individual protected species is present in the moon pool area.
      ii. If a protected species is observed in the moon pool prior to movement of the vessel, the vessel must not be moved and equipment must not be deployed or retrieved, except for human safety considerations. If the observed animal leaves the moon pool, the operator may commence activities. If the observed animal remains in the moon pool, contact BSEE prior to planned movement of the vessel according to reporting requirements (see Reporting Requirements under Protected Species within an Enclosed Moon Pool Reporting).
   c. *BOEM does not advocate the lowering of crew members into the moon pool to free protected species. NMFS should be contacted if protected species are encountered in the moon pool.*

A.5 PDC 5: Minimize Entanglement Risk During ROV Usage, Buoy Deployment, Operations, and Retrieval

PDC 5 minimizes the risk of entanglement of ESA-listed marine mammal or sea turtle species during ROV usage, buoy deployment, operations, and equipment retrieval, and in the unlikely event that entanglement does occur, ensures proper reporting of entanglement events according to the measures specified below.

A.5.1 BMPs:

1. ROVs: A Clearance Zone (600 m for all ESA-listed marine mammals and sea turtle species) must be monitored for 30 minutes of pre-clearance observation by PSOs before ROVs are deployed.
    a. If any ESA-listed species is observed within the Clearance Zone during the 30-minute pre-clearance period, the 30-minute clock must be paused. If the PSO confirms the animal has exited the zone and headed away from the survey vessel, the 30-minute clock that was paused may resume. The pre-clearance clock will reset to 30 minutes if the animal dives or visual contact is otherwise lost.
2. Ensure that any buoys attached to the seafloor use the best available mooring systems. Buoys, lines (chains, cables, or coated rope systems), swivels, shackles, and anchor designs must prevent any potential entanglement of ESA-listed species while ensuring the safety and integrity of the structure or device.
3. All mooring lines and ancillary attachment lines must use one or more of the following measures to reduce entanglement risk: shortest practicable line length, rubber sleeves, weak-links, chains, cables or similar equipment types that prevent lines from looping, wrapping, or entrapping protected species.
4. Any equipment must be attached by a line within a rubber sleeve for rigidity. The length of the line must be as short as necessary to meet its intended purpose.
5. During all buoy deployment and retrieval operations, buoys should be lowered and raised slowly to minimize risk to ESA-listed species and benthic habitat. Additionally, PSO should monitor for ESA-listed species in the area prior to and during deployment and retrieval and work should be stopped if ESA-listed species are observed within 500 m of the vessel to minimize entanglement risk.
6. If a live or dead marine protected species becomes entangled, you must immediately contact the applicable NMFS stranding coordinator using the reporting contact details (see Reporting Requirements section) and provide any on-water assistance requested.
7. All buoys must be properly labeled with owner and contact information.

A.6 PDC 6: Protected Species Observers

Qualified third-party PSOs to observe Clearance and Shutdown Zones must be used as outlined in the conditions above.

A.6.1 BMPs:

1. All PSOs must have completed an approved PSO training program and must receive NMFS approval to act as a PSO for geophysical surveys. Documentation of NMFS approval for geophysical survey activities in the Pacific and copies of the most recent training certificates of individual PSOs' successful completion of a commercial PSO training course with an overall examination score of 80% or greater must be provided upon request. Instructions and application

requirements to become a NMFS-approved PSO can be found at: www.fisheries.noaa.gov/national/endangered-species-conservation/protected-species-observers.

2. For situations where third-party party PSOs are not required, crew members serving as lookouts must receive training on protected species identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements.
3. PSOs deployed for geophysical survey activities must be employed by a third-party observer provider. While the vessel is underway, they must have no other tasks than to conduct observational effort, record data, and communicate with and instruct relevant vessel crew to the presence of ESA-listed species and associated mitigation requirements. PSOs on duty must be clearly listed on daily data logs for each shift. When PSOs are required on vessels when geophysical surveys are underway, non-third-party observers may be approved by NMFS on a case-by-case basis for limited, specific duties in support of approved, third-party PSOs.
4. A minimum of one PSO (assuming condition 5 is met) must be on duty observing for ESA-listed species at all times that noise-producing equipment < 180 kHz is operating, or the survey vessel is actively transiting during daylight hours (i.e., from 30 minutes prior to sunrise and through 30 minutes following sunset). Two PSOs must be on duty during nighttime operations. A PSO schedule showing that the number of PSOs used is sufficient to effectively monitor the affected area for the project (e.g., surveys) and record the required data must be included. PSOs must not be on watch for more than 4 consecutive hours, with at least a 2-hour break after a 4-hour watch. PSOs must not be on active duty observing for more than 12 hours in any 24-hour period.
5. Visual monitoring must occur from the most appropriate vantage point on the associated operational platform that allows for 360-degree visual coverage around the vessel. If 360-degree visual coverage is not possible from a single vantage point, multiple PSOs must be on watch to ensure such coverage.
6. Suitable equipment must be available to each PSO to adequately observe the full extent of the Clearance and Shutdown Zones during all vessel operations and meet all reporting requirements.
    a. Visual observations must be conducted using binoculars and the naked eye while free from distractions and in a consistent, systematic, and diligent manner.
    b. Rangefinders (at least one per PSO, plus backups) or reticle binoculars (e.g., 7 x 50) of appropriate quality (at least one per PSO, plus backups) to estimate distances to ESA-listed species located in proximity to the vessel and Clearance and Shutdown Zone(s).
    c. Digital full frame cameras with a telephoto lens that is at least 300 mm or equivalent. The camera or lens should also have an image stabilization system. Used to record sightings and verify species identification whenever possible.
    d. A laptop or tablet to collect and record data electronically.
    e. Global Positioning Units (GPS) if data collection/reporting software does not have built-in positioning functionality.
    f. PSO data must be collected in accordance with standard data reporting, software tools, and electronic data submission standards approved by BOEM and NMFS for the particular activity.
    g. Any other tools deemed necessary to adequately perform PSO tasks.

A.7 PDC 7: Reporting Requirements

To ensure compliance and evaluate effectiveness of mitigation measures, regular reporting of survey activities and information on all protected and ESA-listed species will be required as follows.

A.7.1 BMPs:

1. Data requirements: Data from all PSO observations must be recorded based on standard PSO collection and reporting requirements. PSOs must use standardized electronic data forms to record data. The following information must be reported electronically in a format approved by BOEM and NMFS:

   Visual Effort:

   a. Vessel name;
   b. Dates of departures and returns to port with port name;
   c. Lease number;
   d. PSO names and affiliations;
   e. PSO ID (if applicable);
   f. PSO location on vessel;
   g. Height of observation deck above water surface (in meters);
   h. Visual monitoring equipment used;
   i. Dates and times (Greenwich Mean Time) of survey on/off effort and times corresponding with PSO on/off effort;
   j. Vessel location (latitude/longitude, decimal degrees) when survey effort begins and ends; vessel location at beginning and end of visual PSO duty shifts; recorded at 30 second intervals if obtainable from data collection software, otherwise at practical regular interval;
   k. Vessel heading and speed at beginning and end of visual PSO duty shifts and upon any change;
   l. Water depth (if obtainable from data collection software) (in meters);
   m. Environmental conditions while on visual survey (at beginning and end of PSO shift and whenever conditions change significantly), including wind speed and direction, Beaufort scale, Beaufort wind force, swell height (in meters), swell angle, precipitation, cloud cover, sun glare, and overall visibility to the horizon;
   n. Factors that may be contributing to impaired observations during each PSO shift change or as needed as environmental conditions change (e.g., vessel traffic, equipment malfunctions);
   o. Survey activity information, such as type of survey equipment in operation, acoustic source power output while in operation, and any other notes of significance (i.e., pre-clearance survey, ramp-up, shutdown, end of operations, etc.);

   Visual Sighting (all Visual Effort fields plus):

   a. Watch status (sighting made by PSO on/off effort, opportunistic, crew, alternate vessel/platform);

b. Vessel/survey activity at time of sighting;
c. PSO/PSO ID who sighted the animal;
d. Time of sighting;
e. Initial detection method;
f. Sighting's cue;
g. Vessel location at time of sighting (decimal degrees);
h. Direction of vessel's travel (compass direction);
i. Direction of animal's travel relative to the vessel;
j. Identification of the animal (e.g., genus/species, lowest possible taxonomic level, or unidentified); also note the composition of the group if there is a mix of species;
k. Species reliability;
l. Radial distance;
m. Distance method;
n. Group size; Estimated number of animals (high/low/best);
o. Estimated number of animals by cohort (adults, yearlings, juveniles, calves, group composition, etc.);
p. Description (as many distinguishing features as possible of each individual seen, including length, shape, color, pattern, scars or markings, shape and size of dorsal fin, shape of head, and blow characteristics);
q. Detailed behavior observations (e.g., number of blows, number of surfaces, breaching, spyhopping, diving, feeding, traveling; as explicit and detailed as possible; note any observed changes in behavior);
r. Mitigation Action; Description of any actions implemented in response to the sighting (e.g., delays, shutdown, ramp-up, speed or course alteration, etc.) and time and location of the action.
s. Behavioral observation to mitigation;
t. Equipment operating during sighting;
u. Source depth (in meters);
v. Source frequency;
w. Animal's closest point of approach and/or closest distance from the center point of the acoustic source;
x. Time entered shutdown zone;
y. Time exited shutdown zone;
z. Time in shutdown zone;
aa. Photos/Video

2. Final report: The project proponent must submit a final monitoring report to BOEM and NMFS (details to be provided) within 90 days after completion of survey activities. The report must fully document the methods and monitoring protocols, summarizes the survey activities and the data recorded during monitoring, estimates of the number of protected and/or ESA-listed species that may have been taken during survey activities, describes, assesses and compares the effectiveness of monitoring and mitigation measures. PSO sightings and effort data and trackline data in Excel spreadsheet format must also be provided with the final monitoring report.

3. Vessel strike: In the event of a vessel strike of a protected species by any survey vessel, the project proponent must immediately report the incident to BOEM (details to be provided) and NMFS (details to be provided) and for marine mammals to the NOAA West Coast stranding hotline at 1-866-767-6114 and 562-506-4315. The report must include the following information:

- **a.** Name, telephone, and email or the person providing the report;
- **b.** The vessel name;
- **c.** The Lease Number;
- **d.** Time, date, and location (latitude/longitude) of the incident;
- **e.** Species identification (if known) or description of the animal(s) involved;
- **f.** Vessel's speed during and leading up to the incident;
- **g.** Vessel's course/heading and what operations were being conducted (if applicable);
- **h.** Status of all sound sources in use;
- **i.** Description of avoidance measures/requirements that were in place at the time of the strike and what additional measures were taken, if any, to avoid strike;
- **j.** Environmental conditions (wave height, wind speed, light, cloud cover, weather, water depth);
- **k.** Estimated size and length of animal that was struck;
- **l.** Description of the behavior of the species immediately preceding and following the strike;
- **m.** If available, description of the presence and behavior of any other protected species immediately preceding the strike;
- **n.** Disposition of the animal (e.g., dead, injured but alive, injured and moving, blood or tissue observed in the water, last sighted direction of travel, status unknown, disappeared); and
- **o.** To the extent practicable, photographs or video footage of the animal(s).

4. Protected Species within an Enclosed Moon Pool: It is unlikely that a protected species would come in contact with a moon pool, but the following applies: If a protected species is observed within an enclosed moon pool and does not demonstrate any signs of distress or injury or an inability to leave the moon pool of its own volition, measures described in this section must be followed (only in cases where they do not jeopardize human safety). Although this particular situation may not require immediate assistance and reporting, a protected species could potentially become disoriented with their surroundings and may not be able to leave the enclosed moon pool of their own volition. Within 24 hours of any observation, and daily after that for as long as an individual protected species remains within a moon pool (i.e., in cases where an ESA-listed species has entered a moon pool, but entrapment or injury has not been observed), reporting is required.

   a. For initial reporting, the following information is required:

      i. Time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable);
      ii. Species identification (if known) or description of the animal(s) involved;
      iii. Condition of the animal(s) (including carcass condition if the animal is dead);
      iv. Observed behaviors of the animal(s), if alive;
      v. If available, photographs or video footage of the animal(s); and
      vi. General circumstances under which the animal was discovered.

b. After the initial report (see above), the following reporting measures must be followed, and information must be reported to BSEE (contact details to be provided) for operations requiring use of a moon pool to continue:
   i. Describe the animal's status to include external body condition (e.g., note any injuries or noticeable features), behaviors (e.g., floating at surface, chasing fish, diving, lethargic, etc.), and movement (e.g., has the animal left the moon pool and returned on multiple occasions?);
   ii. Description of current moon pool activities, if the animal is in the moon pool (e.g., drilling, preparation for demobilization, etc.);
   iii. Description of planned activities in the immediate future related to vessel movement or deployment of equipment;
   iv. Any additional photographs or video footage of the animal, if possible;
   v. Guidance received and followed from NMFS liaison or stranding hotline that was contacted for assistance;
   vi. Whether activities in the moon pool were halted or changed upon observation of the animal; and
   vii. Whether the animal remains in the pool at the time of the report, or if not, the time/date the animal was last observed.

5. Sightings of any injured or dead protected species must be immediately reported, regardless of whether the injury or death is related to survey operations, to BOEM (details to be provided), and the NOAA West Coast stranding hotline at 1-866-767-6114 and 562-506-4315. If the project proponent's activity is responsible for the injury or death, they must ensure that the vessel assist in any salvage effort as requested by NMFS. When reporting sightings of injured or dead protected species, the following information must be included:
   a. Time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable);
   b. Species identification (if known) or description of the animal(s) involved;
   c. Condition of the animal(s) (including carcass condition if the animal is dead);
   d. Observed behaviors of the animal(s), if alive;
   e. If available, photographs or video footage of the animal(s); and
   f. General circumstances under which the animal was discovered.

6. Reporting and Contact Information:
   a. Injurious Takes of Endangered and Threatened Species:
      i. NOAA West Coast stranding hotline at 1-866-767-6114 and 562-506-4315.
   b. Injurious Takes of Endangered and Threatened Species:
      i. NOAA NMFS Long Beach Office, Protected Resources Division (details to be provided).
      ii. BOEM Office of Environment, Pacific Region (details to be provided).

U.S. Department of the Interior (DOI)
DOI protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors the Nation's trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.

Bureau of Ocean Energy Management (BOEM)
BOEM's mission is to manage development of U.S. Outer Continental Shelf energy and mineral resources in an environmentally and economically responsible way.