UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 21668
Juneau, AK 99802-1668

Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Section 7(a)(4) Conference Opinion

Eareckson Air Station Long-term Fuel Pier Repairs, Shemya Island, Alaska

NMFS Consultation Number: AKRO-2023-02892

Action Agencies: National Marine Fisheries Service (NMFS), Office of Protected Resources, Permits and Conservation Division; Pacific Air Forces Regional Support Center; and U.S. Army Corps of Engineers

Affected Species and Determinations:

ESA-Listed Species	Status	Is the Action Likely to Adversely Affect Species?	Is the Action Likely to Adversely Affect Critical Habitat?	Is the Action Likely To Jeopardize the Species?	Is the Action Likely To Destroy or Adversely Modify Critical Habitat?
Steller Sea Lion, Western DPS (*Eumetopias jubatus*)	Endangered	Yes	No	No	No
Humpback Whale, Western North Pacific DPS (*Megaptera novaeangliae*)	Endangered	Yes	No	No	No
Humpback Whale, Mexico DPS (*Megaptera novaeangliae*)	Threatened	Yes	No	No	No
Sperm Whale (*Physeter macrocephalus*)	Endangered	Yes	N/A	No	N/A
Fin Whale (*Balaenoptera physalus*)	Endangered	Yes	N/A	No	N/A
Blue whale (*Balaenoptera musculus*)	Endangered	No	N/A	N/A	N/A
North Pacific Right Whale (*Eubalaena japonica*)	Endangered	No	No	N/A	No
Sei Whale (*Balaenoptera borealis*)	Endangered	No	N/A	N/A	N/A
Humpback Whale, Central America DPS (*Megaptera novaeangliae*)	Endangered	No	No	N/A	No
Cook Inlet Beluga Whale (*Delphinapterus leucas)*	Endangered	No	No	N/A	No
Eastern North Pacific Southern Resident Killer Whale (*Orcinus orca*)	Endangered	No	No	N/A	No

ESA-Listed Species	Status	Is the Action Likely to Adversely Affect Species?	Is the Action Likely to Adversely Affect Critical Habitat?	Is the Action Likely To Jeopardize the Species?	Is the Action Likely To Destroy or Adversely Modify Critical Habitat?
Gray Whale, Western North Pacific DPS (*Eschrichtius robustus*)	Endangered	No	N/A	N/A	N/A
Sunflower sea star (*Pycnopodia helianthoides*)	Proposed Threatened	No	None proposed at this time.	N/A	N/A

Consultation Conducted By: National Marine Fisheries Service, Alaska Region

Issued By: ______________________

Jonathan M. Kurland

Regional Administrator

Date: March 1, 2024

Accessibility of this Document

Every effort has been made to make this document accessible to individuals of all abilities and compliant with Section 508 of the Rehabilitation Act. The complexity of this document may make access difficult for some. If you encounter information that you cannot access or use, please email us at Alaska.webmaster@noaa.gov or call us at 907-586-7228 so that we may assist you.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

TERMS AND ABBREVIATIONS

Abbreviation	Term
ADEC	Alaska Department of Environmental Conservation
AKR	Alaska Region
District Court	U.S. District Court for the District of Alaska
DPS	Distinct Population Segment
ESCA	Endangered Species Conservation Act
EEZ	Exclusive Economic Zone
ESA	Endangered Species Act
Hz	Hertz
IHA	Incidental Harassment Authorization
IPCC	Intergovernmental Panel on Climate Change
ITS	Incidental Take Statement
kHz	Kilohertz
Km	Kilometers
MML	Alaska Fisheries Science Center's Marine Mammal Laboratory
MMPA	Marine Mammal Protection Act
MMRP	Military Munitions Response Program
MLLW	Mean Lower Low Water
µPa	Micro Pascal
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollution Discharge Elimination System
NRC	National Research Council
Opinion	Biological Opinion
PCB	Polychlorinated biphenyls
PTS	Permanent Threshold Shift
RMS	Root Mean Square
SEL	Sound Exposure Level
TTS	Temporary Threshold Shift
USFWS	United States Fish and Wildlife Services
VGP	Vessel General Permit

1 INTRODUCTION

Section 7(a)(2) of the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. § 1536(a)(2)) requires each Federal agency to ensure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When a Federal agency's action "may affect" a protected species, that agency is required to consult with the National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service (USFWS), depending upon the endangered species, threatened species, or designated critical habitat that may be affected by the action (50 CFR § 402.14(a)). Federal agencies may fulfill this general requirement informally if they conclude that an action may affect, but "is not likely to adversely affect" endangered species, threatened species, or designated critical habitat, and NMFS or the USFWS concurs with that conclusion (50 CFR § 402.14(b)).

Section 7(b)(3) of the ESA requires that at the conclusion of consultation, NMFS and/or USFWS provide an opinion stating how the Federal agency's action is likely to affect ESA-listed species and their critical habitat. If incidental take is reasonably certain to occur, section 7(b)(4) requires the consulting agency to provide an incidental take statement (ITS) that specifies the impact of any incidental taking, specifies those reasonable and prudent measures necessary or appropriate to minimize such impact, and sets forth terms and conditions to implement those measures.

On July 5, 2022, the U.S. District Court for the Northern District of California issued an order vacating the 2019 regulations that were revised or added to 50 CFR part 402 in 2019 ("2019 Regulations," see 84 FR 44976, August 27, 2019) without making a finding on the merits. On September 21, 2022, the U.S. Court of Appeals for the Ninth Circuit granted a temporary stay of the district court's July 5 order. On November 14, 2022, the Northern District of California issued an order granting the government's request for voluntary remand without vacating the 2019 regulations. The District Court issued a slightly amended order two days later on November 16, 2022. As a result, the 2019 regulations remain in effect, and we are applying the 2019 regulations here. For purposes of this consultation and in an abundance of caution, we considered whether the substantive analysis and conclusions articulated in the biological opinion and incidental take statement would be any different under the pre-2019 regulations. We have determined that our analysis and conclusions would not be any different. New proposed rules were published in the *Federal Register* on June 22, 2023 (88 FR 40753).

In this document, the action agencies are NMFS Office of Protected Resources Permits and Conservation Division (hereafter referred to as Permits Division), the Pacific Air Forces Regional Support Center (USAF; lead action agency), and United States Army Corps of Engineers (USACE) Alaska District. The NMFS Permits Division plans to issue an incidental harassment authorization (IHA) pursuant to section 101(a)(5)(D) of the Marine Mammal Protection Act of 1972, as amended (MMPA; 16 U.S.C. § 1361 et seq.), to the USAF for harassment of marine mammals incidental to the proposed action to repair the fuel pier at Eareckson Air Station on Shemya Island, Alaska (88 FR 74451). The USACE also plans to issue a Clean Water Act section 404 permit for the proposed action. The consulting agency for this proposal is NMFS's Alaska Region. This document represents NMFS's biological opinion (opinion) on the effects of this proposal on endangered and threatened species and designated critical habitat.

The opinion and ITS were prepared by NMFS Alaska Region in accordance with section 7(b) of the ESA (16 U.S.C. § 1536(b)), and implementing regulations at 50 CFR part 402.

The opinion and ITS are in compliance with the Data Quality Act (44 U.S.C. § 3504(d)(1)) and underwent pre-dissemination review.

1.1 Background

This opinion is based on information provided in the October, 2023, Biological Assessment (BA) and the proposed IHA. Other sources of information relied upon include consultation communications (emails and virtual meetings, monitoring reports). A complete record of this consultation is on file at NMFS's Juneau, Alaska office.

The proposed action will repair the only pier on Shemya Island (Figure 1). The repair to the fuel pier will include installing a steel combination wall (combi-wall) system around the current pier, installing an engineered revetment, and setting-up a barge landing zone. The project will also include project specific vessels expected to start Spring 2024 and expected completion in 2026. The in-water work is expected to occur from April 1, 2024 through March 31, 2025 with project specific vessel transits occurring in 2024, 2025, and 2026.

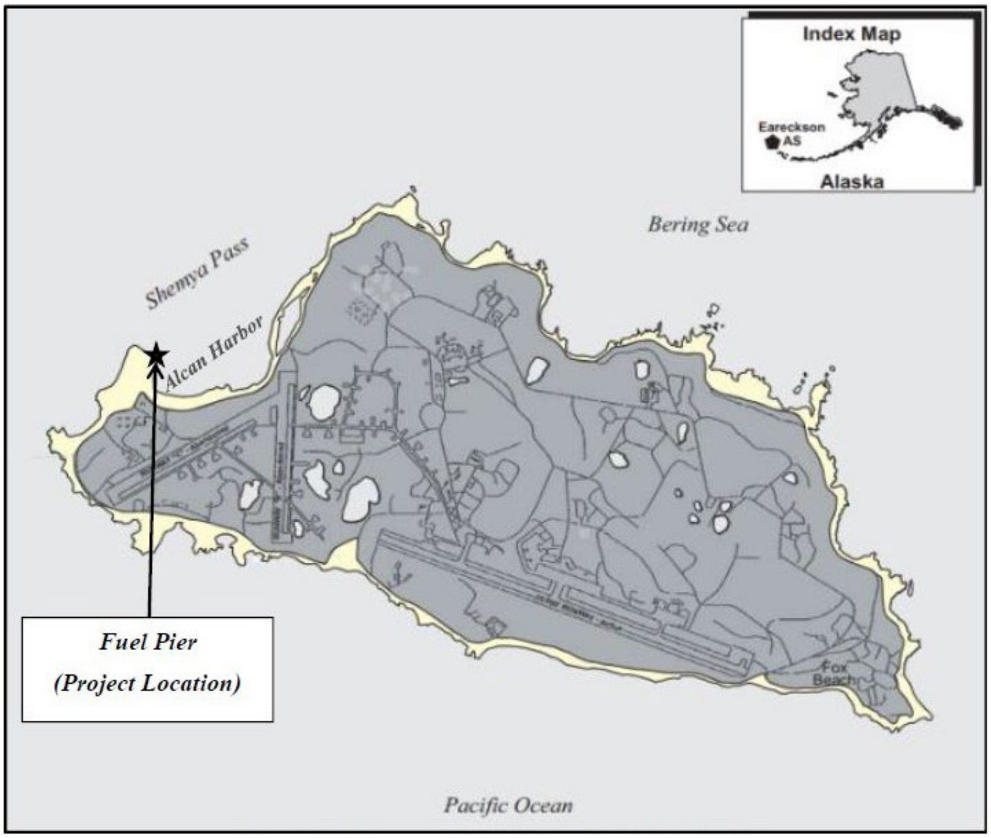

Figure 1. Map of the projection location in Alcan Harbor on Shemya Island in the western Aleutian Islands.

This opinion considers the effects of all the in-water activates including vessel transit of materials and construction barges, instillation of steel H piles and pipe-combi-wall system, and excavation for the new engineered revetment along the western shoreline. Including in water screening for the Military Explosives of Concern (MEC) and the effects of the proposed issuance of an IHA on the endangered western distinct population segment (DPS) Steller sea lion (*Eumetopias jubatus*), threatened Mexico DPS humpback whale, the endangered Central American and Western North Pacific humpback whale (*Megatera novaeangliae*), endangered sei whale (*Balaenoptera borealis*), endangered fin whale (*Balaenoptera physalus*), endangered Western North Pacific gray whale (*Eschrichtius robustus*), endangered blue whale (*Balaenoptera musculus*), endangered North Pacific right whale (*Eubalaena japonica*), endangered Cook Inlet beluga whale (*Delphinapterus leucas*), endangered Southern Resident DPS killer whale (*Orcinus orca*), and endangered sperm whale (*Physeter macrocephalus*). Steller sea lion critical habitat occurs within the project area including three haulouts (Alaid, Nizki, and Shemya) whose 20-kilometer zone spatially overlap with the ensonified zone (or harassment zone). Project dedicated vessel will transit through critical habitat for the Western North Pacific and Central America DPS humpback whales, Cook Inlet beluga whale, and Steller sea lion. Vessel traffic has the potential to transit through critical habitat for Mexico DPS humpback whale, Southern Resident killer whale, and North Pacific right whale. There is no critical habitat designated for sperm whales, fin whales, blue whales, sei whales, or gray whales. In addition, the action agency requested to a discretionary conference on the sunflower sea star (88 FR 16212, March 16, 2023) and requested concurrence with a not likely to adversely affect determination in the consultation. In the event the sunflower sea star is listed, this opinion includes analysis of the species similar to that of listed species. No critical habitat has been proposed for the sunflower sea star at this time.

1.2 Consultation History

- November 1, 2022: NMFS PRD received a copy of the USAF IHA application and cover letter
- February 13, 2023 – May 10, 2023: discussions with USACE
- May 15, 2023: a revised IHA application was received
- July 20, 2023, August 17, 2023, and August 31, 2023: NMFS Permits Division emailed USACE follow up questions on the IHA application
- July 25, 2023 and September 6, 2023: NMFS PRD received responses from the July 20th email.
- August 4, 2023, and August 9, 2023: Early Review Team (ERT), with participants from NMFS Permits Division and NMFS AKR, met to discuss the project to initiate form consultation under Section 7 of the ESA.
- August 22, 2023: USACE was notified that the final decision for sunflower sea stars is expected in March of 2024 and that NMFS recommends action agencies conference on the proposed sunflower sea star if sunflower sea stars occur within the project area
- October 23, 2023: NMFS AKR received a request for consultation, draft IHA, and proposed Federal Register Notice (FRN) from the NMFS Permits Division
- October 24, 2023: NMFS AKR received a Biological Assessment from USAF prepared by USACE Alaska District
- October 31, 2023: the Proposed IHA published in the Federal Register (88 FR 74451)
- November 15, 2023: NMFS PRD provided the standard mitigation measures for review to USACE.
- November 15, 2023: the USACE provided edits and comments on the mitigation measures.
- November 17, 2023: NMFS PRD confirmed via email that the revised mitigation measures were accepted and formal consultation was initiated.
- November 28, 2023: NMFS PRD requested information on the MEC work
- November 15, 2023, and January 5, 2024: NMFS PRD requested confirmation of the correct Action Agency(ies). On January 5, 2024, USACE confirmed there would be a 404 permit issued and USACE is managing the construction project.
- On January 26, 2024: NMFS PRD notified by email that we would consider both USACE and USAF Action Agencies.
- February12 and 13, 2024: NMFS PRD requested additional information by email on MEC detection in water and the likelihood of in-water detonation. USACE provided the requested information on February 13th and 15th.

2 DESCRIPTION OF THE PROPOSED ACTION AND ACTION AREA

2.1 Proposed Action

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies in the United States or upon the high seas. 50 C.F.R. § 402.02.

This opinion considers the effects of the Eareckson Air Station Long-term fuel pier repairs, which involves the installation of a new pier. The proposed project is located in Alcan Harbor on Shemya Island (Figure 1). The existing pier will not be removed, rather construction of the new pier will occur around the existing pier with the new pier encapsulating the old structure. The project will also install an engineered revetment to reduce scouring of the combi wall by placing 12-ton armor rock at the toe of the wall. The wall toe protection would be placed at a depth that would accommodate a fuel/supply barge draft of 21 ft. setting-up a barge landing zone (Figure 2). The proposed action will also include vessel transit of construction materials barges to the project site. Approximately, five barges each year (2024, 2025, and 2026) would originate from Seattle, WA, and transit within Alaska between Seward, Kodiak, and Anchorage, returning at the end of the season to Seattle, WA. Each vessel is anticipated to be 100-foot tugboat towing 400- by 100- foot barge.

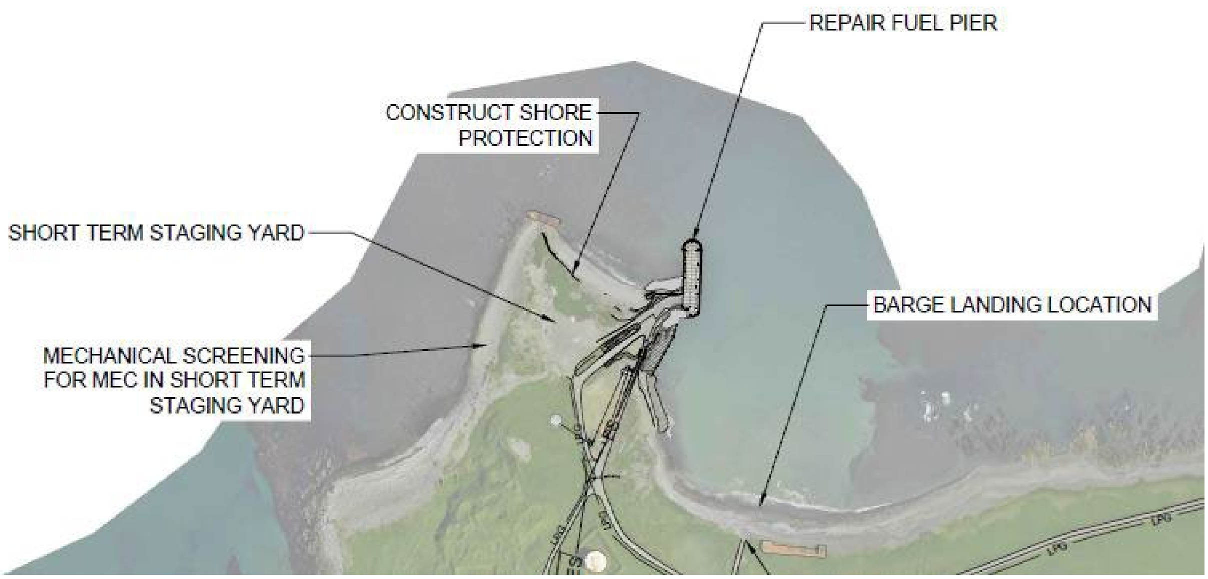

Figure 2. Key project locations for the fuel pier repair including fuel pier location, barge landing location, short term staging yard, and area for mechanical screening for military explosives of concern (from Draft IHA Application).

2.1.1 Proposed Activities

Eareckson Air Station is located in Alcan Harbor on Shemya Island in the Aleutian Islands (Figure 1). The Eareckson Air Station fuel dock is used by the U.S. Air Force for fuel delivery for use by on-island generator systems that aid in the operation of Homeland Defense early warning radar surveillance and communications systems. Eareckson Air Station also functions as an emergency divert airfield supporting commercial and air traffic destined for Japan, China, Indochina, and other destinations in Asia and the Pacific. Eareckson Air Station is restricted to mission-related personnel. No public recreation or tourism is permitted.

The purpose of the project is to replace the degraded pier and implement measures to maintain and protect the new dock from the frequent severe weather conditions, and counter the eroding effects on the shoreline from the wave actions in the near shore environment surrounding the dock (Figure 2)**.** The project will involve construction activities and project specific vessels.

The project activities by year are:

- 2024: Vessel mobilization, pile installation (round exterior piles), screening/clearance activities, remote equipment operations, removal of existing precast dolosse from western shoreline, and crushing/recycling concrete. The IHA for this project is for the pile installation planned in 2024.
- 2025: Cyclopean concrete placement, pier deck demolition, pressure grouting on existing pier structure, tieback installation, pier leveling course placement, electrical system rough-in, and fuel line repair and backfill. No IHA is sought for these activities and no in-water construction activities are planned and the only in-water activities are the project dedicated vessel traffic.
- 2026: Pour in place pier concrete deck, electrical system upgrades finish, fuel line upgrades finish, shoreline revetment installation, and demobilization. No IHA is sought for these activities as other project activities are either not in-water activities or are in-water activities (e.g. revetment insulations, project specific vessel traffic) and can be mitigated to avoid the request for incidental take.

2.1.1.1 Construction Activities

The pier's in-water construction is proposed to begin in April of 2024. The project would take three construction seasons (April to October) to complete.

Construction of the proposed pier would follow the pile installation sequence below:

1. Set one or two cantilevered templates utilizing existing pier as support. These cantilevered templates would not be installed in the water. However, template pile may be utilized in some areas to offer additional support and are included in Table 1.
2. Within the frame, loft, and stab 6 to 12 each 42-inch permanent pile.
3. Within the frame, vibrate, impact, and down-the-hole (DTH) drill 42-inch diameter pipe pile. Only one pile would be driven at a time, even if two pile templates are used.
4. Remove the frame and any temporary piles and move to the next permanent pile location. Repeat this process for placement of all the permanent piles.

The steel pipe-pile combi-wall system will encapsulate most of the existing pier with the proposed combi-wall installed up to 15 feet off the existing pier's footprint creating an exterior pipe pile wall

(Figure 3). Template frames for the pile wall would be installed to construct the new pier exterior structure and subsequently removed (Table 1). Most pile templates will be installed utilizing the existing structure and designed and constructed to cantilever off the existing fuel pier structure (i.e., not be placed in the water). Some 30-inch template piles may be required for additional support, such as at corners, and if needed, these template piles would be installed in the water and are included in Table 1.

The main component of the combi-wall system would be interlocking steel pipe piles that would be pile-driven and/or socketed into bedrock or, at a minimum, 30 feet below the mudline. There are 83 piles on the long sides and 21 piles on each short side for a total of 208, 42-inch round interlocking steel pipe piles required to construct the steel combi-wall system (Table 1, Figure 3).

The two hundred eight (208) permanent 42-inch diameter pile will be vibrated through the soil layer to the specified embedment depths developed during design. Remotely operated vibratory hammer pile driving would be the method used to drive the piles through the bottom sediment to specified depths. If a vibratory hammer alone was unable to achieve the specified embedment depth, a diesel or hydraulic impact hammer would be utilized. Piles would be socketed into bedrock via a drill. It is expected that most, if not all piling will require a rock socket. Rock sockets will be installed utilizing a DTH hammer and bit (Table 1).

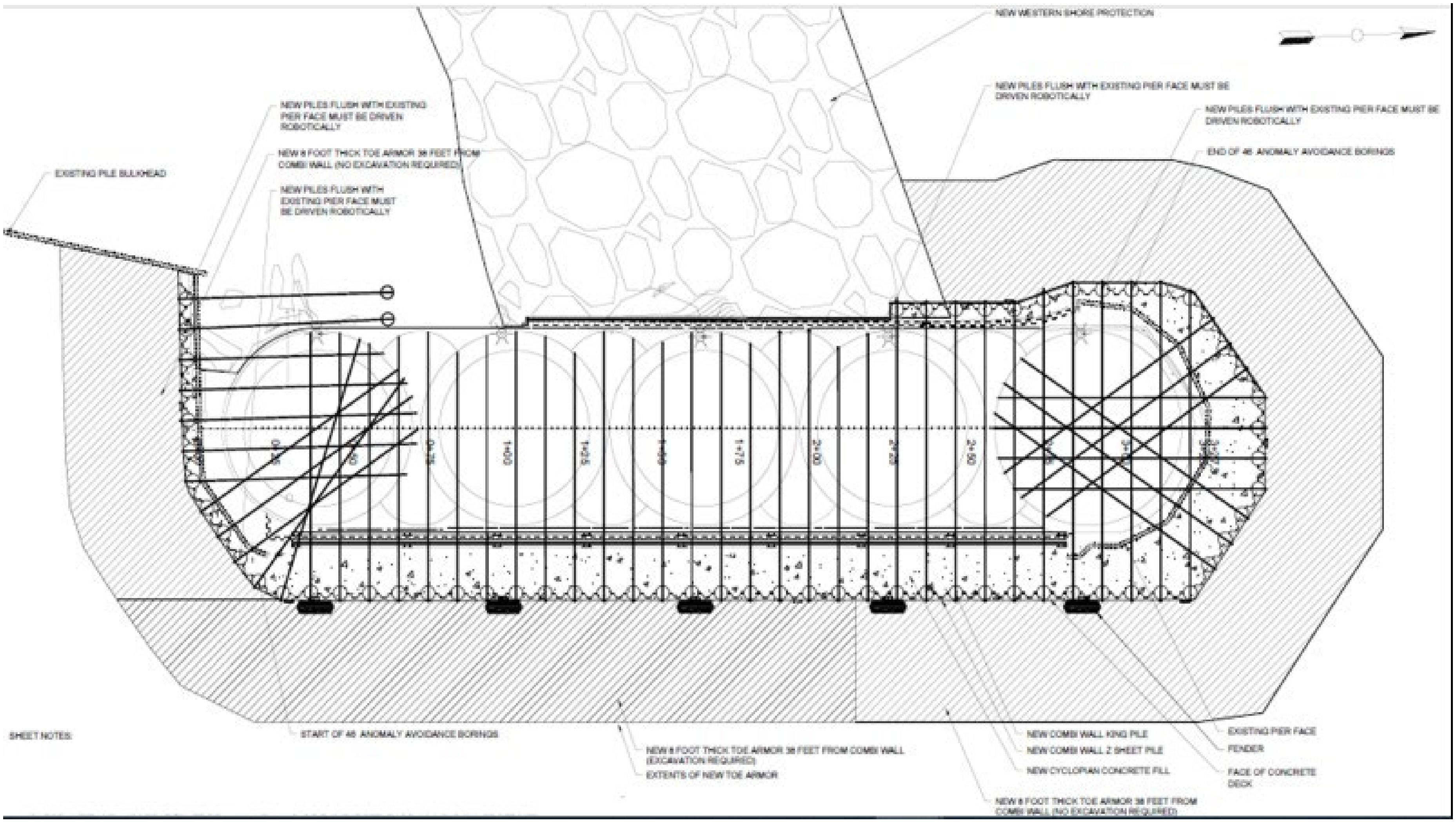

Figure 3. Project design (Figure 1-2; IHA Application).

Table 1. Summary of Piles to be Installed and Removed

Pile Diameter and Type	Temp Pile Installation	Temp Pile Removal	Perm Pile Installation
Diameter of Piles (inches)	30	30	42
Pile Type	Steel	Steel	Steel
Total Number of Piles	60	60	208[1]
Vibratory Pile Driving			
Total Quantity	60	60	208
Max # Piles Vibrated per Day	4	4	4
Vibratory Time per Pile (minute)	15	15	30
Vibratory Time per Day (minute)	60	60	120
Number of Days	15	15	52
Vibratory Time Total (minute)	900	900	6,240
Impact Pile Driving			
Total	44	-	208
Max # Piles Impacted per Day	4	-	4
# of Strikes per Pile	900	-	1,800
Impact Time per Pile (minutes)	30	-	45
Impact Time per Day (minutes)	120	-	180
Number of Days	11	-	52
Impact Time Total	1,320	-	9,360
Down-the-Hole Drilling			
Total	6	-	208
Max # of Piles Installed per Day	3	-	208
Time per Pile (minutes)	150	-	180
Time per Day (minutes)	450	-	540
Number of Days	2	-	70
DTH Drilling Time Total (minutes)	900	-	37,440

2.1.1.2 Reinforcement, Erosion, and Scouring Protections

Several steps will be undertaken to address damage to the existing pier and the eroding shoreline and to reinforce and prevent similar damage to the new pier. Cyclopean concrete fill, concrete filled with rubble consisting of concrete debris and clean rock from on-island or upland-imported sources, will be used to fill in the space between the existing pier structure and new exterior steel combi-wall (Figure 3). The cyclopean concrete will extend from the seafloor to just below the new pile wall tieback elevation. There are existing voids and undermining in the original cells of the pier where the structural fill has eroded away. These and similar voids will be filled via

[1] The 208 42-inch steel pipes are presented under all three hammer types since a combination of hammers may be needed.

pressure grouting after vibro-compaction of existing gravel fill and pressure grouting to mitigate settlement and improve load path and transfer.

A cast-in-place concrete deck, precast concrete cap, galvanic aluminum or magnesium anodes, tieback anchors, seven 200-ton bollards, pipe bull rail, and five low-profile fender panels will be installed. The fender panels are steel-framed, ultra-high-molecular-weight polyethylene faced panels with foam-filled floating fenders to allow retraction of the fenders along the berthing face during severe weather to reduce potential damage. The new deck would reach approximately +23 feet mean lower low water (MLLW).

There are large holes in the existing sheet pile that expose the pier structural components to the surrounding constant wave energy, and the entire eastern berthing face of sheet pile has been torn off and other sheet piles have been worked loose by wave action. The local wave action and currents have been progressively eroding the shoreline, which, if not addressed, have the potential to cut off pier access from the mainland. To reduce scouring of the new pier, two rock layers will be placed using a crane, clamshell bucket, hydraulic grapple, and large excavator. This barrier will be placed on top of the seabed at an approximately -38 feet MLLW depth to accommodate a barge draft of 21 feet. The scour protection will extend approximately 25 feet out from the pier toe before declining on a 1V on 2H slope to the mudline, and it would be about seven feet thick. The under layer will consist of filter stone, and the top layer would consist of 5- to 10-ton armor rock.

The western shoreline engineered revetment would replace the current failing 150-linear foot dolosse revetment with approximately up to 750 linear feet of reinforced engineered revetment. The new engineered revetment would extend from the west side of the pier to the western tip of the headlands to minimize erosion to nearshore infrastructure from strong wave action and severe weather. The engineered revetment will be constructed using a combination of material from the former revetment (i.e., 12-ton dolosse and bedding rock) and new filter, bedding, and armored stone. New stone would range approximately between less than 1-ton up to 30-ton stone. The structure would have a crest of approximately +25 feet MLLW. A berm with a height of approximately +13.3 feet MLLW would be incorporated between the crest and a toe with a 1V on 4H slope. The flank protection of the western shoreline engineered revetment would tie into the natural existing contours.

The replacement fuel pier is within a Military Munitions Response Program (MMRP) site and although prior surveys and clearance of the Alcan Harbor Ordnance MMRP site have been completed, there is potential for munitions and explosives of concern to migrate within the site. As such, magnetometer-based surveys for MEC will be conducted prior to ground disturbing activities within the boundaries of the MMRP site to detect anomalies and inform follow-on actions to the extent practicable. In the extremely unlikely event that a MEC is discovered within in-water sediment, determination on the proper action (blow-in-place or moving it for follow-on disposal) will be made based on the specific munition, when/where munition was identified, risk to personnel and infrastructure, and other factors. Excavated material from in-water work and from the western shoreline engineered revetment installation would follow the MEC screening protocols. In water material would be excavated with a clamshell bucket and placed in a hopper that deposits the material onto a conveyor leading to a 6-inch remote controlled grizzly rock screener. Subsequently, material six inches or larger would be further inspected for MEC prior to transfer by armored equipment to a screening plant with a specialized magnet belt to remove all potential metals and munitions. These protocols would include remotely controlled equipment to run the material through the screening process. Cleared material would be transferred to an upland, low-grade staging area while MEC would be transferred from the construction site to the MEC storage and disposal site.

Excavated material from these activities would be used as upland fill, south of the revetment to raise the grade of depression that periodically floods from severe weather events. Dolosse outside of the marine waters from the prior revetment would be rigged with straps by commercial divers for removal, as necessary, using an excavator or crane. This equipment would be remotely operated if activity is ground disturbing. Removed dolosse and precast materials (e.g., wave dissipating concrete blocks and pier caps) would be transferred to the concrete disposal area via truck and repurposed as cyclopean concrete fill for construction and repair activities.

2.1.1.3 Transport of Materials and Equipment

Supplies and equipment will be transported to the project site via tug and barge. Approximately five barges per year (100-foot tugboat towing 400- by 100-foot barges) will deploy from Seattle, WA, between January and March each year (2024, 2025, and 2026). Each vessel will transit within Alaskan waters likely between Kodiak, Seward, Anchorage, and Shemya Island, with each transit taking up to a month. The potential vessel trips by the project-specific vessels for each year are present in Table 2. Project-dedicated vessels will travel along standard commercial shipping routes, though the vessel routes are not fully defined and include an extended area for assessment purposes (Figure 4).

Table 2. Project specific vessel transits between ports and the project on Shemya Island.

Potential Trips	Location		
	Originate	Midway	Terminal
One Way	Seattle, WA	N/A	Shemya Island, AK
One Way	Seattle, WA	Seward, AK	Shemya Island, AK
Round Trip	Shemya Island, AK	Seward, AK	Shemya Island, AK
Round Trip	Shemya Island, AK	Kodiak, AK	Shemya Island, AK
Round Trip	Shemya Island, AK	Anchorage, AK	Shemya Island, AK
One way	Shemya Island, AK	N/A	Seattle, WA

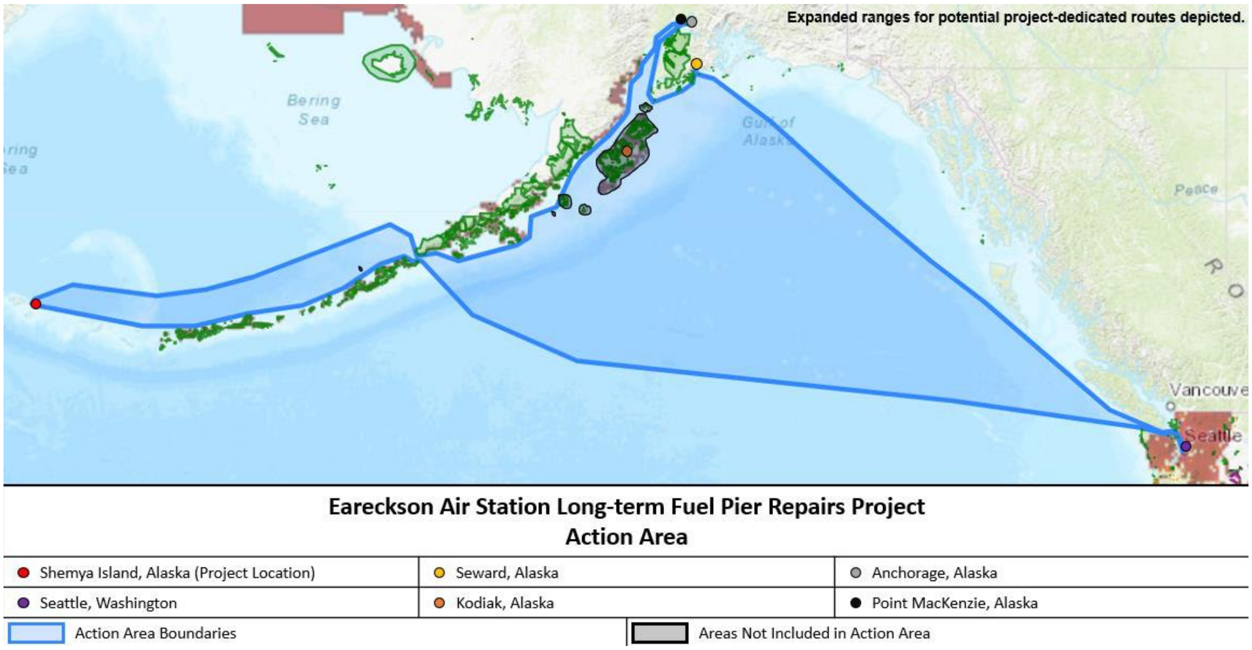

Figure 4. Approximate route of project specific vessel traffic including all ports (USACE, 2023).

2.1.2 Mitigation Measures

For all reporting that results from implementation of these mitigation measures, NMFS will be contacted using the contact information specified in Table 4. In all cases, notification will reference the NMFS consultation tracking number (AKRO-2023-02892). The USACE informed NMFS via email on November 15, 2023, that the proposed action will incorporate the following mitigation measures:

General Mitigation Measures

1. The USACE will inform NMFS of impending in-water activities a minimum of one week prior to the onset of those activities (email information to akr.section7@noaa.gov).
2. If construction activities will occur outside of the time window specified in this letter, the applicant will notify NMFS of the situation at least 60 days prior to the end of the specified time window to allow for reinitiation of consultation.
3. In-water work will be conducted at the lowest points of the tidal cycle when feasible.
4. Consistent with AS 46.06.080, trash will be disposed of in accordance with state law. The project proponent will ensure that all closed loops (e.g., packing straps, rings, bands, etc.) will be cut prior to disposal. In addition, the project proponent will secure all ropes, nets, and other marine mammal entanglement hazards so they cannot enter marine waters.

2.1.2.1 PSO Requirements

5. At least one PSO will have either prior experience as a PSO in Alaska, or will have taken a NMFS-approved PSO or marine mammal observer training course.
6. PSO training will include:
   a. field identification of marine mammals and marine mammal behavior;
   b. ecological information on marine mammals and specifics on the ecology and management concerns of those marine mammals;
   c. ESA and MMPA regulations;
   d. proper equipment use;
   e. methodologies in marine mammal observation and data recording and property reporting protocols; and
   f. an overview of PSO roles and responsibilities.
7. PSOs will be individuals independent from the project proponent and must have no other assigned tasks during monitoring periods.
8. The action agency or its designated non-federal representative will provide resumes or qualifications of PSO candidates to consultation biologist and akr.prd.section7@noaa.gov approval at least one week prior to in-water work. NMFS will provide a brief explanation of lack of approval in instances where an individual is not approved.
9. PSOs will:
   a. collectively be able to effectively observe the entirety of the shutdown zone;
   b. be able to identify marine mammals and accurately record the date, time, and species, of all observed marine mammals in accordance with project protocols;
   c. be able to identify listed marine mammals that may occur in the action area, at a distance equal to the outer edge of the applicable shutdown zone and determine marine mammal's location and distance from sound source;
   d. have the ability to effectively communicate orally, by radio or in person with project personnel to provide real-time information on listed marine mammals;
   e. possess a copy of mitigation measures; and
   f. possess data forms.
10. PSOs will not scan for marine mammals for more than four hours without at least a one hour break from monitoring duties between shifts. PSOs will not perform PSO duties for more than 12 hours in a 24-hour period.
11. PSOs will have the ability, authority, and obligation to order appropriate mitigation response, including shutdown, to avoid takes of listed marine mammals.
12. One or more PSOs will perform PSO duties onsite throughout the authorized activity.

13. Where a team of three or more PSOs are required, a lead observer or monitoring coordinator will be designated.
14. For each in-water activity, PSOs will monitor all marine waters within the applicable shutdown zone radius for that activity. Table 3 provides shutdown and harassment zones for in-water pile driving activities.

Table 3. Shutdown and Harassment Zones for In-Water Pile Driving Activities and Dredging, Screening, and Underwater Excavating Activities.

<table>
<tr><th rowspan="2">Pile size, type, and method</th><th colspan="3">Minimum shutdown zone (m)[2]</th><th rowspan="2">Level B Harassment zones (m)</th></tr>
<tr><th>Low-frequency (humpback whales, gray whale, North Pacific right whale, Sei whale, fin whale, blue whale)</th><th>Mid-frequency (sperm whale)</th><th>Otariid (Steller sea lion)</th></tr>
<tr><td>42-inch Steel Pipe Pile, Vibratory</td><td colspan="3">50</td><td>16,343</td></tr>
<tr><td>30-inch Steel Pipe Pile, Vibratory</td><td colspan="3">25</td><td>11,656</td></tr>
<tr><td>42-inch Steel Pipe Pile, DTH</td><td>2,600</td><td>100</td><td>100</td><td>39,811</td></tr>
<tr><td>30-inch Steel Pipe Pile, DTH</td><td>2,300</td><td rowspan="2">80</td><td>90</td><td>39,811</td></tr>
<tr><td>42-inch Steel Pipe Pile, Impact</td><td>2,100</td><td>80</td><td>1,359</td></tr>
<tr><td>30-inch Steel Pipe Pile, Impact</td><td>1,000</td><td>50</td><td>50</td><td>1,166</td></tr>
<tr><td>Dredging, screening, and underwater excavating activities</td><td colspan="4">300</td></tr>
</table>

15. PSOs will be positioned such that they will collectively be able to monitor the entirety of each activity's shutdown zone.
16. Prior to commencing any activity listed in Table 3, PSOs will scan waters within the appropriate shutdown zone and confirm no listed marine mammals are within the shutdown zone for at least 30 minutes immediately prior to initiation of the in-water activity. If one or more listed marine mammals are observed within the shutdown zone, the in-water activity will not begin until the listed marine mammals exit the shutdown

[2] The shutdown zones are based on rounding up the Level A zones.

zone of their own accord, or the shutdown zone has remained clear of listed marine mammals for 30 minutes (for cetaceans) or 15 minutes (for pinnipeds) immediately prior to the commencement of the activities listed in Table 3.

17. The on-duty PSOs will continuously monitor the shutdown zone and adjacent waters during any of the activities listed in Table 3 for the presence of listed marine mammals.
18. Activities listed in Table 3 will only take place:
    a. between sunrise and sunset;
    b. during conditions with a Beaufort Sea State of 4 or less; and
    c. when the entire shutdown zone and adjacent waters are visible (e.g., monitoring effectiveness is not reduced due to rain, fog, snow, haze, or other environmental/atmospheric conditions).
19. If visibility degrades such that PSOs can no longer ensure that the shutdown zone remains devoid of listed marine mammals during any of the activities listed in Table 3, the crew will stop activities until the entire shutdown zone is visible and the PSOs has indicated that the zone remained devoid of listed marine mammals for 30 minutes.
20. The PSOs will order ongoing activities listed in Table 3 to immediately cease if one or more listed marine mammals has entered, or appears likely to enter, the shutdown zone.
21. If any of the activities listed in Table 3 are shut down due to the presence of listed marine mammals in and/or approaching the shutdown zone, the activities may commence when the PSOs provides assurance that listed marine mammals were observed exiting and/to moving away from the shutdown zone or after the PSO provides assurance that listed marine mammals have not been seen in the shutdown zone for 30 minutes (for cetaceans) or 15 minutes (for pinnipeds).
22. Prior to commencing any activity listed in Table 3, or at changes in watch, PSOs will establish a point of contact with the construction crew. The PSO will brief the point of contact as to the shutdown procedures if the PSO observes that listed marine mammals are likely to enter or approach the shutdown zone. If the point of contact goes "off shift" and delegates their duties, the point of contact must inform the PSO and brief the new point of contact.

2.1.2.2 Impact Pile Installation (Pipe Piles or H Piles)

23. If no listed marine mammals are observed within the applicable shutdown zone (see Table 3) for 30 minutes immediately prior to pile installation, soft-start procedures will be implemented immediately prior to activities. Soft-start procedures require contractors to provide an initial set of strikes at no more than half the operational power, followed by a 30-second waiting period, then two subsequent reduced-power-strike sets. A soft-start must be implemented:
    a. at the start of each day's impact pile installation;
    b. any time pile installation has been shut down or delayed due to the presence of a listed marine mammal;

   c. whenever pile installation has temporarily stopped (≤30 min) and PSO observation has also stopped; or
   d. whenever pile installation has temporarily stopped for more than 30 min and PSO observation has also stopped.

24. Following the soft-start procedure, operational impact pile installation may commence and continue provided listed marine mammals remain absent from the shutdown zone.
25. Following a lapse of impact pile installation activities of more than 30 minutes, the PSO will authorize resumption of impact pile installation only after the PSO provides assurance that listed species have not been present in the shutdown zone for at least 30 minutes immediately prior to resumption of operations.

2.1.2.3 Vibratory Pipe and Sheet Pile Removal and Installation

26. If no listed marine mammals are observed within the applicable shutdown zone (see Table 3) for 30 minutes immediately prior to pile removal or installation, vibratory pile removal or installation may commence. This pre-pile removal or installation observation period will take place at the start of each day's vibratory pile removal or installation, each time pile removal or installation has been shut down or delayed due to the presence of a listed species, and following a cessation of pile driving for a period of 30 minutes or longer.
27. Following a lapse of vibratory pile removal or installation activities of more than 30 minutes, the PSO will authorize resumption of vibratory pile removal or installation only after the PSO provides assurance that listed marine mammals have not been present in the shutdown zone for at least 30 minutes immediately prior to resumption of operations.

2.1.2.4 Down-the-Hole (DTH) Drilling

28. If no listed marine mammals are observed within the DTH pile driving shutdown zone for 30 minutes immediately prior to pile driving, soft-start procedures will be implemented immediately prior to activities. Soft start requires contractors to activate the drilling equipment at no more than half the operational power for several seconds, followed by a 30 second waiting period, then two subsequent reduced power start-ups. A soft start must be implemented at the start of each day's DTH pile driving, any time pile driving has been shutdown or delayed due the presence of a listed species, and following cessation of pile driving for a period of 30 minutes or longer.
29. Following this soft-start procedure, operational pile driving may commence and continue provided listed marine mammals remain absent from the shutdown zone.
30. Following a lapse of pile driving activities of more than 30 minutes, the PSO will authorize resumption of pile driving only after the PSO provides assurance that listed marine mammals have not been present in the shutdown zone for at least 30 minutes immediately prior to resumption of operations.

2.1.2.5 Dredging/Screening/Underwater Excavating Activities

31. All vessels involved in dredging, screening, and underwater excavating operations, including survey vessels, will transit at velocities ≤10 knots.
32. Dredging, screening, and underwater excavating activities will shut down whenever a listed marine mammal enters or approaches within the shutdown zone (Table 3).
33. Following a lapse of dredging, screening, and underwater excavating activities of more than 30 minutes, the PSO will authorize resumption of the activity only after the PSO provides assurance that listed marine mammals have not been present within the shutdown zone for at least 30 minutes immediately prior to resumption of operations.
34. If dredged spoils are deposited at an in-water site, the site must have a current of greater than 3 knots, the vessel making the deposit must keep moving at 3 knots or more throughout disposal, and the site must be outside of Cook Inlet beluga whale critical habitat.

2.1.2.6 Intertidal Fill/Bank Stabilization and Maintenance

35. Fill material will consist of rock fill that is free of fine sediments to the extent practical, or will come from on-site dredged material.
36. Fill material will be obtained from local sources or will be free of non-native marine and terrestrial vegetation species.
37. A PSO must be present whenever sheet piles are installed and will follow mitigation measures for impact and vibratory pile driving listed above.

2.1.2.7 Project-Dedicated Vessels

Mitigations will be implemented unless they would compromise the safety of vessel and crew.

38. Vessel operators will:
    a. maintain a watch for marine mammals at all times while underway;
    b. stay at least 91 meters (100 yards) away from listed marine mammals, except that they will remain at least 460 meters (500 yards) away from endangered North Pacific right whales;
    c. travel at less than 5 knots when within 274 meters (300 yards) of a whale;
    d. avoid changes in direction and speed within 274 meters (300 yards) of a whale, unless doing so is necessary for maritime safety;
    e. not position vessel(s) in the path of a whale, and will not cut in front of a whale in a way or at a distance that causes the whale to change direction of travel or behavior (including breathing/surfacing pattern);
    f. reduce vessel speed to 10 knots or less when weather conditions reduce visibility to 1.6 kilometers (1 mile) or less; and

g. adhere to the Alaska Humpback Whale Approach Regulations when vessels are transiting to and from the project site: (see 50 CFR §§ 216.18, 223.214, and 224.103(b); these regulations apply to all humpback whales). Specifically, pilot and crew will not:

   i. approach, by any means, including by interception (i.e., placing a vessel in the path of an oncoming humpback whale), within 100 yards of any humpback whale:

   ii. cause a vessel or other object to approach within 100 yards of any humpback whale; or

   iii. disrupt the normal behavior or prior activity of a humpback whale by any other act or omission.

39. If a whale's course and speed are such that it will likely cross in front of a vessel that is underway, or approach within 91 meters (100 yards) of the vessel, and if maritime conditions safely allow, the engine will be put in neutral and the whale will be allowed to pass beyond the vessel, except that vessels will remain 460 meters (500 yards) from North Pacific right whales.

40. Vessels will not allow lines to remain in the water unless both ends are under tension and affixed to vessels or gear.

41. Project-specific barges will travel at 12 knots or less.

2.1.2.7.1 Vessel Transit, North Pacific Right Whales, and their Designated Critical Habitat

42. Vessels will:

   a. remain at least 460 meters (500 yards) from North Pacific right whales; and

   b. not travel through designated North Pacific right whale critical habitat if practicable (50 CFR 226.215). If traveling through North Pacific right whale critical habitat cannot be avoided, vessels will:

      i. travel through North Pacific right whale critical habitat at 5 knots or less (without a PSO on watch); or at 10 knots or less while PSOs maintain a constant watch for listed species from the bridge; and

      ii. maintain a log indicating the time and geographic coordinates at which vessels enter and exit North Pacific right whale critical habitat.

2.1.2.7.2 Vessel Transit, Western DPS Steller Sea Lions, and their Designated Critical Habitat

43. Vessels will not approach within 5.5 kilometers (3 nautical miles) of rookery sites listed in 50 CFR § 224.103(d); and

44. Vessels will not approach within 914 meters (3,000 feet) of any Steller sea lion haulout or rookery.

2.1.2.7.3 Vessel Transit and Project Activities, Cook Inlet Beluga Whales, and their Designated Critical Habitat

45. Project activity noise in excess of the 120 dB threshold will not occur between the shoreline and the mean lower low water (MLLW) line in the Susitna Delta (Beluga River to the Little Susitna River; see Figure 5 below) between April 15 and November 15. To help accomplish this:
    a. Project vessel(s) operating in or transiting through Cook Inlet will maintain a distance of at least 1.5 miles south of the MLLW line; and
    b. Operation of airguns in Cook Inlet will not occur within 10 statute miles (8.6 nautical miles, 16 km) of the MLLW line between the Beluga and Little Susitna Rivers.
46. Vessel transit will not extend within 1.2 km with an empty barge, within 2.2 km with a full barge, or into the area between the shoreline and the MLLW line. Project-specific barges will travel 12 knots or less in Cook Inlet.

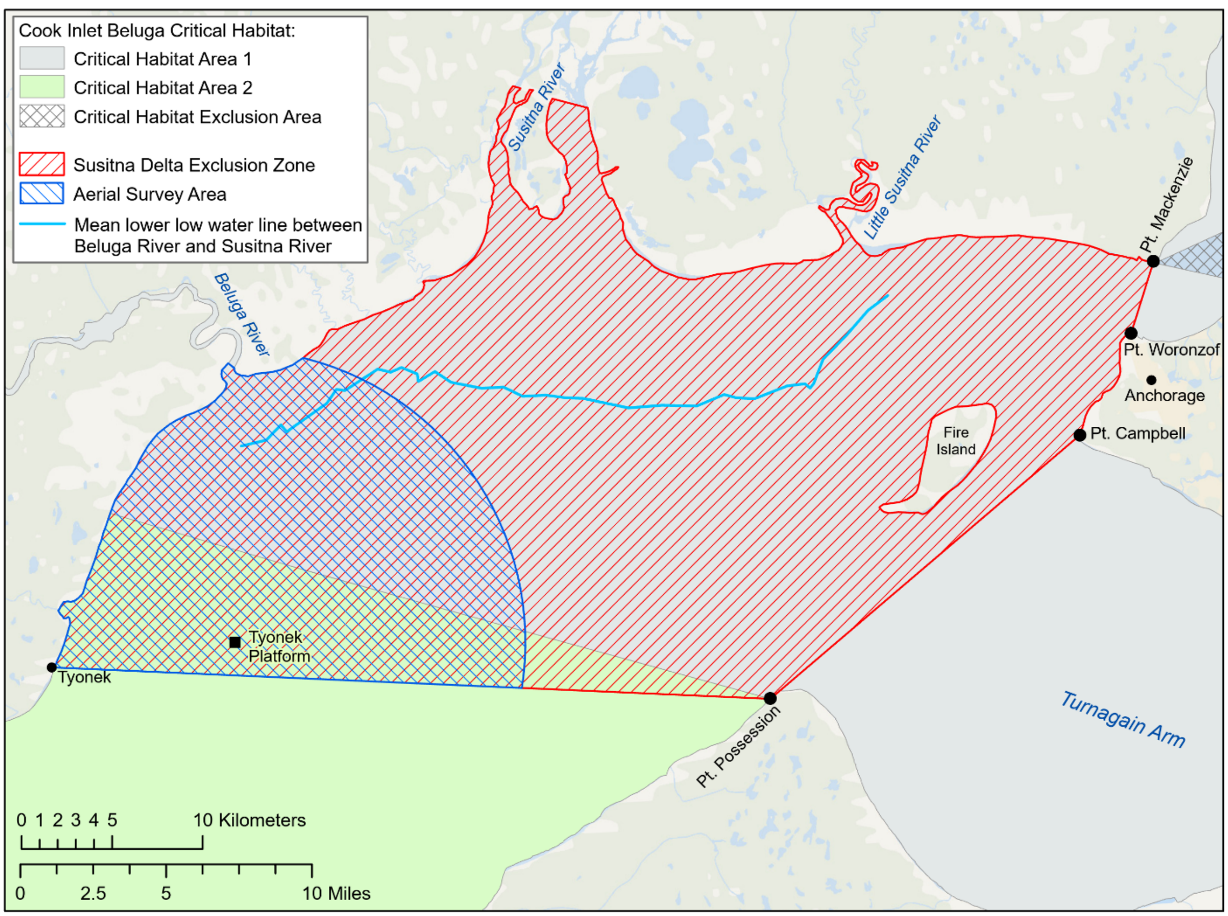

Figure 5. Susitna Delta Exclusion Zone, showing MLLW line between the Beluga and Little Susitna Rivers (red hashed area is the exclusion zone for seismic activity).

2.1.2.8 Data Collection

PSOs have the following responsibilities for data collection:

47. PSOs will record observations on data forms or into electronic data sheets.
48. The project proponent will ensure that PSO data will be submitted electronically in a format that can be queried such as a spreadsheet or database (i.e., digital images of data sheets are not sufficient).
49. PSOs will record the following:
    a. project name, date, shift start time, shift stop time, and PSO identifier;
    b. date and time of each reportable event (e.g., a listed marine mammal observation, operation shutdown, reason for operation shutdown, change in weather conditions);
    c. weather parameters (e.g., percent cloud cover, percent glare, visibility) and sea state where the Beaufort Wind Force Scale will be used to determine sea state (https://www.weather.gov/mfl/beaufort);
    d. species, numbers, and, if possible, sex and age class of observed listed marine mammal;
    e. the predominant anthropogenic sound-producing activities occurring during each listed marine mammal observation;
    f. observations of listed marine mammal behaviors and reactions to anthropogenic sounds and presence;
    g. geographic coordinates of initial, closest, and last location of listed species, including distance from observer to the listed species, and minimum distance from the predominant sound-producing activity to listed species; and
    h. whether the presence of a listed species necessitated the implementation of mitigation measures to avoid acoustic impact (i.e., shutdown), and the duration of time that normal operations were affected by the presence of listed species.

2.1.2.9 Reporting

2.1.2.9.1 Unauthorized Take

50. If a listed marine mammal is determined by the PSO to have been disturbed, harassed, harmed, injured, or killed (e.g., a listed marine mammal is observed entering a shutdown zone before operations can be shut down, or is injured or killed as a direct or indirect result of the action), the PSO will report the incident to NMFS within one business day, with information submitted to akr.prd.records@noaa.gov. These PSO records will include:
    a. digital, query enabled documents containing PSO observations and records, and digital, query enabled reports;

b. the date, time, and location of each event (provide geographic coordinates);

c. description of the event;

d. number of individuals of each listed marine mammal species affected;

e. the time the animal(s) was first observed or entered the shutdown zone, and, if known, the time the animal was last seen or exited the zone, and the fate of the animal;

f. mitigation measures implemented prior to and after the animal was taken;

g. if a vessel struck a listed marine mammal, the contact information for the PSO on duty on the vessel or the contact information for the individual piloting the vessel; and

h. photographs or video footage of the animal(s), if available.

2.1.2.9.2 Stranded, Injured, Sick or Dead Listed Species (not associated with the project)

51. If the PSO observes an injured, sick, or dead marine mammals (i.e., stranded), they will notify the Alaska Marine Mammal Stranding Hotline at 877-925-7773. The PSOs will submit photos and available data to aid NMFS in determining how to respond to the stranded animal. If possible, data submitted to NMFS in response to stranded marine mammals will include date/time, location of stranded marine mammal, species and number of stranded individuals, description of the stranded marine mammal's condition, event type (e.g., entanglement, dead, floating), and behavior of live-stranded marine mammals.

2.1.2.9.3 Illegal Activities

52. If the PSO observes listed marine mammals or other marine mammals being disturbed, harassed, harmed, injured, or killed (e.g., feeding or unauthorized harassment), these activities will be reported to NMFS Alaska Region Office of Law Enforcement (Table 2; 1-800-853-1964).
53. Data submitted to NMFS will include date/time, location, description of the event, and any photos or videos taken.

2.1.2.9.4 North Pacific Right Whales

54. All observations of North Pacific right whales will be reported to NMFS within 24 hours.

2.1.2.9.5 Final Report

55. A final report will be submitted to NMFS within 90 calendar days of the completion of the project summarizing the data recorded by emailing it to akr.section7@noaa.gov. The report will summarize all in-water activities associated with the proposed action, and results of PSO monitoring conducted during the in-water activities.

56. The final report for projects will include:
    a. summaries of monitoring efforts, including dates and times of construction, dates and times of monitoring, dates and times and duration of shutdowns due to listed marine mammal presence;
    b. dates and times of listed marine mammal observations, geographic coordinates of listed marine mammals at their closest approach to the project site, including date, water depth, species, age/size/gender (if determinable), and group sizes;
    c. number of listed marine mammals observed (by species) during periods with and without project activities (and other variables that could affect detectability);
    d. observed listed marine mammal behaviors and movement types versus project activity at the time of observation;
    e. numbers of marine mammal observations/individuals seen versus project activity at time of observation; and
    f. digital, query enabled documents containing PSO observations and records, and digital, query enabled reports.

Table 4. Summary of Agency Contact Information.

Reason for Contact	**Contact Information**
Consultation Questions & Unauthorized Take	akr.prd.section7@noaa.gov, mandy.keogh@noaa.gov
Reports & Data Submittal	akr.prd.records@noaa.gov
Stranded, Injured, or Dead Marine Mammals (not related to the project)	Stranding Hotline (24/7 coverage) 1-877-925-7773
Oil Spill & Hazardous Materials Response	U.S. Coast Guard National Response Center: 1-800-424-8802 and AKRNMFSSpillResponse@noaa.gov
Illegal Activities *(not related to project activities; e.g., feeding, unauthorized harassment, or disturbance to marine mammals)*	NMFS Office of Law Enforcement (AK Hotline): 1-800-853-1964
In the event that this contact information becomes obsolete	NMFS Anchorage Main Office: 907-271-5006 or NMFS Juneau Main Office: 907-586-7236

2.2 Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR § 402.02). For this reason, the action area is typically larger than the project area and extends out to a point where no measurable effects from the proposed action occur.

The Eareckson Air Station Fuel pier is located in Alcan Harbor on Shemya Island within the Aleutian Islands (Figure 1). The action area includes: (1) the area in which construction activities will take place (Figure 1-3), (2) an ensonified area around the installation activities (Figure 6), and (3) the vessel transit routes taken by the material and construction barges to the project site (Figure 4).

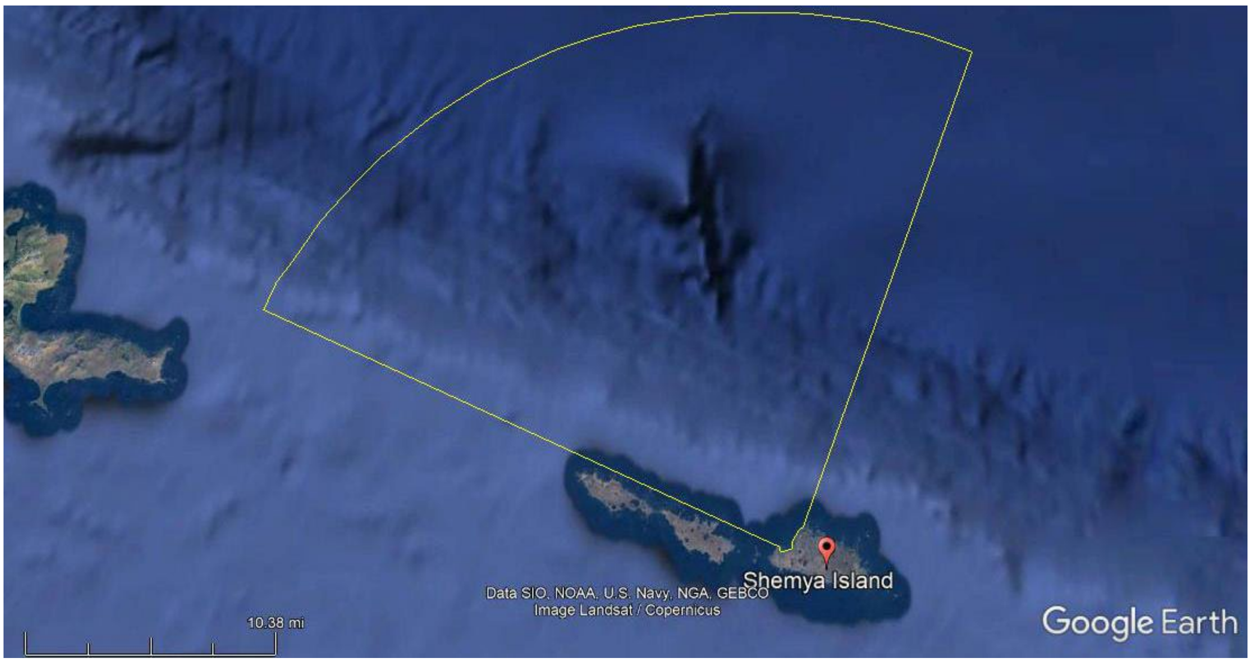

Figure 6. The Eareckson Air Station Action Area Showing Level B Isopleths (USACE, 2023).

NMFS defines the ensonified portion of the action area for this consultation to include the area within which project-related noise levels exceed 120 dB re 1 μPa root mean square (rms), and are expected to approach ambient noise levels (i.e., the point where no measurable effect from the project will occur).

The action area includes the area ensonified by 42-inch DTH pile driving, which has the largest isopleth of any construction activity in this project. Propagation of noise from the proposed project is partially constrained by local geography including Nizki Island and Alaid Island to the East of Shemya Island (Figure 6). The project action area extends 40 kilometers from the fuel pier.

3 APPROACH TO THE ASSESSMENT

Section 7(a)(2) of the ESA requires Federal agencies, in consultation with NMFS, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. The jeopardy analysis considers both survival and recovery of the species. The adverse modification analysis considers the impacts to the conservation value of the designated critical habitat.

To jeopardize the continued existence of a listed species means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR § 402.02). As NMFS explained when it promulgated this definition, NMFS considers the likely impacts to a species' survival as well as likely impacts to its recovery. Further, it is possible that in certain, exceptional circumstances, injury to recovery alone may result in a jeopardy biological opinion (51 FR 19926, 19934; June 3, 1986).

Under NMFS's regulations, the destruction or adverse modification of critical habitat means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species (50 CFR § 402.02).

The designation(s) of critical habitat for Steller sea lion, Southern Resident killer whale, and Cook Inlet belugas use(s) the term primary constituent element (PCE) or essential features. The 2016 critical habitat regulations (81 FR 7414; February 11, 2016) replaced this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a "destruction or adverse modification" analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this biological opinion, our use of the term PBF also applies to Primary Constituent Elements and essential features.

We use the following approach to determine whether the proposed action described in Section 2 of this opinion is likely to jeopardize listed species or destroy or adversely modify critical habitat:

- Identify those aspects (or stressors) of the proposed action that are likely to have effects on listed species or critical habitat. As part of this step, we identify the action area – the spatial and temporal extent of these effects.

- Identify the range wide status of the species and critical habitat likely to be adversely affected by the proposed action. This section describes the current status of each listed species and its critical habitat relative to the conditions needed for recovery. We determine the range-wide status of critical habitat by examining the condition of its PBFs - which were identified when the critical habitat was designated. Species and critical habitat status are discussed in Section 4 of this opinion.

- Describe the environmental baseline including: past and present impacts of Federal, state, or private actions and other human activities *in the action area*; anticipated impacts of proposed Federal projects that have already undergone formal or early section 7 consultation, and the impacts of state or private actions that are contemporaneous with the consultation in process. The environmental baseline is discussed in Section 5 of this opinion.

- Analyze the effects of the proposed action. Identify the listed species that are likely to co-occur with these effects in space and time and the nature of that co-occurrence (these represent our *exposure analyses*). In this step of our analyses, we try to identify the number, age (or life stage), and gender of the individuals that are likely to be exposed to stressors and the populations or subpopulations those individuals represent. NMFS also evaluates the proposed action's effects on critical habitat PBFs. The effects of the action are described in Section 6 of this opinion with the exposure analysis described in Section 6.2 of this opinion.

- Once we identify which listed species are likely to be exposed to an action's effects and the nature of that exposure, we examine the scientific and commercial data available to determine whether and how those listed species are likely to respond given their exposure (these represent our *response analyses*). Response analysis is considered in Section 6.3 of this opinion.

- Describe any cumulative effects. Cumulative effects, as defined in NMFS's implementing regulations (50 CFR § 402.02), are the effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area. Future Federal actions that are unrelated to the proposed action are not considered because they require separate section 7 consultation. Cumulative effects are considered in Section 7 of this opinion.

- Integrate and synthesize the above factors to assess the risk that the proposed action poses to species and critical habitat. In this step, NMFS adds the effects of the action (Section 6) to the environmental baseline (Section 5) and the cumulative effects (Section 7) to assess whether the action could reasonably be expected to: (1) appreciably reduce the likelihood of both survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminish the value of critical habitat for the conservation of the species. These assessments are made in full consideration of the status of the species and critical habitat (Section 4). Integration and synthesis with risk analyses occurs in Section 8 of this opinion.

- Reach jeopardy and adverse modification conclusions. Conclusions regarding jeopardy and the destruction or adverse modification of critical habitat are presented in Section 9. These conclusions flow from the logic and rationale presented in the Integration and Synthesis Section 8.

- If necessary, define a reasonable and prudent alternative to the proposed action. If, in completing the last step in the analysis, NMFS determines that the action under consultation is likely to jeopardize the continued existence of listed species or destroy or adversely modify designated critical habitat, NMFS must identify a reasonable and prudent alternative to the action.

4 RANGEWIDE STATUS OF THE SPECIES AND CRITICAL HABITAT

This opinion considers the effects of the proposed action on the species and designated critical habitats specified in Table 5. Project-specific vessels will travel between Seattle, Seward, Anchorage, Kodiak, and the project site on Shemya Island (Table 2, Figure 4). The proposed vessel route from Seattle, WA, is expected to transit through designated critical habitat for Southern Resident DPS killer whales and Central America DPS humpback whales. The proposed vessel routes within Alaskan waters between Anchorage, Seward, Kodiak, and Shemya Island may transit through designated critical habitat for Cook Inlet beluga whales, Steller sea lions, North Pacific right whale, Mexico DPS humpback whales, and Western North Pacific DPS humpback whales.

Table 5. Listing status and critical habitat designation for species considered in this opinion and concurrence.

Species	Status	Listing	Critical Habitat
North Pacific Right Whale *(Eubalaena japonica)*	Endangered	NMFS 2008, 73 FR 12024	NMFS 2008, 73 FR 19000
Humpback Whale, Mexico DPS *(Megaptera novaeangliae)*	Threatened	NMFS 2016, 81 FR 62260	NMFS 2021 86 FR 21082
Humpback Whale, Western North Pacific DPS *(Megaptera novaeangliae)*	Endangered	NMFS 2016, 81 FR 62260	NMFS 2021 86 FR 21082
Humpback Whale, Central America DPS (*Megaptera novaeangliae)*	Endangered	NMFS 2016, 81 FR 62260	NMFS 2021 86 FR 21082
Blue Whale (*Balaenoptera musculus*)	Endangered	NMFS 1970, 35 FR 18319	Not designated
Fin Whale (*Balaneoptera physalus*)	Endangered	NMFS 1970, 35 FR 18319	Not designated
Sperm Whale (*Physeter macrocephalus*)	Endangered	NMFS 1970, 35 FR 18319	Not designated
Sei whale (*Balaenoptera borealis*)	Endangered	NMFS 1970, 35 FR 18319	Not designated
Gray whale, Western North Pacific DPS (*Eschrichtius robustus*)	Endangered	NMFS 1970, 35 FR 18319	Not designated
Cook Inlet beluga whale (*Delphinapterus leucas*)	Endangered	NMFS 2008, 73 FR 62919	NMFS 2011, 76 FR 20180
Eastern North Pacific Southern Resident Killer whale (*Orcinus orca*)	Endangered	NMFS 2015 80 FR 7380	NMFS 2021, 71 FR 69054
Steller Sea Lion, Western DPS *(Eumetopias jubatus)*	Endangered	NMFS 1997, 62 FR 24345	NMFS 1993, 58 FR 45269
Sunflower Sea Star *(Pycnopodia helianthoides)*	Proposed	NMFS 2023, 88FR 16212	None proposed at this time.

4.1 Species and Critical Habitat Not Likely to be Adversely Affected by the Action

As described in the Approach to the Assessment section of this opinion, NMFS uses two criteria to identify those endangered or threatened species or critical habitats that are likely to be adversely affected. The first criterion is exposure or some reasonable expectation of a co-occurrence between one or more potential stressors associated with the proposed activities and a listed species or designated critical habitat.

The second criterion is the probability of a response given exposure. For endangered or threatened species, we consider the susceptibility of the species that may be exposed. For example, species exposed to vessel sound that are not likely to exhibit physical, physiological, or behavioral responses given that exposure (at the combination of sound pressure levels and distances associated with an exposure), are unlikely adversely affected by the exposure. We determine that an action would not likely adversely affect an animal if one could not meaningfully measure or detect the effects, or if the effects are extremely unlikely to occur.

In addition, if proposed activities are not likely to destroy or adversely modify critical habitat, further analysis is not required.

We applied these criteria to the species and critical habitats listed above in Table 5 and determined that the following species and designated critical habitats are not likely to be adversely affected by the proposed action: Cook Inlet beluga whales and their critical habitat, blue whale, Western North Pacific gray whales, Central American humpback whale and their critical habitat, Eastern North Pacific Southern Resident killer whale and their critical habitat, North Pacific right whale and their critical habitat, Sei whale, Steller sea lion critical habitat, Mexico DPS humpback whale critical habitat, and Western North Pacific DPS humpback whale critical habitat, and the proposed sunflower sea star. Below we discuss our rationale for those determinations.

4.1.1 Blue Whales, Sei Whales, North Pacific Right Whales, Western North Pacific Gray Whales, Southern Resident DPS Killer Whales, Central America DPS Humpback Whales, Cook Inlet Beluga Whales

The travel route between Seattle, WA, and Seward, Kodiak, Anchorage, and Shemya Island, AK, may overlap with Cook Inlet beluga whales, blue whale, Central American humpback whales (Table 6), Western North Pacific gray whales, Southern Resident DPS killer whales, North Pacific right whales, and sei whales. The known distribution of Cook Inlet beluga whales, Southern Resident DPS killer whales, Central American humpback whales (Table 6), and Western North Pacific DPS gray whale (Table 7) do not overlap with the project area associated with the in-water construction in Alcan Harbor on Shemya Island. Further, no observations of North Pacific right whales, gray whales, blue whales, or sei whales have been reported near Shemya Island, though four sightings of whales during spring through autumn were not identified to species (USACE 2023).

Table 6. Probability of encountering humpback whales from each listed DPS in the North Pacific Ocean (columns) in feeding areas (rows) project specific vessels will transit through. Adapted from (NMFS 2021; Wade 2021).

	Western North Pacific DPS	Mexico DPS	Central America DPS
Aleutian Islands and Bering Sea	2%	7%	0%
Gulf of Alaska	1%	11%	0%
Southeast Alaska/ Northern British Columbia	0%	2%	0%
Southern British Columbia/ Washington	0%	25%	6%

Table 7. Probability of encountering gray whales from the Eastern North Pacific population and the Western North Pacific distinct population segment in the North Pacific Ocean in relevant feeding areas during the summer months and migratory corridor during the spring and fall months. Adapted from (Damon-Randall 2023).

	Eastern North Pacific Population	**Western North Pacific Distinct Population Segment**
Summer Feeding Areas	(June through November)	
Eastern Bering Sea	100%	0%
Western North America (Kodiak Island, Alaska to Northern California)	100%	0%
Migratory Corridor Areas	(March through June and	November through January)
Alaska, Canada, Washington, Oregon, and California	99.6%	0.4%

4.1.1.1 Vessel Traffic

The route proposed for project-specific barges and tugs will originate each year (2024, 2025, and 2026) from Seattle, WA, with transits within Alaskan waters occurring between Seward, Kodiak, Anchorage, and Shemya Island. Approximately five barges per year would be used and the anticipated sizes would be 100-foot tugboats towing 400- by 100-foot barges. Each vessel transit would generally travel no more than eight knots along standard commercial shipping routes. Multiple transits within Alaska will occur between Seward, Kodiak, Anchorage, and Shemya Island (Table 2, Figure 3), with each transit taking about a month.

NMFS has interpreted the term “harass” in the Interim Guidance on the ESA Term "Harass" (Wieting 2016) as to “create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering.”

The potential effects from project vessel traffic, which could include harassment or harm, on listed marine mammal species include:

- vessel strikes
- auditory and visual disturbance
- pollution

4.1.1.1.1 Auditory and visual disturbance

The primary underwater sound associated with the proposed vessel operation is the continuous noise produced from propellers; sound is generated by the collapse of air bubbles (cavitation) created when propeller blades move rapidly through the water (Gray and Greeley 1980).

A whale’s reaction to vessel disturbance may include approach or deflection from the sound source, low level avoidance, short-term vigilant behavior, short-term masking of echolocation or other acoustic communication among individuals. Behavioral reactions to vessels can vary depending on the type and speed of the vessel, and the spatial relationship between the animal and the vessel. Response also varies between individuals of the same species exposed to the same sound, depending on age, individual animals' past experiences, and current behavior.

Proposed mitigation measures to avoid harassing these whales during vessel transits include, but are not limited to: 1) maintaining a watch for ESA-listed marine mammals at all times while underway, 2) reducing vessel speed to less than 5 kn and avoiding changes in direction and speed, unless doing so is necessary for maritime safety, when within 274 m (300 yds.) of a whale, and 3) avoiding North Pacific right whale critical habitat if practical. Even with these avoidance measures, these seven whale species or DPSs may still be exposed to vessel sound; but the sound will be low-frequency, and the duration of the exposure will be temporary (a few minutes) because the vessel will be in transit. Because the sound of the vessels will be continuous, marine mammals will be alerted to their presence before the received level of sound exceeds 120 decibels (dB). Therefore, a startle response is not expected. Rather, deflection and avoidance are expected to be the common responses in those instances where there is any response at all. Moreover, given the overall frequency of vessel traffic along the commercial shipping routes, humpback whales, blue whales, gray whales, North Pacific right whales, sei whales, Southern Resident DPS killer whales, and Cook Inlet beluga whales may routinely encounter vessels and may be habituated to vessel noise. NMFS has no expectation of significant disruption of important behaviors, such as feeding, breeding, resting, and migrating, of these whales due to visual or auditory disturbance from vessels travelling between ports. Thus, we consider such effects to be insignificant.

4.1.1.1.2 Vessel Strike

The proposed project specific routes overlap with the ranges of blue whales, sei whales, Western North Pacific gray whales, Central America humpback whales, North Pacific right whales, Southern Resident DPS killer whales, and Cook Inlet beluga whales, and these species may be encountered during transits. Project vessels will have a short-term presence in the North Pacific, Gulf of Alaska including Cook Inlet, and the Bering Sea.

Vessel strike is an ongoing source of mortality for large whales (Vanderlaan and Taggart 2007; Schoeman et al. 2020) and vessel speed is a principal factor in whether a strike results in death (Laist et al. 2001; Vanderlaan and Taggart 2007; Neilson et al. 2012). In assessing records with known vessel speeds, Laist et al. (2001) found that most lethal ship strikes on large whales occurred when a vessel was traveling in excess of 24.1 km/h (14.9 mph; 13 kn).

Among large whales, humpback whales, fin whales, and gray whales are the most frequent victims of ship strikes (Laist et al. 2001; Neilson et al. 2012). From 1978 to 2011, 108 whale-vessel collisions were recorded in Alaska; humpback whales were the most frequently observed, accounting for 86 percent of all reported collisions (Neilson et al. 2012). Twenty-six large whale-vessel strikes were reported between 2016 and 2020 in Alaska: 18 humpback, three fin, two sperm, and three unidentified whales (Freed et al. 2022). The probability of encountering humpback whales from the Central America DPS humpback whale in the North Pacific Ocean in feeding areas project specific vessels are expected to transit is very low (listed in Table 6 (NMFS 2021; Wade 2021)). The specific migration route and timing of the Western North Pacific gray whales is unknown making it very difficult to predict when and where they pass through the Aleutian chain or along the coast of Alaska (Weller et al. 2012; Weller et al. 2023). However, given the large population size of the Eastern North Pacific gray whale (approximately 26,960 animals; Muto et al. 2022) and the relatively small number of the ESA listed Western North Pacific gray whales (approximately 139 animals, 48% of the population; Cooke 2020) that make a trans-Pacific migration, there is a very low likelihood that a Western North Pacific DPS of gray whale will overlap with project-specific vessels. There have been no reported strikes of blue whales, sei whales, or North Pacific right whales in Alaska since 1978; however, the reported unidentified whale strikes could potentially include these species (Neilson et al. 2012; Delean et al. 2020b; Freed et al. 2022).

Ship strikes of smaller cetaceans are less common than large whales, possibly due to their smaller size and more agile nature. However, Cook Inlet beluga whales have been photographed with propeller scars (McGuire et al. 2014) and one Cook Inlet beluga whale carcass had sharp trauma consistent with a vessel strike (Neilson et al. 2012). Southern Resident DPS killer whale L98 was killed during a vessel interaction in 2006 and J34 was found dead in 2016 with injuries consistent with those incurred during a vessel strike (Carretta et al. 2023).

Project vessels would generally travel no more than eight knots along standard commercial shipping routes, greatly reducing the probability of a vessel strike. Additionally, mitigation measures (2.1.2.6 Project-Dedicated Vessels) will be implemented to minimize potential vessel collisions with marine mammals during project activities. These mitigation measures include, but are not limited to, maintaining a vigilant watch aboard vessels for listed marine mammals and avoiding potential interactions with whales by implementing a five-knot speed restriction when within 274 meters (300 yards) of observed whales. Project vessels will also be maneuvered to keep at least 460 meters (500 yards) away from any observed North Pacific right whales, 91 meters (100 yards) from other listed marine mammals, and avoid approaching whales in a manner that causes them to change direction or separate from other whales in their group.

The probability of strike events depends on the frequency, speed, and route of the marine vessels, and the distribution and density of marine mammals in the area, as well as other factors. With the number of vessel trips, transitory nature of project-related vessel traffic, slow transit speeds, implementation of the mitigation measures, and the low occurrence of these whale species over the majority of the route, we conclude the probability of a project vessel striking a blue whale, sei whale, Western North Pacific Gray Whale, North Pacific right whale, Southern Resident DPS killer whale, or Cook Inlet beluga whale is extremely low and any adverse effects due to vessel strikes are extremely unlikely to occur. Therefore, we consider the potential effects from vessel strikes to be insignificant.

4.1.1.1.3 Pollutant

Pollutant spills or discharges from transiting project vessels could adversely affect Central America DPS humpback whales, North Pacific right whales, blue whales, sei whales, North Pacific gray whales, Southern resident DPS killer whales, and Cook Inlet beluga whale. Pollutants can affect marine mammals if contact with skin, inhalation, or ingestion occurs. The impacts of pollutants depend on duration and severity of exposure. In addition to liquid or gas pollutants, solid waste pollution such as marine debris (ship lines, packing bands, etc.) may enter the marine environment and interact with listed species through entanglement and ingestion.

Mitigation measures will be in place to minimize the potential for debris into the marine environment. All materials will be appropriately managed, containerized, and secured during project specific vessel transits, in accordance with applicable regulations and policies. Proper operation and low speeds will also reduce the likelihood of a wreck or accident. Even in the unlikely event of a spill, spills from transiting vessels are unlikely to affect listed species because dispersal and evaporation of fuels and other pollutants are expected to occur quickly due to wind and tidal currents. The listed species found throughout the transit routes are also likely to be widely distributed and not in close proximity to the spill source (transiting vessels).

It is unknown what impact marine debris such as packing bands and loops may have on cetacean species. Discarded or lost lines from vessels could become an entanglement hazard for listed cetaceans. To address these sources of debris, there is a mitigation measure to ensure trash will be disposed of in accordance with state law (AS 46.06.080) and specifically ensure cutting of all unused packing straps, plastic rings, and other synthetic loops, and securing all ropes and nets, to ensure they do not blow or wash into the marine environment. These measures will help to prevent entanglement of marine wildlife. However, due to the large area of the project vessel transit routes, the extremely small number of lines expected to be lost from vessels associated with this action, and the relatively low density of cetaceans, we conclude it is unlikely that listed cetacean species will be affected by marine debris.

Considering the wide distribution and low density of the listed cetaceans throughout the transit portions of the action area, and the measures in place to reduce the entanglement risk of packing bands and loops and to avoid marine mammals while in transit, we conclude that harmful exposure from project-related stressors to Central America DPS humpback whales, North Pacific right whales, sei whales, North Pacific gray whales, blue whales, Southern Resident DPS killer whales, and Cook Inlet beluga whales, is discountable.

4.1.1.2 In Water Construction Activities

The proposed project is located in Alcan Harbor on Shemya Island in the Western Aleutian Island Chain (Figure 1). The distributions of the Southern resident DPS killer whales, Cook Inlet beluga whales, and Central America DPS humpback (Table 6) do not overlap with the project area associated with the in water construction in Alcan Harbor on Shemya Island.

The distributions of blue whales, sei whales, North Pacific right whales, and gray whales do overlap with the project area and these species may occur infrequently in the surrounding waters around Shmya Island. However, they are not expected to occur in the area affected by pile driving activities.

In summary, NMFS concludes that pile driving activities associated with the proposed action are not likely to adversely affect the blue whale, sei whale, Central America DPS humpback whale, North Pacific right whale, Western North Pacific gray whale, Southern Resident DPS killer whale, Cook Inlet beluga whale. These species will not be discussed further.

4.1.2 Sunflower Sea Star

The proposed project is located in Alcan Harbor on Shemya Island in the Western Aleutian Island Chain (Figure 1). There have been observations of the sunflower sea star on the south side of the Aleutian Islands; however, no observations have been West of Kuluk Bay on Adak Island and there are no observations on the North side of the Aleutian Islands (Bering Sea) (https://alaskafisheries.noaa.gov/mapping/sz/index.html?tab=ss&layout=h2; (Gravem et al. 2021; Lowry 2022), therefore we do not expect sunflower sea stars to occur within the project area within Alcan Harbor where in water construction will occur. No critical habitat is proposed at this time.

4.1.3 Effects to Critical Habitat for the North Pacific Right Whale, Steller sea lion, Southern Resident DPS Killer Whale, Cook Inlet Beluga Whale, Central America DPS humpback whales, Western North Pacific DPS humpback whales, and Mexico DPS humpback whales

Project-specific vessels may pass through critical habitat for the Southern Resident DPS killer whales and Central America DPS humpback whales during the transit to/from Seattle, WA, and may pass through critical habitat for the North Pacific right whale, Mexico DPS and Western North Pacific DPS humpback whale, Steller sea lion, and Cook Inlet beluga whale when project vessels transit between ports within Alaska including Seward, Anchorage, Kodiak, and Shemya Island (Table 2). The potential stressors from project specific vessels include disturbance to the waters' surface and pollutants resulting from accidental spills or releases of petroleum products. While the size and composition of a spill influences the severity of effects to critical habitat, the evaporation of fuels and other pollutants are expected to occur quickly due to wind and tidal currents.

The proposed action is not likely to adversely affect critical habitat for North Pacific Right whales, Southern Resident DPS killer whales, Mexico DPS, Central America DPS, and Western North Pacific DPS humpback whales, Steller sea lions, and Cook Inlet beluga whales for the reasons discussed below.

4.1.3.1 North Pacific Right Whale Critical Habitat

NMFS designated critical habitat for the northern right whale in the North Pacific Ocean on July 6, 2006 (71 FR 38277), and the same areas of critical habitat for the North Pacific right whale was re-designated in the eastern Bering Sea and in the Gulf of Alaska effective on May 8, 2008 (73 FR 19000, April 8, 2008; Figure 7). The physical or biological features (PBFs) deemed necessary for the conservation of North Pacific right whales are the copepods *Calanus marshallae*, *Neocalanus cristatus*, and *N. plumchris*, and the euphausiid *Thysanoessa raschii*, in areas of the North Pacific Ocean in the Bering Sea and Gulf of Alaska in which North Pacific right whales are known or believed to feed (50 CFR § 226.215).

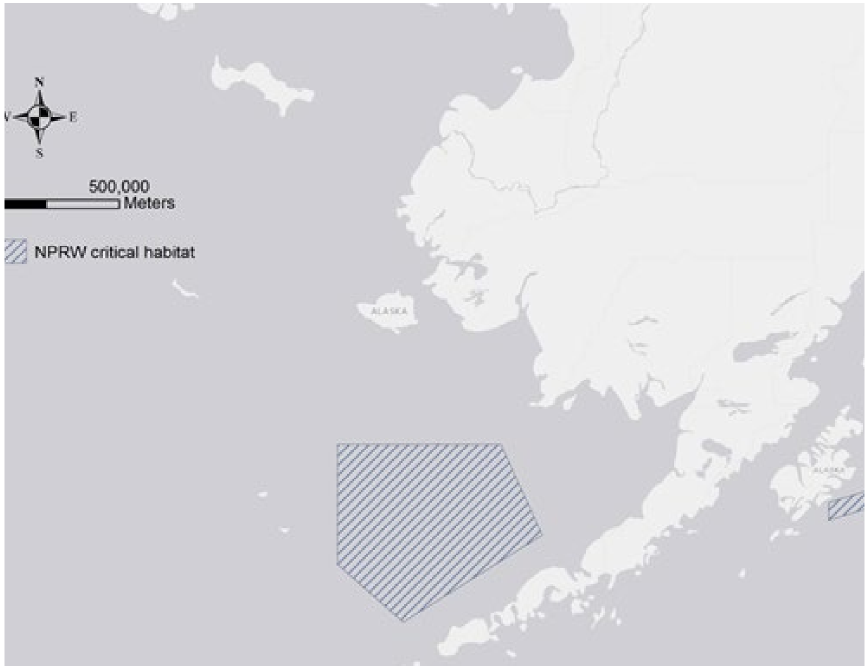

Figure 7. North Pacific right whale critical habitat in the Bering Sea and Gulf of Alaska.

The ensonfied action area for pile driving activities does not overlap with designated critical habitat for the North Pacific right whale. Overlap with North Pacific right whale critical habitat and project activities could occur during transits of project specific delivery of materials and equipment to a project site. Project specific vessels are expected to travel in normal shipping lanes and follow mitigation measures in place to protect North Pacific right whale critical habitat from vessel disturbances. The passage of a vessel on the surface of the water is not expected to disrupt or disturb any of copepods or ephausiids the North Pacific right whales depend upon and, therefore, the quality of their prey resources will not be diminished. For these reasons we conclude that North Pacific right whale critical habitat is not likely to be adversely affected because there is no aspect of the passage of the project-specific vessels over or near critical habitat that will negatively impact the essential features of North Pacific right whale critical habitat.

4.1.3.2 Mexico DPS, Central America DPS, and WNP DPS Humpback whale critical habitat

On April 21, 2021, NMFS published a final rule to designate critical habitat for the Mexico DPS, Central America DPS, and Western North Pacific DPS humpback whale (86 FR 21082; Figure 8). Only one PBF was identified: adequate prey resources, though the prey varies some among the DPSs. Critical habitat for the Western North Pacific DPS includes areas in the eastern Aleutian Islands, the Shumagin Islands, an around Kodiak Island, and for the Mexico DPS includes those same areas plus the Prince William Sound area (50 CFR 226.227). Critical habitat for the Central America DPS includes a narrow area in the Strait of Juan de Fuca and the Juan de Fuca Canyon off of Washington State that may overlap with project specific vessels (Figure 4) that will transit from Seattle, WA, to Alaska at the start and end of each construction season each year.

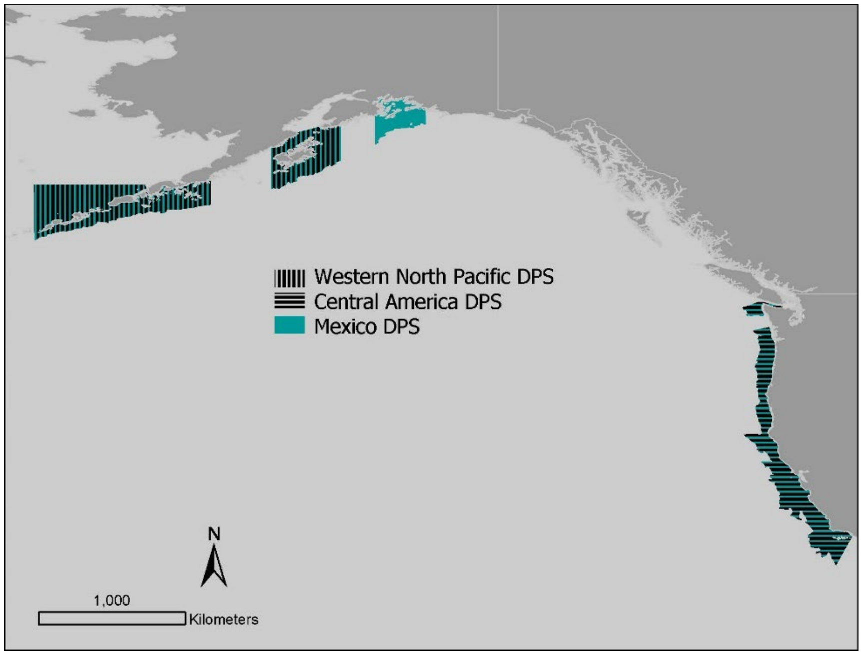

Figure 8. Designated critical habitat for the Mexico DPS, Western North Pacific DPS, and Central America DPS.

For the Mexico DPS, the PBF associated with critical habitat include: prey species, primarily euphausiids (*Thysanoess*a, *Euphausia*, *Nyctiphanes*, and *Nematoscelis*) and small pelagic schooling fishes, such as Pacific sardine (*Sardinops sagax*), northern anchovy (*Engraulis mordax*), and Pacific herring (*Clupea pallasii*), of sufficient quality, abundance, and accessibility within humpback whale feeding areas to support feeding and population growth.

For the Western North Pacific DPS, the PBF associated with critical habitat include: prey species, primarily euphausiids (*Thysanoessa* and *Euphuasia*) and small pelagic schooling fishes, such as Pacific herring, capelin (*Mallotus villosus*), juvenile walleye pollock (*Gadus chalcogrammus*), and Pacific sand lance (*Ammodytes personatus*) of sufficient quality, abundance, and accessibility within humpback whale feeding areas to support feeding and population growth.

For the Central America DPS, the PBF associated with critical habitat include: Prey species, primarily euphausiids (*Thysanoessa*, *Euphausia*, *Nyctiphanes*, and *Nematoscelis*) and small pelagic schooling fishes, such as Pacific sardine, northern anchovy, and Pacific herring, of sufficient quality, abundance, and accessibility within humpback whale feeding areas to support feeding and population growth.

There is a potential for unauthorized spills. However, a large spill is unlikely and a small spill would likely disperse quickly due to tide-induced turbulence and mixing. We expect no toxins to be released into the environment that would be of a quantity to prey. We do not expect that the passage of a vessel on the surface of the water will have a measurable effect on aggregations of these prey species. The eddies or wake of the vessels across the surface of the water may cause temporary mixing or displacement of a relatively small number of zooplankton, but we do not expect that this disturbance would affect the prey distribution or abundance in a meaningful or measurable way. For these reasons we conclude that the passage of the project-specific vessels over or near critical habitat will not adversely impact the essential features of Central America DPS, Mexico DPS, the Western North Pacific DPS, and humpback whale critical habitat.

4.1.3.3 Steller sea lion critical habitat

NMFS designated critical habitat for Steller sea lions on August 27, 1993 (58 FR 45269). The following essential features were identified at the time of listing:

1. Alaska rookeries, haulouts, and associated areas identified in 50 CFR 226.202(a), including:
    a. Terrestrial zones that extend 914 m (3,000 ft) landward
    b. Air zones that extend 914 m (3,000 ft) above the terrestrial zone
    c. Aquatic zones that extend 914 m (3,000 ft) seaward from each major rookery and major haulout east of 144° W longitude
    d. Aquatic zones that extend 37 km (20 nm) seaward from each major rookery and major haulout west of 144° W longitude

2. Three special aquatic foraging areas identified in 50 CFR 226.202(c):
    a. Shelikof Strait
    b. Bogoslof
    c. Seguam Pass

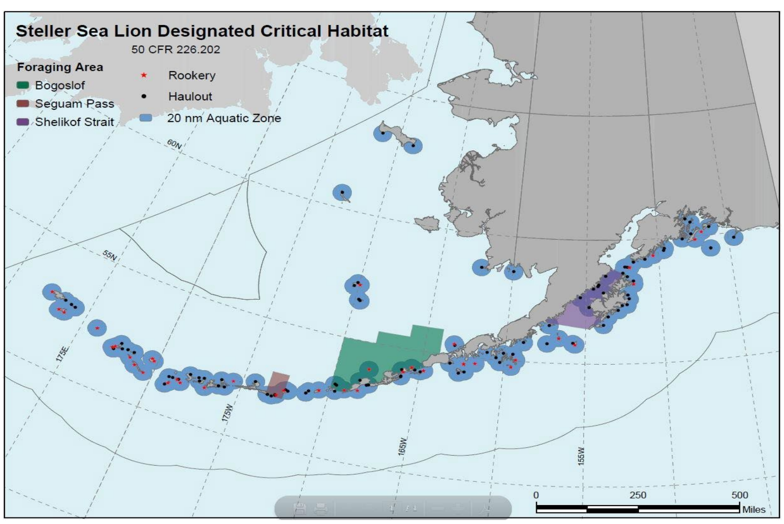

Figure 9. Designated Steller sea lion critical habitat and special aquatic foraging areas.

Project specific vessel routes may transit through Steller sea lion critical habitat and the three special aquatic foraging areas within Alaska (Figure 4; Figure 9). Vessels are expected to follow mitigation measures in place to protect Steller sea lion critical habitat from vessel disturbance. In addition, we expect the project vessels will be traveling in normal shipping lanes when in Steller sea lion range. The passage of a vessel on the surface of the water is not expected to disrupt or disturb any of the primary prey species which Steller sea lions depend upon and, therefore, the quality of their prey resources will not be diminished. For these reasons we conclude that the passage of the project-specific vessels over or near Steller sea lion critical habitat will not adversely affect the essential features of Steller sea lion critical habitat.

Three major haulouts are located on or near Shemya Island are Shemya, Nizki, and Alaid. The 40 kilometer ensonfied zones for 30-inch and 42-inch down the hole pile driving overlaps with the 37 kilometer area around two haulouts (Nizki and Alaid). Based on the short duration of DTH pile driving we expect any adverse effects to designated critical habitat for Steller sea lions would be temporary and immeasurably small (insignificant), therefore, the project is not likely to adversely affect Steller sea lion critical habitat.

4.1.3.4 Southern Resident DPS killer whale critical habitat

NMFS published a final rule to designate critical habitat for Southern Resident DPS killer whales on November 29, 2006 (71 FR 69054). On August 2, 2021, NMFS published a revision to that rule designating six additional coastal areas along the U.S. West Coast (86 FR 41668).

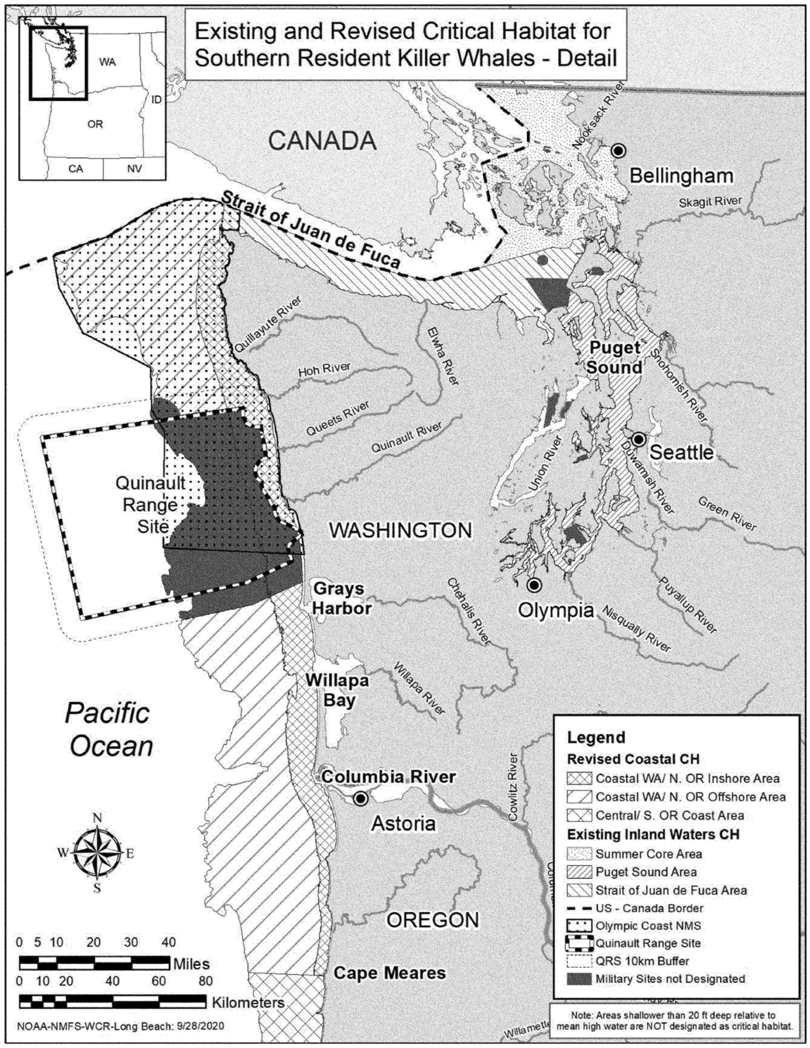

Figure 10. Designated Southern Resident DPS killer whale critical habitat.

The following physical or biological features were identified as essential to the conservation of the Southern Resident DPS killer whale:

1. Water quality to support growth and development
2. Prey species of sufficient quantity, quality and availability to support individual growth, reproduction and development, as well as overall population growth
3. Passage conditions to allow for migration, resting, and foraging

Project specific vessels have the potential for transit through Southern Resident killer whale critical habitat including Puget Sound, a narrow area in the Strait of Juan de Fuca and waters immediately off the coast of Washington (Figure 10) as the vessels transit from Seattle, WA to Alaska (Figure 4) at the start and end of the construction season each year. There is a potential for unauthorized spills. However, a large spill is unlikely and a small spill would likely disperse quickly due to tide-induced turbulence and mixing. We expect no toxins to be released into the environment that would be of a quantity to impact water quality or quantity, or quality and availability of prey species. Vessel passage on the surface of the water is not expected to disrupt or disturb any of the primary prey species and prey resource quality will not be diminished. The sound and presence of project vessels could cause killer whales to avoid or abandon certain areas; however, the duration of exposure to the vessels and associated noise will be brief and temporary, lasting on the order of minutes. The impact of project-specific vessel transit on Southern Resident DPS killer whale passage is very unlikely. Limited project-specific vessel transit through this highly industrialized waterway will not negatively affect the essential features of designated critical habitat. For these reasons we conclude that there is no aspect of the passage of the project-specific vessels over or near critical habitat that will negatively impact the essential features of Southern Resident DPS killer whale critical habitat and the project is not likely to adversely affect Southern Resident DPS killer whale critical habitat.

4.1.3.5 Cook Inlet beluga whale critical habitat

NMFS designated critical habitat for the Cook Inlet beluga whale on April 11, 2011 (76 FR 20180; Figure 11). Cook Inlet beluga whale critical habitat includes five primary constituent elements (PCEs), more recently and henceforth referred to as physical or biological features (PBFs) deemed essential to the conservation of the Cook Inlet beluga whale (50 CFR § 226.220(c)):

1. Intertidal and subtidal waters of Cook Inlet with depths <30 ft (MLLW) and within 8 km (5 mi) of high and medium flow anadromous fish streams
2. Primary prey species consisting of four species of Pacific salmon (Chinook, sockeye, chum, and coho), Pacific eulachon, Pacific cod, walleye pollock, saffron cod, and yellowfin sole
3. Waters free of toxins or other agents of a type and amount harmful to Cook Inlet beluga whales
4. Unrestricted passage within or between the critical habitat areas
5. Waters with in-water noise below levels resulting in the abandonment of critical habitat areas by Cook Inlet beluga whales

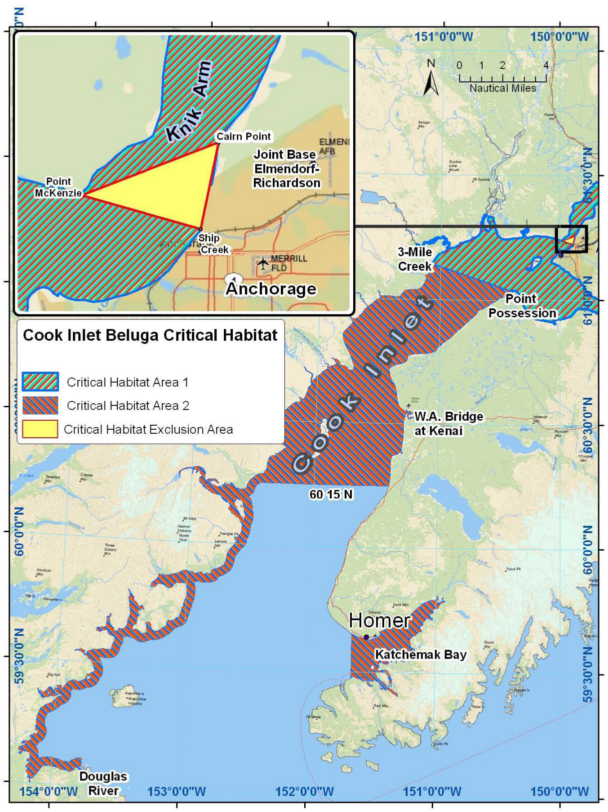

Figure 11. Designated Cook Inlet beluga whale critical habitat.

Project vessels are expected to travel in normal shipping lanes in Cook Inlet, which are located outside of PBF #1. The passage of a vessel on the surface of the water is not expected to disrupt or disturb any of the primary prey species listed in PBF #2, and prey resource quality will not be diminished. Unauthorized spills could occur; however, a large spill is extremely unlikely, and a small spill is expected to rapidly disperse due to tide-induced turbulence and mixing. We do not expect toxins to be released into the environment in amounts that would be harmful to Cook Inlet belugas, and any adverse effects to PBF #3 are improbable. The sound and presence of project specific vessels could cause belugas to avoid or abandon certain areas; however, the duration of exposure to the vessel and associated noise will be brief and temporary, lasting on the order of minutes. The impact of project-specific vessel transit on beluga passage and occurrence is very unlikely, and adverse effects to PBF #4 and PBF #5 are extremely unlikely to occur. For these reasons, we determine that the vessel transit through critical habitat will not adversely impact the essential features of Cook Inlet beluga critical habitat.

In summary, we find that the temporary passage of the materials and construction barges over the water surface of critical habitat for North Pacific right whales, Southern Resident DPS killer whales, Central America DPS, Mexico DPS and WNP DPS humpback whales, Steller sea lions, and Cook Inlet beluga whales will have an immeasurably small effect on the features determined to be essential for these species. Therefore, we conclude that the proposed action is not likely to adversely affect critical habitat for North Pacific right whales, Southern Resident DPS killer whales, Central American DPS, Mexico DPS, and WNP DPS humpback whales, Steller sea lions, and Cook Inlet beluga whales. As such, critical habitat will not be discussed further in this opinion.

4.2 Climate Change

Global climate change is a threat that affects all species. Because it is a shared threat, we present this narrative here rather than in each of the species-specific narratives that follow. A vast amount of literature is available on climate change and for more detailed information we refer the reader to these websites which provide the latest data and links to the current state of knowledge on the topic in general, and in the Arctic specifically:

https://www.ipcc.ch/reports/

https://climate.nasa.gov/evidence/

http://nsidc.org/arcticseaicenews/

https://arctic.noaa.gov/Report-Card

The listed marine mammals we consider in this opinion live in the ocean and depend on the ocean for nearly every aspect of their life history. Factors which affect the ocean, like temperature and pH, can have direct and indirect impacts on marine mammals and the resources they depend upon. Global climate change may affect all the species we consider in this opinion, but it is expected to affect them differently. First, we provide background on the physical effects climate change has caused on a broad scale; then we focus on changes that have occurred in Alaska. Finally, we provide an overview of how these physical changes translate to biological effects.

4.2.1 Physical Effects of Climate Change

4.2.1.1 Air temperature

There is consensus throughout the scientific community that atmospheric temperatures are increasing, and will continue to increase, for at least the next several decades (Watson and Albritton 2001; Oreskes 2004). The Intergovernmental Panel on Climate Change (IPCC) estimated that since the mid-1800s, average global land and sea surface temperature has increased by 0.85°C (±0.2°C), with most of the change occurring since 1976 (IPCC 2019). This temperature increase is greater than what would be expected given the range of natural climatic variability recorded over the past 1,000 years (Crowley 2000).

Continued emission of greenhouse gases is expected to cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems (IPCC 2019). The average global land and ocean surface temperature for January 2023 was 0.87°C (1.57° Fahrenheit; F) above the 20th century average of 12.0°C (53.6°F). This was the seventh-warmest January in the 174-year global record (https://www.ncei.noaa.gov/access/monitoring/monthly-report/global/202301/supplemental/, accessed March 2023).

Across Alaska, average air temperatures have been increasing, and the average annual temperature is now 1.65-2.2°C (3-4°F) warmer than during the early and mid-century (Thoman and Walsh 2019). Winter temperatures have increased by 3.3°C (6°F) (Chapin et al. 2014) and the snow season is shortening (Thoman and Walsh 2019). The statewide average annual temperature in 2020 was 27.5°F, 1.5°F above the long-term average even though it was the coldest year since 2012[3]. Some of the most pronounced effects of climate change in Alaska include disappearing sea ice, shrinking glaciers, thawing permafrost, and changing ocean temperatures and chemistry (Chapin et al. 2014).

4.2.1.2 Ocean Heat

Higher air temperatures have led to higher ocean temperatures. More than 90 percent of the excess heat created by global climate change is stored in the world's oceans, causing increases in ocean temperature (IPCC 2019; Cheng et al. 2020). The upper ocean heat content, which measures the amount of heat stored in the upper 2,000 m (6,561 ft) of the ocean, was the highest on record in 2019 by a wide margin, and is the warmest in recorded human history (Cheng et al. 2020). The seas surrounding Alaska have been unusually warm in recent years, with unprecedented warmth in some cases (Thoman and Walsh 2019). This effect can be seen throughout the Alaska region (Figure 12), including the Bering, Chukchi, and Beaufort seas (Thoman and Walsh 2019).

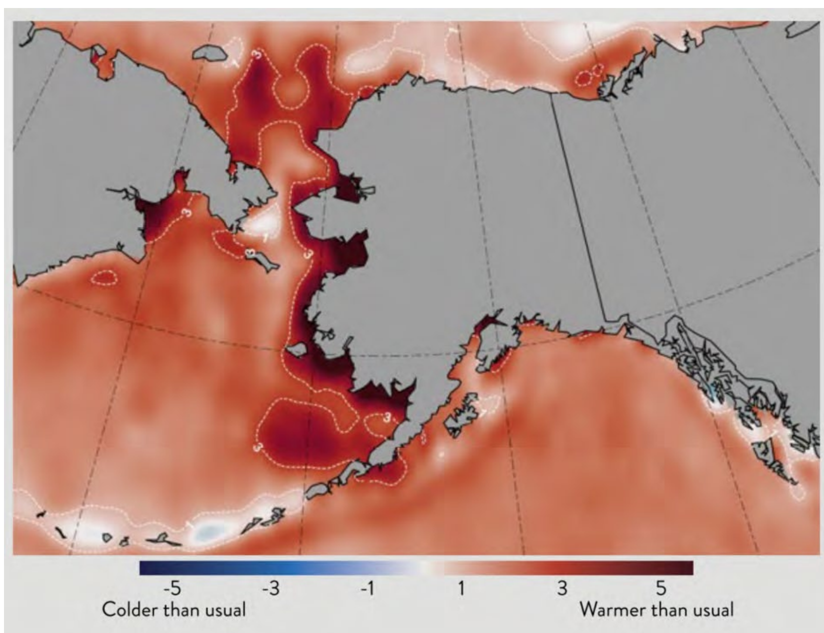

Figure 12. Summer sea surface temperature in 2019 showing warmer water (colored red) compared to average (colored white) water temperatures (2014-2018). Map taken from Thoman and Walsh (2019).

[3] https://www.ncdc.noaa.gov/sotc/national/202013 viewed on 12/24/2023

Warmer ocean water affects sea ice formation and melt. In the first decade of the 21st century, Arctic sea ice thickness and annual minimum sea ice extent (i.e., September sea ice extent) declined at a considerably accelerated rate and continues to decline (Stroeve et al. 2007; Stroeve and Notz 2018). Approximately three-quarters of summer Arctic sea ice volume has been lost since the 1980s (IPCC 2013). In addition, old ice (> 4 years old), which is thicker and more resilient to melting than young ice, constituted 33 percent of the ice pack in 1985, but by March 2019, it represented only 1.2 percent of the ice pack in the Arctic Ocean (Perovich et al. 2019; Meier et al. 2021). Based on data available since 1985, multiyear ice in 2021 reached its second lowest level by the end of summer and ice volume was at a record low (at least since 2010) in April 2021 (Meier et al. 2021). Overland (2020) suggests that the loss of the thicker older ice makes the Arctic ecosystem less resilient. Both the maximum sea ice extent (March) and the minimum (September) have consistently been decreasing, although the summer minimums are more pronounced (Perovich et al. 2019).

Marine heat waves, another ocean water anomaly, are described as a coherent area of extreme warm temperature at the sea surface that persists (Frölicher et al. 2018). Marine heatwaves are a key ecosystem driver and there has been an increase from 30 percent in 2012 to nearly 70 percent of global oceans in 2016 experiencing strong or severe heatwaves (Suryan et al. 2021). The largest recorded marine heat wave occurred in the northeast Pacific Ocean from 2013-2015 (Frölicher et al. 2018). Initially called "the blob" the northeast Pacific marine heatwave first appeared off the coast of Alaska in the winter of 2013-2014 and by the end of 2015 it stretched from Alaska to Baja California. In mid-2016, the PMH began to dissipate, based on sea surface temperature data but warming re-intensified in late-2018 and persisted into fall 2019 (Suryan et al. 2021). Consequences of this event included an unprecedented harmful algal bloom that extended from the Aleutian Islands to southern California, mass strandings of marine mammals, shifts in the distribution of invertebrates and fish, and shifts in abundance of several fish species (Cavole et al. 2016). Cetaceans, forage fish (capelin and herring), Steller sea lions, adult cod, chinook and sockeye salmon in the Gulf of Alaska were all impacted by the Pacific marine heatwave (Bond et al. 2015; Peterson et al. 2016; Sweeney et al. 2018; Gabriele et al. 2022; Hastings et al. 2023).

4.2.1.3 Ocean Acidification

For 650,000 years or more, the average global atmospheric carbon dioxide (CO_2) concentration varied between 180 and 300 parts per million (ppm), but since the beginning of the industrial revolution in the late 1700s, atmospheric CO_2 concentrations have been increasing rapidly, primarily due to anthropogenic inputs (Fabry et al. 2008; Lüthi et al. 2008). The world's oceans have absorbed approximately one-third of the anthropogenic CO_2 released, which has buffered the increase in atmospheric CO_2 concentrations (Feely et al. 2004; Feely et al. 2009). Despite the oceans' role as large carbon sinks, the CO_2 level continues to rise and is currently over 420 ppm[4].

As the oceans absorb CO_2, the pH of seawater is reduced becoming more acidic, a process referred to as ocean acidification. Ocean acidification reduces the saturation states of certain

[4] https://gml.noaa.gov/ccgg/trends/ accessed 12/14/23.

biologically important calcium carbonate minerals like aragonite and calcite that many organisms use to form and maintain shells (Bates et al. 2009; Reisdorph and Mathis 2014). When seawater is supersaturated with these minerals, calcification (growth) of shells is favored. Likewise, when the sea water becomes undersaturated, dissolution is favored (Feely et al. 2009).

High latitude (colder) oceans have naturally lower saturation states of calcium carbonate minerals than more temperate or tropical waters, making Alaska's oceans more susceptible to the effects of ocean acidification (Fabry et al. 2009; Jiang et al. 2015). Model projections indicated that aragonite under saturation would start to occur by about 2020 in the Arctic Ocean and by 2050, all of the Arctic will be under saturated with respect to aragonite (Feely et al. 2009; Qi et al. 2017). Large inputs of low-alkalinity freshwater from glacial runoff and melting sea ice contribute to the problem by reducing the buffering capacity of seawater to changes in pH (Reisdorph and Mathis 2014). As a result, seasonal under saturation of aragonite was already detected in the Bering Sea at sampling stations near the outflows of the Yukon and Kuskokwim Rivers, and the Chukchi Sea (Fabry et al. 2009). Models and observations indicate that rapid sea ice loss will increase the uptake of CO_2 and exacerbate the problem of aragonite under saturation in the Arctic (Yamamoto et al. 2012; DeGrandpre et al. 2020).

Under saturated waters are potentially highly corrosive to any calcifying organism, such as corals, bivalves, crustaceans, echinoderms and many forms of zooplankton such as copepods and pteropods, and consequently may affect Arctic food webs (Fabry et al. 2008; Bates et al. 2009). Pteropods, which are often considered indicator species for ecosystem health, are prey for many species of carnivorous zooplankton, fishes including salmon, mackerel, herring, and cod, and baleen whales (Orr et al. 2005). Because of their thin shells and dependence on aragonite, under increasingly acidic conditions, pteropods may not be able to grow and maintain shells (Lischka and Riebesell 2012). It is uncertain if these species, which play a large role in supporting many levels of the Alaskan marine food web, may be able to adapt to changing ocean conditions (Fabry et al. 2008; Lischka and Riebesell 2012).

Climate change is projected to have substantial direct and indirect effects on individuals, populations, species, and the structure and function of marine, coastal, and terrestrial ecosystems in the foreseeable future (Hinzman et al. 2005; Burek et al. 2008a; Doney et al. 2012; Huntington et al. 2020). The physical effects on the environment described above have impacted, are impacting, and will continue to impact marine species in a variety of ways (IPCC 2014), including shifting abundances, changes in distribution, changes in timing of migration, changes in periodic life cycles of species. For example, cetaceans with restricted distributions linked to water temperature may be particularly susceptible to range restriction (Learmonth et al. 2006; Isaac 2009). Macleod (2009) estimated that, based on expected shifts in water temperature, 88 percent of cetaceans will be affected by climate change, 47 percent will be negatively affected, and 21 percent will be put at risk of extinction. Of greatest concern are cetaceans with ranges limited to non-tropical waters, and preferences for shelf habitats (Macleod 2009).

4.2.2 Biological Effects of Climate Change

Climate change is projected to have substantial direct and indirect effects on individuals, populations, species, and the structure and function of marine, coastal, and terrestrial ecosystems in the foreseeable future (Hinzman et al. 2005; Burek et al. 2008b; Doney et al. 2012; Huntington et al. 2020). The physical effects on the environment described above have impacted, are impacting, and will continue to impact marine species in a variety of ways (IPCC 2014), such as:

- Shifting abundances
- Changes in distribution
- Changes in timing of migration
- Changes in periodic life cycles of species.

Climate change is expected to have direct and indirect impacts on marine mammal species (Gulland et al. 2022). Climate change is likely to have its most pronounced effects on species whose populations are already in tenuous positions (Isaac 2009). An increase in greenhouse gas concentrations and associated higher air and sea temperatures (Overland et al. 2019) has led to spatial and temporal reductions of sea ice in the Arctic (Stroeve et al. 2012; Notz and Stroeve 2016; Stroeve and Notz 2018). While this directly leads to loss of habitat for some ice-associated marine mammal species (e.g., ice seals) (Laidre et al. 2008; Huntington et al. 2016; Huntington et al. 2017), others may gain habitat (e.g., baleen whales) (Moore and Laidre 2006; Moore et al. 2022)). Indirectly, climate change is predicted to be associated with changes in prey bases (Florko et al. 2021), shifting species distribution (predators and competitors), and the introduction of invasive species and range expansion of potential vector species (Stafford et al. 2023). Additionally, longer ice-free periods are likely to result in increased vessel traffic and fisheries operations in the Arctic, leading to increased risk of entanglements in fishing gear, vessel strikes, and disturbance from sound (Moore et al. 2012; Citta et al. 2014; Halliday et al. 2022). Furthermore, indirect effects of climate change may include altered pathogen transmission and exposure to toxicants (Burek et al. 2008a; VanWormer et al. 2019).

4.3 Status of Listed Species and Critical Habitat Likely to be Adversely Affected by the Action

This opinion examines the status of each species and critical habitat that is likely to be adversely affected by the proposed action. Species status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' current "reproduction, numbers, or distribution" as described in 50 CFR § 402.02. The opinion also examined above the condition of critical habitat throughout the designated area, and discussed the current function of the essential PBFs that help to form that conservation value.

For each species, we present a summary of information on the population structure and distribution of the species to provide a foundation for the exposure analyses that appear later in this opinion. Then we summarize information on the threats to the species and the species' status given those threats to provide points of reference for the jeopardy determinations we make later in this opinion. That is, we rely on a species' status and trend to determine whether an action's effects are likely to increase the species' probability of becoming extinct.

4.3.1 Western DPS Steller Sea Lions

4.3.1.1.1 Population Structure and Status

Steller sea lions were listed as a threatened species under the ESA on December 4, 1990 (55 FR 49204). In 1997, NMFS reclassified Steller sea lions as two DPSs (62 FR 24345; May 5, 1997); the eastern DPS was listed as threatened and the Western DPS was listed as endangered. On November 4, 2013, the eastern DPS was removed from the endangered species list (78 FR 66140). Information on Steller sea lion biology, threats, and habitat (including critical habitat) is available in the revised Steller Sea Lion Recovery Plan (NMFS 2008) and 5-year Status Review (NMFS 2020).

The Western DPS of Steller sea lions decreased from an estimated 220,000 to 265,000 animals in the late 1970s to fewer than 50,000 in 2000 (Loughlin et al. 1984; Loughlin and York 2000; Burkanov and Loughlin 2005). Factors that may have contributed to this decline include incidental take in fisheries, competition with fisheries for prey, legal and illegal shooting, predation, exposure to contaminants, disease, and ocean regime shift-driven climate change (NMFS 2008). The recent comprehensive aerial photographic and land-based surveys of Western DPS Steller sea lions estimated a total Alaska population (both pups and non-pups) of 52,932 (Muto et al. 2021). There are strong regional differences in trends in abundance of Western DPS Steller sea lions, with mostly positive trends in the Gulf of Alaska and eastern Aleutian Islands and generally negative trends in the central and western Aleutian Islands (Fritz et al. 2014). Pup counts declined in the eastern and central Gulf of Alaska between 2015 and 2017, counter to the increases observed in both regions since 2002 (Sweeney et al. 2017). These declines may have been due to changes in prey availability from the marine heatwave that occurred in the northern Gulf of Alaska from 2014 to 2016 (Bond et al. 2015; Petersen et al. 2016). Pup counts rebounded to 2015 levels in 2019; however, non-pup counts in Gulf of Alaska regions declined (Sweeney et al. 2019). The trends in counts of Western DPS Steller sea lion pups and non-pups (adults and juveniles) in the Western Aleutian Islands between 2002 and 2018 were -6.47 for both age groups (Sweeney et al. 2018; Young et al. 2023). Shemya Island is located within the western Aleutian Islands (Figure 13).

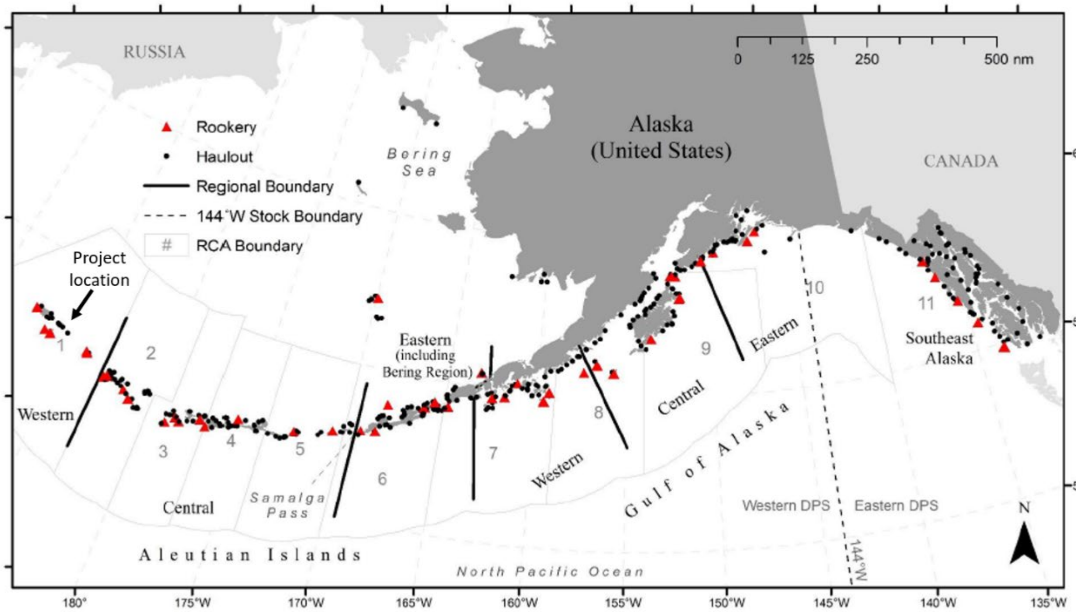

Figure 13. Steller sea lion rookeries and haul outs (Fritz et al. 2016)) with project location denoted by the arrow.

4.3.1.1.2 Distribution

Steller sea lions range along the North Pacific rim from northern Japan to California, with centers of abundance in the Gulf of Alaska and Aleutian Islands (Loughlin et al. 1984). Pinnipeds are amphibious and use rookeries for pupping, nursing, and mating during the summer and use haul outs to rest throughout the year. Most adult Steller sea lions exhibit high site fidelity (Sandegren 1970) and use rookeries during the pupping and breeding season (Pitcher and Calkins 1981; Gisiner 1985). During the breeding season some juveniles and non-breeding adults can be found at or near rookeries, but most are on haul outs (Call and Loughlin 2005). Steller sea lions are not known to migrate but may disperse, especially juveniles and males, during the fall and winter (Jemison et al. 2013; Jemison et al. 2018; Muto et al. 2022). In the fall, adults including females with dependent offspring leave the rookeries and use haulouts to access foraging locations (Pitcher and Calkins 1981; Fadely and Lander 2012; Lander et al. 2020).

4.3.1.1.3 Feeding, Diving, Hauling out, and Social Behavior

Steller sea lions are generalist predators that eat a variety of fishes and cephalopods (Pitcher and Calkins 1981; Calkins and Goodwin 1988; NMFS 2008) with diet and foraging ecology varying both geographically and seasonally (Sinclair and Zeppelin 2002; Beck et al. 2007; Sinclair et al. 2013; Keogh et al. 2019) likely reflecting changes in prey distribution and foraging strategies.

Steller sea lions tend to make shallow dives of less than 250 m, but are capable of deeper dives (NMFS 2008). Female foraging trips during winter tend to be longer in duration, farther from shore, and with deeper dives. Summer foraging dives, on the other hand, tend to be closer to shore and are shallower (Merrick and Loughlin 1997). During summer, Steller sea lions feed mostly over the continental shelf and shelf edge. Adult females alternate foraging trips at sea and periods onshore nursing their pups beginning after a perinatal periods of 7 to 10 days (Maniscalco et al. 2002; Maniscalco et al. 2006). Females attending pups forage within 20 nm of breeding rookeries (Merrick and Loughlin 1997), which is the basis for designated critical habitat around rookeries and major haulout sites.

Steller sea lions are gregarious animals that often travel in large groups of up to 45 individuals (Keple 2002), and rafts of several hundred Steller sea lions are often seen adjacent to haulouts. Individual rookeries and haulouts may be comprised of hundreds of animals. At sea, groups usually consist of females and sub adult males as adult males are usually solitary (Loughlin 2002).

4.3.1.1.4 Hearing

The ability to detect sound and communicate underwater is important for a variety of Steller sea lion life functions, including reproduction and predator avoidance. NMFS categorizes Steller sea lions in the otariid pinniped functional hearing group, with an applied frequency range between 60 Hz and 39 kHz in water (NMFS 2018b). Studies of Steller sea lion auditory sensitivities have found that this species detects sounds underwater between 1 and 25 kHz (Kastelein et al. 2005), and in air between 250 Hz and 30 kHz (Mulsow and Reichmuth 2010). Sound signals from vessels are typically within the hearing range of Steller sea lions, whether the animals are in the water or hauled out.

4.3.1.1.5 Threats to the Species

Natural Threats

Killer whale predation on the Western DPS, under reduced population size, may cause significant reductions in the stock (NMFS 2008). Steller sea lions are also vulnerable to predation from sleeper sharks (Horning and Mellish 2014). Juvenile Steller sea lions were found to underutilize foraging habitats and prey resources based on predation risk by killer whales and sleeper sharks (Frid et al. 2009).

Steller sea lions have been serologically positive for several pathogens (Burek et al. 2005; Nymo et al. 2018). Reproductive failure and neonatal mortality can be caused by several infectious disease agents some of which (e.g. Brucella spp, phocine distemper virus) have been confirmed in Steller sea lions, though not commonly (Esquible et al. 2019). It is currently unknown what if any population level effect these infections may have. Significant negative effects of these factors may occur in combination with stress, which may compromise the immune system. If other factors, such as disturbance, injury, or difficulty feeding occur, it is more likely that disease and parasitism can play a greater role in population reduction.

Anthropogenic Threats

Subsistence hunters removed 209 Western DPS Steller sea lions between 2014 and 2018 in controlled and authorized harvests (Muto et al. 2021). Examination of Steller sea lion carcasses by the Marine Mammal Stranding Networks in Alaska and Northwest (Washington, Oregon) between 1990 and 2015 found evidence of human interactions including fishery interactions, firearms, and boat collisions (Esquible and Atkinson 2019). Between 2016 and 2020 human-caused mortality and injury of the Western DPS Steller sea lions (n = 148) was primarily caused by entanglement in fishing gear, in particular, commercial trawl gear (n=113; Freed et al. 2022).

Concern also exists regarding competition between commercial fisheries and Steller sea lions for the same resource: stocks of pollock, Pacific cod, and Atka mackerel. Limitations on fishing grounds, duration of fishing season, and monitoring have been established to prevent Steller sea lion nutritional deficiencies as a result of inadequate prey availability.

Contaminants including organochlorines in pinnipeds has been linked to various deleterious biological and physiological effects, including reproductive impairment, immune suppression, and increased risk of cancer and infectious disease (Reijnders 1986; Beckmen et al. 2003; Randhawa et al. 2015). Exposure to mercury, a heavy metal, remains a focus of ongoing investigation. Mercury has both natural (e.g. volcanic activity, geological deposits) and anthropogenic (e.g. incineration of coal, gold mining) sources (Selin 2009; Pirrone et al. 2010). Total mercury concentrations measured in hair samples collected from pups in the western-central Aleutian Islands were detected at levels that cause neurological and reproductive effects in other species (Rea et al. 2013; Rea et al. 2022); however, limited studies have explored the relationships between methyl mercury and immune and neurological functions in Steller sea lions (Levin et al. 2020; Lian et al. 2020; Kennedy et al. 2021).

4.3.1.1.6 Occurrence in the Action Area

There are major haulouts and rookeries throughout the Aleutian Island Arc and along the southern end of southwest Alaska (Figure 13) including three major haulouts (Shemya, Nizki, and Alaid) located on or near Shemya Island. Steller sea lions are highly influenced by prey resources. As central place foragers, they return to their haul out or rookery after foraging trips (Jemison et al. 2018).

Marine Transit Routes

Given the wide dispersal of individuals, both the Western DPS and eastern DPS of Steller sea lions will likely be encountered along the transit routes (Figure 4). Project vessels will transit through Steller sea lion critical habitat in Prince William Sound and the Gulf of Alaska; the materials and construction barges may also travel in proximity to Steller sea lion critical habitat in the Aleutian Islands but likely not in Southeast Alaska (Figure 4). An area of high occurrence of Steller sea lions likely extends from the shore to water depths of 500 m. In the Gulf of Alaska, foraging habitat is primarily shallow, nearshore, and continental shelf waters 8 to 24 km offshore with a secondary occurrence inshore of the 1,000 m isobaths, and a rare occurrence seaward of the 1,000 m isobaths.

Alcan Harbor, Shemya Island

The construction area and surrounding waters likely contain sources of prey species in which Steller sea lions forage year-round. There are no rookeries within the in water construction action area; however, the 40 kilometer ensonfied zones for 30-inch and 42-inch DTH pile driving overlaps with the 37 kilometer area around two haulouts (Nizki and Alaid). Steller sea lions were observed in May within the expected ensonified area for the project in Alcan Harbor during USACE 2021 Marine Mammal Surveys of Shemya Island. A total of 6 observations within the ensonified area were made between May 20 and 23rd and two observation outside of the ensonified area were recorded during May and June observations. No Steller sea lions were seen during observations in July through October. Between spring 2016 and summer 2021, one Steller sea lion was observed with Alcan harbor and one Steller sea lion was observed during winter surveys between 2018 and 2020 within the harbor.

4.3.2 Mexico DPS Humpback whales and Western North Pacific DPS Humpback whales

Humpback whales are found in all oceans of the world with a broad geographical range from tropical to temperate waters in the Northern Hemisphere and from tropical to near-ice-edge waters in the Southern Hemisphere. Additional information on humpback whale biology and natural history is available at:

https://www.fisheries.noaa.gov/species/humpback-whale

https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-species-stock

4.3.2.1.1 Population Structure and Status

The humpback whale was listed as endangered under the Endangered Species Conservation Act (ESCA) on December 2, 1970 (35 FR 18319), primarily due to overharvest by commercial whalers. Congress replaced the ESCA with the ESA in 1973, and humpback whales continued to be listed as endangered. Humpback whales are also considered “depleted” under the MMPA.

The end of commercial whaling lead to an increase in humpback whale numbers. NMFS conducted a global status review (Bettridge et al. 2015) and published a final rule recognizing 14 DPSs on September 8, 2016 (81 FR 62260). Four of these DPSs were designated as endangered and one as threatened, with the remaining nine not warranting ESA listing status.

Based on an analysis of migration between winter mating/calving areas and summer feeding areas using photo-identification, Wade (2021) concluded that whales feeding in Alaskan waters belong primarily to the Hawaii DPS (recovered), with small numbers from the Western North Pacific DPS (endangered) and Mexico DPS (threatened). There are approximately 1,084 animals in the Western North Pacific DPS and 2,913 animals in the Mexico DPS (Wade 2021), the population trend is unknown for both DPSs with the Mexico DPS unlikely to be declining (81 FR 62260 . The Hawaii DPS is not listed under the ESA and is estimated at 11,540 animals, and the annual growth rate is between 5.5 and 6.0 percent. Humpback whales in the Southeast Alaska summer feeding area are comprised of approximately 98 percent Hawaii DPS individuals and 2 percent Mexico DPS individuals. The probability of encountering humpback whales from each listed DPS in the North Pacific Ocean varies greatly (Table 6). Whales from the Mexico DPS, Hawaii DPS, and the Western North Pacific DPS overlap on feeding grounds off Alaska, and are visually indistinguishable unless individuals have been photo-identified on breeding grounds and again on feeding grounds. All waters off the coast of Alaska may contain ESA-listed humpbacks.

4.3.2.1.2 Distribution

Humpback whales migrate in the late fall to wintering areas where they calve and mate and in the spring to summer feeding areas where they forage. This is largely driven by their preference for abundant prey sources in temperate and subpolar waters. Thus, they migrate to Alaska in the spring to forage in the coastal and inland waters. Humpback whales will cooperate in groups in summer to forage cooperatively, but generally they are observed alone or within small groups for short durations (Jurasz and Jurasz 1979).

4.3.2.1.3 Feeding and Prey Selection

Humpback whales exhibit flexible feeding strategies, sometimes foraging alone and sometimes cooperatively (Clapham 1993). Humpback whales are 'gulp' or 'lunge' feeders, capturing large mouthfuls of prey during feeding rather than continuously filtering food, as may be observed in some other large baleen whales (Goldbogen et al. 2008; Simon et al. 2012). When lunge feeding, whales advance on prey with their mouths wide open, then close their mouths around the prey and trap them by forcing engulfed water out past the baleen plates.

Compared to some other baleen whales, humpbacks are relatively generalized in their prey selection. In the Northern Hemisphere, known prey includes euphausiids (krill), copepods, juvenile salmonids, herring, Arctic cod, walleye pollock, pteropods, and cephalopods (Johnson and Wolman 1984; Perry et al. 1999b; Straley et al. 2018).

In the North Pacific, humpback whales forage in the coastal and inland waters along California, north to the Gulf of Alaska and the Bering Sea, and west along the Aleutian Islands to the Kamchatka Peninsula and into the Sea of Okhotsk (Tomilin 1967; Johnson and Wolman 1984).

Humpback whales migrate in the late fall to wintering areas where they calve and mate and in the spring to summer feeding areas where they forage. This is largely driven by their preference for abundant prey sources in temperate and subpolar waters. Thus, they migrate to Alaska in the spring to forage in the coastal and inland waters. Humpback whales will cooperate in groups in summer to forage cooperatively, but generally they are observed alone or within small groups for short durations.

4.3.2.1.4 Vocalization and Hearing

Humpback whales produce a wide variety of sounds ranging from 20 Hz to 10 kHz. During the breeding season males sing long, complex songs, with frequencies in the 20-5,000 Hz range and intensities as high as 181 dB (Payne 1970; Winn et al. 1970; Thompson et al. 1986). Source levels average 155 dB and range from 144 to 174 dB (Thompson et al. 1979). The songs appear to have an effective range of approximately 10 to 20 km. Animals in mating groups produce a variety of sounds (Tyack 1981; Silber 1986).

Social sounds associated with aggressive behavior by male humpback whales in breeding areas are very different than songs and extend from 50 Hz to 10 kHz (or higher), with most energy in components below 3 kHz (Tyack and Whitehead 1983; Silber 1986). These sounds appear to have an effective range of up to 9 km (Tyack and Whitehead 1983).

Humpback whales produce sounds less frequently in their summer feeding areas. Feeding groups produce distinctive sounds ranging from 20 Hz to 2 kHz, with median durations of 0.2-0.8 seconds and source levels of 175-192 dB (Thompson et al. 1986). These sounds are attractive and appear to rally animals to the feeding activity (D'Vincent et al. 1985; Sharpe and Dill 1997).

NMFS categorizes humpback whales in the low-frequency cetacean functional hearing group, with a generalized hearing range between 7 Hz and 35 kHz (NMFS 2018b). Baleen whales have inner ears that appear to be specialized for low-frequency hearing.

4.3.2.1.5 Threats to the Species

Natural Threats

There is limited information on natural sources of injury or mortality to humpback whales. Based upon prevalence of tooth marks, attacks by killer whales appear to be highest among humpback whales migrating between Mexico and California, although populations throughout the Pacific Ocean appear to be targeted to some degree (Steiger et al. 2008).

Thirteen marine mammal species in Alaska were examined for domoic acid; humpback whales indicated a 38 percent prevalence (Lefebvre et al. 2016). Saxitoxin was detected in 10 of the 13 species, with the highest prevalence in humpback whales at 50 percent. The occurrence of the nematode *Crassicauda boopis* appears to increase the potential for kidney failure in humpback whales and may be preventing some populations from recovering (Lambertsen 1992).

A declared UME involved humpback and fin whales occurred in portions of the Gulf of Alaska and Bering Sea in Alaska and British Columbia (Savage 2017). The event was jointly investigated by NOAA Fisheries and Department of Fisheries and Oceans, Canada and was defined as occurring from May 22, 2015 to December 31, 2015 in the Gulf of Alaska and from April 23, 2015 to April 16, 2016 in British Columbia. Based upon the findings from the investigation, a definitive cause of the UME was not determined although ecological factors were a contributory cause (i.e., the 2015 El Nino, Pacific marine heatwave and Pacific Coast Domoic Acid Bloom).

Anthropogenic Threats

Historically, commercial whaling represented the greatest threat to humpback whales and was ultimately responsible for humpback whales being listed as an endangered species. In 1965, the International Whaling Commission banned commercial hunting of humpback whales in the

Pacific Ocean, and, as a result, this threat has largely been curtailed. No commercial whaling occurs within the range of Mexico or Western North Pacific DPS humpbacks, and Alaskan subsistence hunters are not authorized to take humpback whales.

Vessel strike is one of the main threats and sources of anthropogenic impacts to humpback whales in Alaska. Neilson et al. (2012) summarized 108 ship strike events in Alaska from 1978 to 2011; 86 percent involved humpback whales. Eighteen humpbacks were struck by vessels between 2016 and 2020 (Freed et al. 2022). Most ship strikes of humpback whales are reported in Southeast Alaska (Helker et al. 2019), where high vessel traffic overlaps with whale presence.

Fishing gear entanglement is another major threat. Entanglement may result in only minor injury or may potentially significantly affect individual health, reproduction, or survival. Every year humpback whales are reported entangled in fishing gear in Alaska, particularly pot gear and gill net gear. Between 2016 and 2020, entanglement of humpback whales (n = 47) was the most frequent human-caused source of mortality and injury of large whales (Freed et al. 2022).

4.3.2.1.6 Occurrence in the Action Area

Marine Transit Routes

The summer feeding range of humpback whales in the North Pacific includes waters of the Russian Far East, Beaufort Sea, Bering Sea, Chukchi Sea, Gulf of Alaska, Western Canada, and the U.S. West Coast (Young et al. 2022). Relatively high densities of humpback whales occur throughout much of Southeast Alaska and northern British Columbia. Southeast Alaska was identified as a biologically important area (BIA) for seasonal feeding due to the high density of animals from March-November (Ferguson et al. 2015). The second version of BIAs split the previous Southeast BIA with three seasonal occurrences into 10 BIAs and 2 Watch List areas, each with their own temporal delineation (Wild et al. 2023).

Due to the timing of their seasonal migrations between summer feeding areas and winter areas, humpback whales occurring along the project-dedicated vessel routes will likely be conducting foraging activities in the summer and fall months. Also, in the late fall (starting in October), they maybe migrating southward to wintering areas if encountered.

If project vessels deploy from Anchorage, the proposed vessel route is expected to transit through Mexico DPS critical habitat, the Kodiak BIA, and multiple Southeast BIAs. Vessels deploying from Seattle, WA will also transit through multiple Southeast BIAs. During project-dedicated vessel movement, there exists the moderate potential of encountering a humpback whale. If a humpback whale is encountered, it would likely an individual or small group occurring within coastal waters.

Humpback whales have been observed throughout Cook Inlet, however they are primarily seen in lower and mid Cook Inlet. During the NMFS aerial beluga whale surveys from 1993–2016, there were 88 sightings of an estimated 192 individual humpback whales. A large number of these sightings occurred in the vicinity of Elizabeth Island, Iniskin and Kachemak Bays, and there were also a number of sightings north of Anchor Point (Rugh et al. 2000; Rugh et al. 2005; Shelden et al.

2013; Shelden et al. 2015; Shelden et al. 2017). Additionally, humpback whales have been observed within Cook Inlet by marine mammal observers (Lomac-MacNair et al. 2014; Owl Ridge 2014).

4.3.2.1.7 Alcan Harbor, Shemya Island

The 40 kilometer ensonfied zones for 30-inch and 42-inch DTH pile driving likely contain sources of prey species in which humpback whales feed on during in water construction activities. Humpback whales were observed within the expected ensonified area for the project in Alcan Harbor during USACE 2021 Marine Mammal Surveys of Shemya Island. Four humpback whales were observed within the project area between June 16th and 20th in 2021 and four observations outside of the ensonified area during July and September observations. Between 2016 and 2021, no humpback whales (or unknown whale species) were observed within Alcan harbor.

4.3.3 Fin whale

4.3.3.1.1 Population Structure and Status

The fin whale was decimated by commercial whaling in the 1800s and early 1900s. It was listed as an endangered species under the ESCA in 1970 (35 FR 8491, June 2, 1970 (baleen whales listing); 35 FR 18319, December 2, 1970 (fin whale listing)), and continued to be listed as endangered following passage of the ESA. Critical habitat has not been designated for the fin whale. A recovery plan for the fin whale was published on July 30, 2010 (NMFS 2010a). Fin whales have two recognized subspecies: *B. p. physalus* occurs in the North Atlantic Ocean (Gambell 1985), while *B. p. quoyi* occurs in the Southern Ocean (Fischer 1829). For management purposes, three stocks of fin whales are currently recognized in U.S. Pacific waters: 1) Alaska (Northeast Pacific), 2) California/Washington/Oregon, and 3) Hawaii (Young et al. 2023). However, Mizroch et al. (2009) suggest that this structure should be reviewed and updated, if appropriate, to reflect current data that suggests there may be at least 6 populations of fin whales in this region.

It is difficult to assess the current status of fin whales because (1) there is no general agreement on the size of the fin whale population prior to whaling, and (2) estimates of the current size of the different fin whale populations vary widely. Prior to exploitation by commercial whalers, fin whales are thought to have numbered greater than 464,000 worldwide, and are now estimated to number approximately 119,000 worldwide (Braham 1991). The 2022 Alaska marine mammal stock assessment provides a population estimate of 3,168 for fin whales but cautions this is likely an underestimate for the entire stock because it is based on surveys which covered only a small portion of the stock's range (Muto et al. 2022; Young et al. 2023). This estimate was based on surveys done in the Gulf of Alaska which were more recent (Rone et al. 2017a) and provides a higher estimate than estimates based on surveys done in Western Alaska and the Aleutian Islands (Moore et al. 2002; Zerbini et al. 2006).

As used in this opinion, "populations" are isolated demographically, meaning they are driven more by internal dynamics like birth and death processes than by the geographic redistribution of individuals through immigration or emigration.

4.3.3.1.2 Distribution

In the North Pacific, the fin whale occurs in the Gulf of Alaska and waterbodies along the west coast of the United States year-round and in waterbodies near the Aleutian Islands and Bering Sea during the summer (Moore et al. 1998; Stafford et al. 2007; Mizroch et al. 2009). Fin whales are typically found in deep water (Matsuoka et al. 2013; Rone et al. 2017b) away from the immediate coast (Clarke et al. 2020). Panigada et al., (2008) found water depth to be the most significant variable in describing fin whale distribution, with more than 90 percent of sightings occurring in waters deeper than 2,000 m.

Fin whales migrate, generally spending the spring and early summer feeding in cold, high latitude waters as far north as the Chukchi Sea, with regular feeding grounds in the Gulf of Alaska, Prince William Sound, along the Aleutian Islands, and around Kodiak Island, primarily on the western side. Feeding BIA's have been identified for fin whales near Kodiak Island and in the Bering Sea (Figure 14)(Brower et al. 2022; Wild et al. 2023). During the NMFS aerial beluga whale surveys in Cook Inlet from 2000 through 2016, 10 sightings of approximately 26 individual fin whales in lower Cook Inlet were observed (Shelden et al. 2013; Shelden et al. 2015; Shelden et al. 2017).

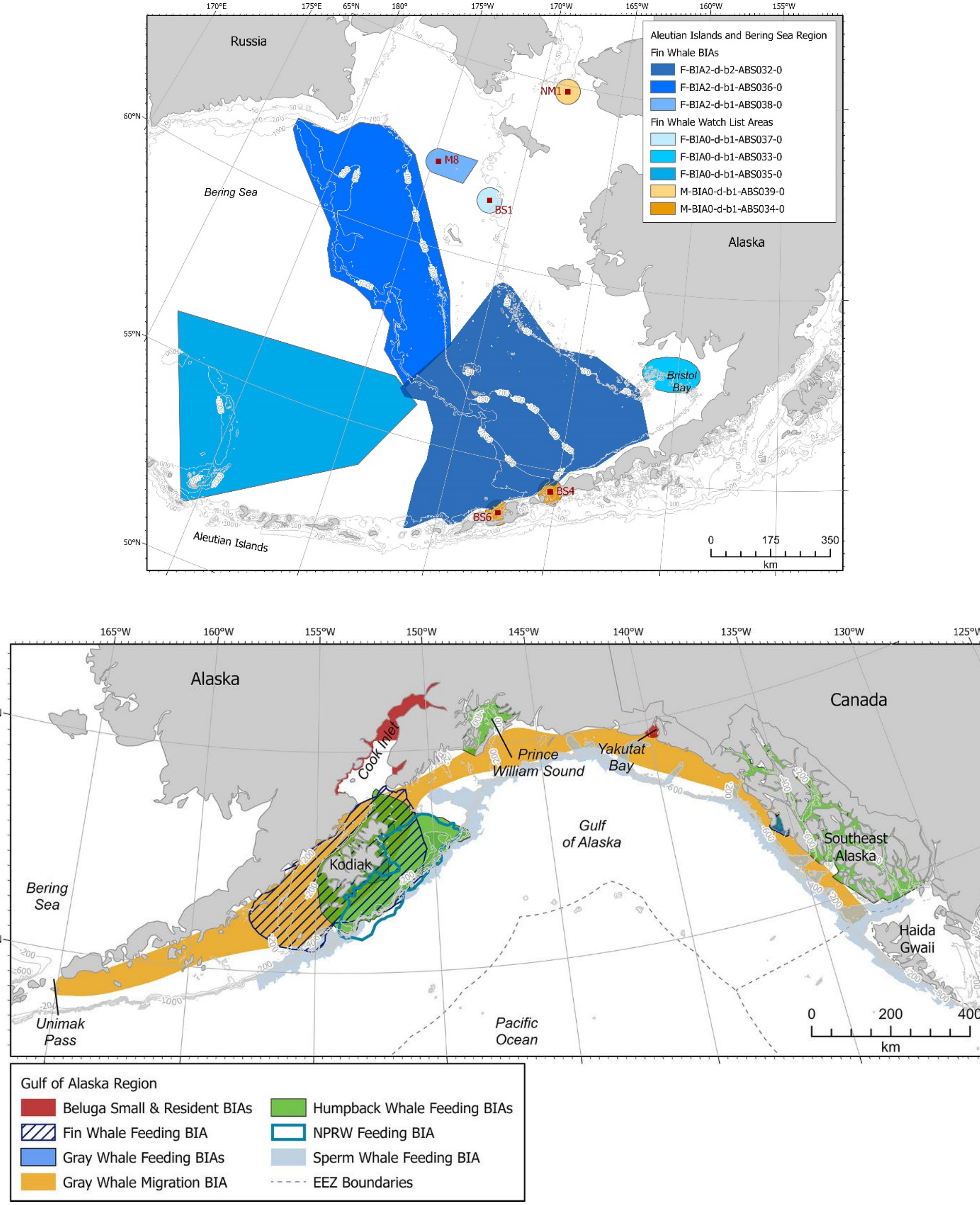

Figure 14. Fin whale BIAs for Bering Sea and Aleutians (top; taken from Brower et al. 2022) and Gulf of Alaska (bottom; taken from Wild et al. 2023).

4.3.3.1.3 Feeding and Prey Selection

Fin whales, like humpback and blue whales, exhibit lunge-feeding behavior, where large amounts of water and prey are taken into the mouth and filtered through the baleen (Brodie 1993; Goldbogen et al. 2006; Goldbogen et al. 2008). Feeding may occur in shallow waters on prey such as sand lance (Overholtz and Nicolas 1979) and herring (Nøttestad et al. 2002), but most foraging is observed in high-productivity, upwelling, or thermal front marine waters (Panigada et al. 2008). In the North Pacific, fin whales consume euphausiids (mainly *Euphausia pacifica*, *Thysanoessa longipes*, *T. spinifera*, and *T. inermis*) and large copepods (mainly *Calanus cristatus*), followed by schooling fish such as herring, walleye pollock (*Theragra chalcogramma*), and capelin (Nemoto 1970; Kawamura 1980).

The percentage of time fin whales spend at the surface varies. Some authors have reported that fin whales make 5 to 20 shallow dives with each of these dive lasting 13-20 seconds followed by a deep dive lasting between 1.5 and 15 minutes (Gambell 1985; Stone et al. 1992; Lafortuna et al. 2003). Other authors have reported that the fin whale's most common dives last between 2 and 6 minutes, with 2 to 8 blows between dives (Watkins 1981; Hain et al. 1992). More recent data support average dives of 98 m and 6.3 min for foraging fin whales, while non-foraging dives are 59 m and 4.2 min (Croll et al. 2001). However, Lafortuna et al. (2003) found that foraging fin whales have a higher blow rate than when traveling. Foraging dives in excess of 150 m are known to occur (Panigada et al. 1999).

4.3.3.1.4 Vocalization and Hearing

Fin whales produce a variety of low-frequency sounds in the 10 Hz to 0.2 kHz range (Thompson et al. 1992; Rice et al. 2021). The most typical signals are long, patterned sequences of short duration (0.5 to 2 s) infrasonic pulses in the 18 to 35 Hz range (Patterson and Hamilton 1964). The seasonality and stereotype of the bouts of patterned sounds suggest that these sounds are male reproductive displays (Watkins et al. 1987), while the individual counter calling data of McDonald et al. (1995) suggest that the more variable calls are contact calls. Some authors suggest there are geographic differences in the frequency, duration, and repetition of the pulses (Thompson et al. 1992).

While there is no direct data on hearing in low-frequency cetaceans, the applied frequency range is expected to be between 7 Hz and 35 kHz (NMFS 2018b). Estimates based on scans of a fin whale calf skull indicate the range of best hearing for fin whale calves to range from approximately 20 Hz to 10 kHz, with maximum sensitivities between 1 to 2 kHz (Cranford and Krysl 2015).

4.3.3.1.5 Threats to the Species

Natural

There is limited information on natural sources of injury or mortality to fin whales. However, the occurrence of the nematode *Crassicauda boopis* appears to increase the potential for kidney failure and may be preventing some fin whale populations from recovering (Lambertsen 1983).

Predation of fin whales by killer whales has been observed (Vidal and Pechter 1989). Adult fin whales engage in flight responses (up to 40 km/h) to evade killer whales, which involves high energetic output, but show little resistance if overtaken (Ford and Reeves 2008). Killer whale or shark attacks may also result in serious injury or death in very young and sick individuals (Perry et al. 1999a).

A declared UME involved humpback and fin whales occurred in portions of the Gulf of Alaska and Bering Sea in Alaska and British Columbia (Savage 2017). The event was jointly investigated by NOAA Fisheries and Department of Fisheries and Oceans, Canada and was defined as occurring from May 22, 2015 to December 31, 2015 in the Gulf of Alaska and from April 23, 2015 to April 16, 2016 in British Columbia. Based upon the findings from the investigation, a definitive cause of the UME was not determined although ecological factors were a contributory cause (i.e., the 2015 El Nino, Pacific marine heatwave and Pacific Coast Domoic Acid Bloom).

Anthropogenic Threats

Fin whale deaths due to vessel strikes within the West Coast Exclusive Economic Zone (EEZ) are estimated to be 1.6 fin whales per year (Carretta et al. 2022). For Alaska waters, this number is 0.6 fin whales (Muto et al. 2022). However, fin whale deaths from vessel strikes are assumed to be largely underrepresented (Carretta and Henry 2022) likely due, at least in part, to their preference for offshore waters may increase the likelihood of vessel interactions going unreported (Neilson et al. 2012) and due to the animal sinking before it is visible or washing ashore in a remote location inaccessible to humans (Rockwood et al. 2017). From 2000-2022, NMFS confirmed 9 vessel strike reports of live fin whales with unknown outcomes and 2 fin whale carcasses in the Bering Sea had evidence of vessel strike in Alaskan waters (Freed et al. 2022); NMFS AKR Regional Stranding Dataset).

Fin whales experience significant injury and mortality from fishing gear and entanglements (Perkins and Beamish 1979; Carretta et al. 2007; Waring et al. 2007). In 1999, one fin whale was reported killed in the Gulf of Alaska pollock trawl fishery and one was killed the same year in the offshore drift gillnet fishery (Angliss and Outlaw 2005). According to Waring et al. (2007), four fin whales in the western North Atlantic died or were seriously injured in fishing gear, while another five were killed or injured as a result of ship strikes between January 2000 and December 2004.

The organochlorines DDE, DDT, and PCBs have been identified from fin whale blubber, but levels are lower than in toothed whales due to fin whales feeding at a lower level in the food chain (Borrell and Aguilar 1987; Aguilar and Borrell 1988). Females contained lower burdens than males, likely due to mobilization of contaminants during pregnancy and lactation (Aguilar 1987; Gauthier et al. 1997). Contaminant levels increase steadily with age until sexual maturity, at which time levels begin to drop in females and continue to increase in males (Aguilar and Borrell 1988).

4.3.3.1.6 Occurrence in the Action Area

Marine Transit Routes

Fin whale calls were recorded offshore of Washington along the Juan de Fuca Ridge and indicated fin whales travel northwest towards Alaskan waters from August to October (Soule and Wilcock 2013). Project specific vessels departing and returning to Seattle, WA at the start and end of the project each year may transit through Juan de Fuca Ridge and transit of project specific vessels between ports within Alaska including Seward, Anchorage, Kodiak, and Shemya Island (Figure 4). Wild et al. (2023)identified feeding habitat around Kodiak Island, south of the mouth of Cook Inlet, as a BIA for fin whales (Figure 14), indicating the highest densities of fin whales occur between June and September. If project vessels deploy from Anchorage, Seward, and Kodiak, the proposed vessel route may overlap with the Kodiak BIA.

Although fin whales are seen frequently in the Gulf of Alaska while foraging in the summer, peak call rates recorded during April 2006 through 2007 hydrophone surveys within the central North Pacific and the Aleutian Islands occurred in the late summer through winter (specifically, September through November, February, and March) and were seldom detected during early and mid-summer (Stafford et al. 2007; Stafford et al. 2010). During summer (June-September), fin whales migrate from the North Pacific Ocean into the Bering Sea, with peak density in August (Mizroch et al. 2009). Fin whales were often the most sighted large whale along the Bering Sea shelf, especially along the portion called the “Green Belt,” which is a highly productive area due to the abundance of prey (Moore et al. 2002; Zerbini et al. 2006; Friday et al. 2012; Friday et al. 2013).

During project-dedicated vessel transits between Seattle, Anchorage, Seward, Kodiak and Shemya Island, there exists the moderate potential of encountering a fin whale. If a fin whale is encountered, it would likely be an individual or small group.

Alcan Harbor, Shemya Island

Fin whales are typically found in deep water (Matsuoka et al. 2013; Rone et al. 2017a) away from the immediate coast (Clarke et al. 2020); however, the DTH driving activity has a 40 kilometer ensonificaion area that includes deeper waters near Shemya Island. The 40 kilometer ensonfied zones for 30-inch and 42-inch DTH pile driving could contain sources of prey species in which fin whales feed on during in water construction activities. No fin whales were observed within the expected ensonified area for the project in Alcan Harbor during USACE 2021 Marine Mammal Surveys of Shemya Island nor where they observed within Alcan harbor during surveys between 2016 and 2021. There were four observations of unidentified whale species outside of Alcan harbor in spring 2019 and 10 unidentified whales were observed during the 2018 – 2020 winter surveys, outside of the project area.

4.3.4 Sperm Whale

4.3.4.1.1 Population Structure and Status

Commercial whaling from 1800 to the 1980s greatly decreased sperm whale populations worldwide. Sperm whales were the dominant species killed by the commercial whaling industry as it developed in the North Pacific in the years after World War II (Mizroch and Rice 2006; Ivashchenko et al. 2014). The sperm whale was listed as an endangered species under the ESCA in 1970 (35 FR 8491, June 2, 1970; 35 FR 18319, December 2, 1970), and continued to be listed as endangered following passage of the ESA. A recovery plan was completed in 2010 (NMFS 2010b) and critical habitat has not been designated for sperm whales. The International Whaling Commission placed a moratorium on commercial whaling in 1986. Rice (1989) estimated the North Pacific stock of sperm whales at 1,260,000 animals prior to exploitation and that by the 1970s, the North Pacific stock had been reduced to 930,000 whales. Although the number of sperm whales occurring in Alaska waters is unknown, 102,112 sperm whales are estimated to occur in the western North Pacific region (Kato and Miyashita 1998). There is no current reliable estimate of the global abundance of sperm whale, or of the North Pacific stock in Alaska, and therefore the population trend of sperm whales in the North Pacific stock is also unknown (Muto et al. 2021).

The sperm whale is one of the most widely distributed marine mammals (Muto et al. 2021). Currently, the population structure of sperm whales has not been adequately defined (NMFS 2010b). For management purposes under the MMPA, three stocks are currently recognized for sperm whales in U.S. waters of the Pacific Ocean: (1) Alaska (also termed North Pacific stock), (2) California/Washington/Oregon, and (3) Hawaii. The North Pacific stock is the only stock occurring in Alaska waters (Young et al. 2023).

4.3.4.1.2 Distribution

Sperm whales are the largest of the odontocetes (toothed whales), inhabit all oceans worldwide, and can be observed along the pack ice edge in both hemispheres. Sperm whales are primarily found in deep waters, and sightings of sperm whales in water less than 300 m (984 ft) are uncommon. They are usually found far offshore, except in cases where the shelf break or submarine canyons occur close to land (Mizroch and Rice 2013). In the North Pacific the northernmost boundary for sperm whales extends from Cape Navarin, Russia (latitude 62º N) to the Pribilof Islands, Alaska (Omura 1955; Allen and Angliss 2014).

Sperm whales are thought to migrate to higher latitude foraging grounds in the summer and lower latitudes in the winter (Whitehead and Arnbom 1987). The distribution and movement patterns of sperm whales vary significantly between sexes. Mizroch and Rice (2013) analyzed whaling data and found that males and females historically concentrated seasonally along oceanic frontal zones, for example, in the subtropical frontal zone (approximately 28-34°N) and the subarctic frontal zones (approximately 40-43°N). During the summer, males are found in the Gulf of Alaska, Bering Sea, and waters around the Aleutian (Kasuya and Miyashita 1988; Mizroch and Rice 2013; Ivashchenko et al. 2014). Sighting surveys conducted by the Alaska Fisheries Science Center's Marine Mammal Laboratory (MML) in the summer months between 2001 and 2010 found sperm whales to be the most frequently sighted large cetacean in the coastal waters around the central and western Aleutian Islands (MML, unpubl. data). Acoustic surveys, from fixed autonomous hydrophones, detected the presence of sperm whales year-round in the Gulf of Alaska, although they appear to be approximately two times as common in summer than in winter (Mellinger et al. 2004).

Feeding BIAs have been designated for sperm whales along the Aleutians, Bering Sea and Gulf of Alaska. One BIA is located along the Aleutian Islands in April-September and the other BIA is located along the Bering Sea slope in May-September (Figure 15). The BIA in the Gulf of Alaska represent feeding areas that are frequented during spring to fall months, but sperm whales are present in the Gulf of Alaska year-round (Wild et al. 2023).

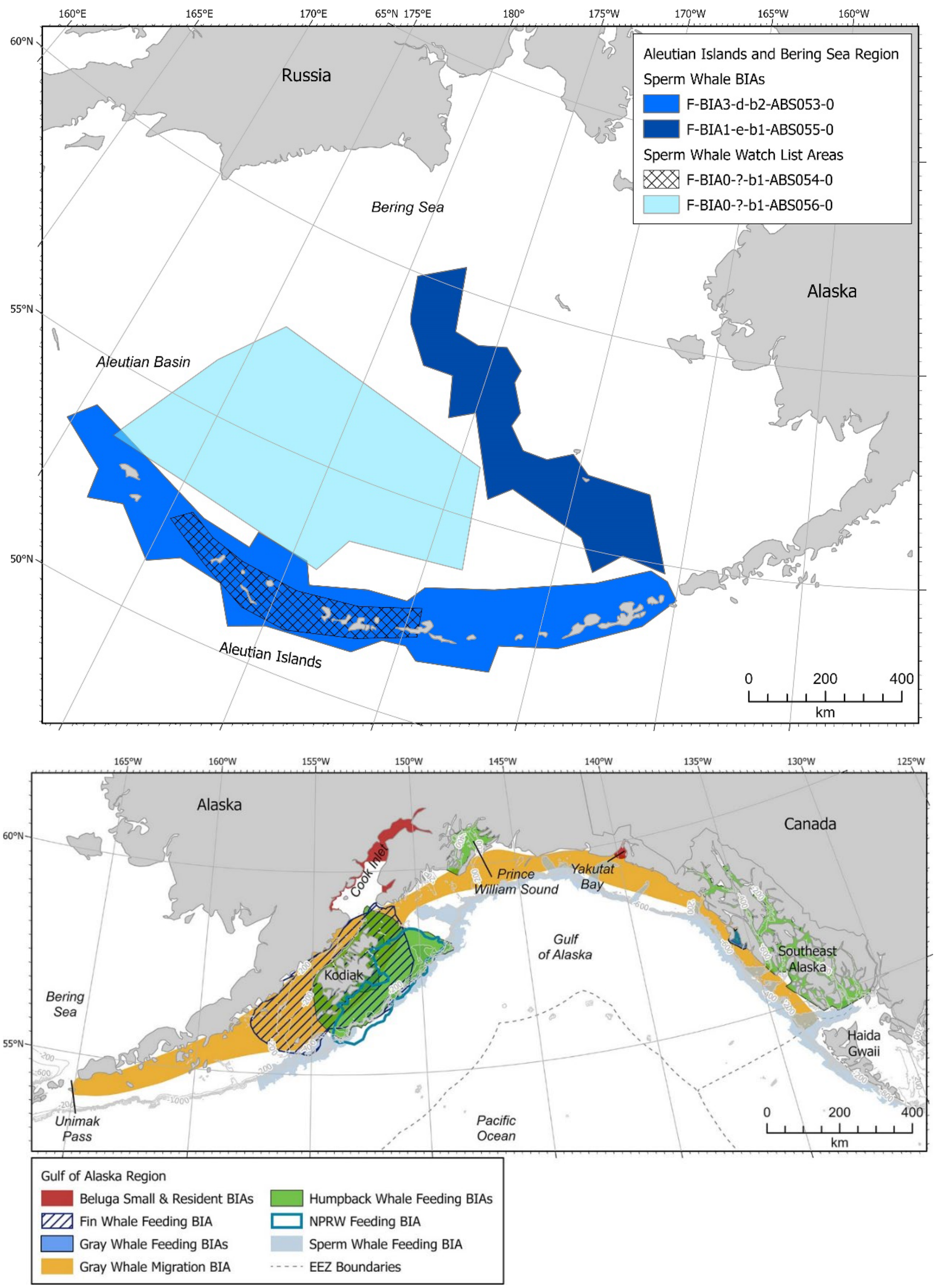

Figure 15. Feeding BIAs for sperm whales in the Aleutians and Bering Sea (top; taken from Brower et al. 2022) and Gulf of Alaska (bottom; taken from Wild et al. 2023).

4.3.4.1.3 Feeding and Prey Selection

Sperm whales are among the deepest marine mammal divers. Males have been known to dive 3,936 ft (1,199.7 m) while females dive to at least 3,280 ft (999.7 m), and dives can last for more than an hour. Giant squid comprise about 80 percent of the sperm whale diet and the remaining 20 percent is comprised of octopus, fish, shrimp, crab, and even small bottom-living sharks. Sperm whales can consume about 3–3.5 percent of their body weight in a day. Sperm whales show evidence of disk-shaped scars and wounds likely made by giant squid resisting capture. They feed primarily on medium-sized to large-sized squids but also take substantial quantities of large demersal and mesopelagic sharks, skates, and fishes (Rice 1989).

4.3.4.1.4 Vocalization and Hearing

Sperm whales are odontocetes (toothed whales) and are considered mid-frequency cetaceans with an applied frequency range of 150 Hz to 160 kHz (Southall et al. 2007; NMFS 2018b). The only direct measurement of hearing was from a young stranded individual from which auditory evoked potentials were recorded and indicated a hearing range of 2.5 to 60 kHz (Carder and Ridgway 1990). Our understanding of sperm whale hearing stems largely from the sounds they produce. In addition, sperm whales have been observed to frequently stop echolocating in the presence of underwater pulses made by echo-sounders and submarine sonar (Watkins et al. 1985). Because they spend large amounts of time at depth and use low-frequency sound, sperm whales are likely to be susceptible to low frequency noise in the ocean.

Sperm whales produce a variety of vocalizations ranging from 0.1 to 20 kHz (Weilgart and Whitehead 1993; Goold and Jones 1995; Møhl et al. 2003; Weir and Goold 2007). Sound production and reception by sperm whales are better understood than for most cetaceans. Sperm whales produce broad-band clicks in the frequency range of 100 Hz to 20 kHz that can be extremely loud for a biological source (peak sound source levels of 200-236 dB re 1µPa), although lower average source level energy has been suggested at around 171 dB re 1 µPa (Weilgart and Whitehead 1993; Møhl et al. 2003). Most of the energy in sperm whale clicks is concentrated at around 2-4 kHz and 10-16 kHz (Weilgart and Whitehead 1993). The highly asymmetric head anatomy of sperm whales is likely an adaptation to produce the unique clicks recorded from these animals (Cranford et al. 1996).

4.3.4.1.5 Threats to the Species

Natural

Sperm whale strandings and mortalities may be related to infections including dolphin morbillivirus (DMV), brucella and other pathogens (West et al. 2015; Mazzariol et al. 2018). Further, while rare, sperm whales are known to mass strand and one theory to explain these events is a ‘sick-leader syndrome’ (Mazzariol et al. 2018). No mass strandings of sperm whales have been observed in Alaska.

Anthropogenic

Although the main direct threat to sperm whales was addressed by the IWC whaling moratorium on commercial whaling, several potential threats remain. The recovery plan for sperm whales lists collisions with vessels, entanglement in fishing gear, reduced prey due to overfishing, habitat degradation, disturbance from anthropogenic noise, and the possibility of illegal or resumed legal whaling at biologically unsustainable rates as potential threats to recovery (NMFS 2010b).

Neilson et al. (2012), reported 108 whale-vessel collision in Alaska between 1978-2011, of which 25 are known to have resulted in mortality, including one definite strike of a sperm whale in the Gulf of Alaska. Since then, one sperm whale died shortly after being struck by a vessel in the Aleutian Islands North of Nikolski Island and postmortem examination of a second sperm whale carcass in 2019 near Juneau Alaska found evidence of a vessel strike (Freed et al. 2022). The possible impact of ship strikes on recovery of sperm whale populations is not well understood. Carcasses that do not drift ashore may go unreported, and those that do strand may show no obvious signs of having been struck by a ship. Because many ship strikes go unreported or undetected for various reasons and the offshore distribution of sperm whales may make ship strikes less detectable than for other species, the estimates of serious injury or mortality should be considered minimum estimates.

Sperm whales have been documented interacting with demersal longline fisheries in the Gulf of Alaska since the 1970s (Straley et al. 2014; Wild et al. 2017; Hanselman et al. 2018). Between 2014 and 2018, mortality and serious injury of sperm whales was observed in the Bering Sea/Aleutian Islands halibut longline fishery (one serious injury in 2015, prorated at 0.75), the Aleutian Islands sablefish pot fishery (one mortality in 2018), and the Gulf of Alaska sablefish longline fishery (one serious injury in 2016, prorated at 0.75). The mortality and serious injury was extrapolated to fishery-wide estimates when possible, resulting in a minimum estimated mean annual mortality and serious injury rate of 3.3 sperm whales in U.S. commercial fisheries between 2014 and 2018 (Breiwick 2013; Young et al. 2023). In July of 2021, a sperm whale became entangled in gear used by the Alaska Fisheries Science Center's Alaska Longline Survey. The interaction resulted in a live release; the whale swam away with no visible gear wrapped around it and is assumed to have survived with no major effects (Eco49 2022).

The possible effects of pollution on sperm whales remain poorly understood. Concentrations of some contaminants including heavy metals such as mercury (Savery et al. 2013; Squadrone et al. 2015) and organochlorines (Evans et al. 2004) in sperm whale's tissue were high enough to cause concern. However, the implication of these contaminates and the potential protective role of selenium for mercury toxicity is still being investigated. Sperm whales have also been documented with ingested plastic debris which has ultimately led to stranding and mortality (Jacobsen et al. 2010; De Stephanis et al. 2013).

4.3.4.1.6 Occurrence in the Action Area

Sperm whales commonly occur in the Gulf of Alaska, Bering Sea, around the Aleutian Islands, and some parts of Southeast Alaska during the summer months and therefore have the potential to be found within the action area. Sperm whales occur year round in the Gulf of Alaska, but appear to be more common during the summer months than winter months (Mellinger et al. 2004). Sperm whales are likely to overlap with project dedicated vessels. Vessels traveling between Seattle, WA and other ports for this project are expected to travel farther offshore (Figure 4, Figure 15). Results from acoustic surveys indicate that sperm whales are present in the Gulf of Alaska year-round where they are most common in the summer months along the continental shelf waters (Mellinger et al. 2004; Straley et al. 2014; Diogou et al. 2019). Sperm whales have been frequently documented in the western Aleutian Islands, from Unalaska to the east out to the far islands. During 12 cetacean surveys in the summers of 2001-2007 and 2009-2010, 393 sightings of adult male sperm whales were made (Fearnbach et al. 2012). They were considered the most frequently sighted large cetacean in coastal waters around the central and western Aleutian Islands (Allen and Angliss 2011). In February 2008, a group of approximately 50 female and immature sperm whales were seen near Koniuji Island, in the central Aleutian Islands (Fearnbach et al. 2012). This was the first time such a large aggregation of females and juveniles were seen so far north since whaling ended. One sperm whale carcass stranded on the western shore of Shemya Island in 2008 and two sperm whales stranded on Buldir Island in 2018.

5 ENVIRONMENTAL BASELINE

The "environmental baseline" refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action areas that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR § 402.02).

This section discusses the environmental baseline, focusing on existing anthropogenic and natural activities within and near the action area and their influences on listed species may be adversely affected by the proposed action. Species that may be affected by the proposed action include the Western DPS Steller sea lions, sperm whale, Mexico and Western North Pacific DPS humpback whale, and fin whale. Although some of the activities discussed below are outside the action area, they may still have an influence on listed species or their habitat in the action area.

5.1 Recent Consultations in the Action Area

NMFS AKR has not issued any biological opinions for projects near Shemya Island or the Western Aleutians. There were two recent letters of concurrence on Shemya Island. One was an emergency consultation for repairs to the dock located on Shemya Island, these repairs returned limited functionality to the fuel pier in Alcan Harbor (AKR-2020-00349) and this Biological Opinion addresses the permanent fix of the pier. The second Letter of Concurrence was an expedited consultation for vessel traffic between Shemya Island and the ports of Seattle, Kodiak, Anchorage, and Seward (AKRO-2023-00524). Within the Western Aleutians there have been three letter of concurrence (one expedited) issued since 2017.

- NOAA Prince of Wales Island/Attu Archaeology Survey Letter of Concurrence (sonar mounted on vessels and an autonomous underwater vehicle); AKRO2023-00511
- Adak FUDS Cleanup Letter of Concurrence (removal of containerized waste and contaminated soil); AKRO-2018-02326/AKR-2018-9807
- Trident Ballyhoo Dock Repair Project (Impact Pile Driving); AKRO-2023-01879.

5.2 Marine Vessel Activity

This project proposes to address damage to the existing pier, to reinforce and strengthen the eroding shoreline to prevent similar damage to the new pier. The Eareckson Air Station fuel pier is part of a USAF Military Station that encompasses the entire Shemya Island. Shemya Island is a remote island in the Wester Aleutian Islands of Alaska. Fuel delivered to the pier is used by on-island generator systems that aid in the operation of Homeland Defense early warning radar surveillance and communications systems. Eareckson Air Station also functions as an emergency divert airfield supporting commercial and air traffic destined for Japan, China, Indochina, and other destinations in Asia and the Pacific. Eareckson Air Station is restricted to mission-related personnel. No public recreation or tourism is permitted. The new fuel pier is not expected to increase or change the vessel traffic after completion of the construction.

The Aleutian Islands and the surrounding waters support multiple active marine shipping routes for goods and services and is one of the shortest routes between North American and Asian ports (the North Pacific Great Circle Route) and as a result thousands of large cargo ships and tanker vessels make these transits each year (Arctic Council 2009; Sullender et al. 2021). Bulk carriers and cellular container ships were common along the North Pacific Great Circle Route between 2015 and 2017, undertaking transits of considerable distance >669 nm; (Silber et al. 2021). During summer months, vessels can travel just south of the Aleutian Islands as opposed to the routes to the north in the Bering Sea which are often used during stormier weather (Chen et al. 2014). Hours of vessel operations in the Bering Sea, which includes the northern rout along the Aleutian Archipelago, varied monthly and between years (2015-2017) with the greatest proportion of hours including vessel categories including fishing, dry cargo/ passenger, and bulk carriers (Silber and Adams 2019). Most transients were made by fishing vessels and were generally short in duration and distance and largely occurring north of the Aleutian Islands (Silber and Adams 2019).

Vessel noise and presence can impact whales by causing behavioral disturbances, auditory interference, or non-auditory physical and physiological effects (e.g., vessel strike). From 1978 to 2011, there were 108 recorded whale-vessel collisions in Alaska, with the majority occurring in Southeast Alaska between May and September (Neilson et al. 2012). Small recreational vessels traveling at speeds over 13 knots were most commonly involved in ship strike encounters; however, all types and sizes of vessels were reported (Neilson et al. 2012). The majority of vessel strikes involved humpback whales (86 percent) and the number of humpback strikes increased annually by 5.8 percent from 1978 to 2011. Between 2000 and 2022, 69 live humpback whale reported vessel strikes were classified as definite or probably and an additional 16 humpback whales showed definite or probably evidence of vessel strikes during postmortem examination (NMFS AKR Office Stranding dataset; (Delean et al. 2020a; Freed et al. 2022). The vast majority of these events occurred in Southeast Alaska, followed by the Gulf of Alaska and then Southcentral Alaska. NMFS implemented regulations to minimize harmful interactions between ships and humpback whales in Alaska (see 50 CFR §§ 216.18, 223.214, and 224.103(b)). NMFS and the National Park Service started the Whale Alert Alaska program in Southeast Alaska. Users, including cruise ships, Alaska Marine Highway ferries, and U.S. Coast Guard vessels, report sightings information, which is shared with other active program users to reduce the risk of ship strike.

Between 2000 and 2022, seven fin whales (1 live, 6 carcasses) were classified as definite or probably vessel strikes, and an additional two reports were considered possible vessel strikes (NMFS AKR Office Stranding dataset; (Delean et al. 2020a; Freed et al. 2022). The two vessel strike reports that involved live fin whales occurred in the Gulf of Alaska, and the carcasses with evidence of vessel strikes were observed in Bering Sea (n=2), Gulf of Alaska (n=2) and Southcentral Alaska (n=3). One sperm whale died shortly after being struck by a vessel in the Aleutian Islands North of Nikolski Island and postmortem examination of a second sperm whale carcass in 2019 near Juneau Alaska found evidence of a vessel strike.

Steller sea lions may be more susceptible to ship strike mortality or injury in harbors or in areas where animals are concentrated, e.g., near rookeries or haulouts (NMFS 2008). There are three confirmed reports of Steller sea lions with injuries indicative of vessel strike in Alaska between 2000 and 2022, two occurred in Gulf of Alaska and one in Southeast Alaska (National Stranding Database, unpublished data). The risk of vessel strike, however, has not been identified as a significant concern for Steller sea lions.

5.3 Fisheries Interactions Including Entanglement

Commercial, recreational, and subsistence fishing occurs in much of Southeast Alaska, Gulf of Alaska, and Aleutian Islands and may harm or kill listed marine species through direct bycatch, gear interactions (entrapments and entanglements), vessel strikes, contaminant spills, habitat modification, competition for prey, and behavioral disturbance or harassment.

Alaska Fisheries accounted for 60 percent of the landings (31 percent of value) in the United States, with the top three ports by volume (pounds) and value being in Alaska including the top port, Dutch Harbor and the 2nd highest port being Aleutian Islands (Service 2022). The Alaska (walleye) pollock (*Gadus chalcogrammus*) fisheries has been the world's largest fishery (Sullender et al. 2021); however, the Alaska pollock landings hit a new 5-year low in volume and value in 2020 (Service 2022). Spatial restrictions on the Pollock fisheries have been implemented by the North Pacific Fishery Management Council in the Aleutian Islands to protect potential prey fields for the Western DPS Steller sea lion. Although open to fishing, there continues to be no directed fishing for pollock in the Aleutian Islands (Barbeaux et al. 2017).

Other economically important fish species within the Aleutian Islands include Atka mackerel (*Pleurogrammus monopterygius*), Pacific cod (*Gadus macrocephalus*), King crab (*Lithodes aequispinus*), and Pacific halibut (*Hippoglossus stenolepis*).

Globally, 6.4 million tons of fishing gear is lost in the oceans every year (Wilcox et al. 2015). Entrapment and entanglement in fishing gear is a frequently documented source of human-caused mortality in cetaceans (see Dietrich et al. 2007). Fisheries interactions have an impact on many marine mammal species. More than 97 percent of whale entanglements are caused by derelict fishing gear (Baulch and Perry 2014).

The main cause of reported of human-marine mammal interactions associated with serious injury and mortality in Alaska between 2013-2017 was entanglement/entrapment, and Steller sea lions were the most common species of human-caused mortality and serious injury (Delean et al. 2020a). Among Western DPS Steller sea lions, the minimum estimated mean annual mortality and injury rate in U.S. commercial fisheries between 2014 and 2018 was 37 individuals (Muto et al. 2021). This an underestimate as no observers have been assigned to several fisheries that are known to interact with this stock. Further, not all entangled animals strand nor are all stranded animals found, reported, or have the cause of death determined. Between 2016 and 2020 human-caused mortality and injury of the Western DPS Steller sea lions (n = 148) was primarily caused by entanglement in fishing gear, in particular, commercial trawl gear (Freed et al. 2022).

Bettridge et al. (2015) report that fishing gear entanglements may moderately reduce the population size or the growth rate of ESA-listed whales. Sperm whales have been documented interacting with demersal longline fisheries in the Gulf of Alaska since the 1970s (Straley et al. 2014; Wild et al. 2017; Hanselman et al. 2018) and mortality and serious injury have been observed in the Bering Sea/Aleutian Islands halibut longline fishery, the Aleutian Islands sablefish pot fishery, and the Gulf of Alaska sablefish longline fishery. Humpback whales have been killed and injured during interactions with commercial fishing gear; however, the frequency of these interactions does not appear to have a significant adverse consequence for humpback whale populations. Most entanglements occur between early June and early September, when humpbacks are foraging in nearshore Alaska waters. A photographic study of humpback whales in southeastern Alaska found at least 53 percent of individuals showed some kind of scarring from fishing gear entanglement (Neilson et al. 2005). Between 2016 and 2020, entanglement of humpback whales (n = 47) was the most frequent human-caused source of mortality and serious injury of large whales (Freed et al. 2022).

Commercial fisheries may indirectly affect marine mammals by reducing the amount of available prey or affecting prey species composition. Competition could exist between listed species and commercial fishing for prey species, as certain fisheries target key Steller sea lion, sperm whale, humpback whale, and fin whale prey, including Pacific cod, salmon, and herring. Fishery management measures have reduced this potential competition in some regions (e.g., no trawl zones and gear restrictions on various fisheries in southeast Alaska). The broad distribution of prey and seasonal fisheries that differ from listed species presence in the area may minimize competition as well.

5.4 Pollutants including Marine Debris and Discharges

Intentional and accidental discharges of contaminants pollute the marine waters of Alaska. Intentional sources of pollution, including domestic, municipal, and industrial wastewater discharges are managed and permitted by the Alaska Department of Environmental Conservation (ADEC). Pollution may also occur from unintentional discharges and spills. Using ADEC's databases for contaminated sites and impaired waterbodies, we identified possible sources of pollution and contaminants for the marine waters, or impaired waters, close to the action area. There are active contaminant sites throughout Cook Inlet, Kodiak Island, and along the Aleutian Islands. On Shemya Island there are over 40 active contaminated sites include two sites within the construction site in Alcan Harbor.[5]

In offshore waters, the most likely sources of pollution and contaminants are ballast water discharge and accidental spills of oil, fuel, and other materials from traversing vessels. Ships can potentially release pollutants and non-indigenous organisms through the discharge of ballast water. Marine organisms picked up in ship ballast water and released into non-native habitats are responsible for significant ecological and economic perturbations costing billions of dollars; this is a recognized worldwide problem. Discharges of wastes from vessels are regulated by the United States Coast Guard and, by law, no discharges of any kind are allowed within three miles of land. The Alaska Department of Fish and Game (ADFG) developed an Aquatic Nuisance Species Management Plan (Fay 2002) in order to protect Alaska's waters. The effects of discharged ballast water and the possible introduction of invasive species on humpback whales, sperm whales, fin whales, and Steller sea lions are unknown.

Vessels also have the potential to introduce debris into the marine environment. Steller sea lions have been found entangled in packing bands. However, the degree to which marine debris such as packing bands and loops impacts Steller sea lions and cetacean species are largely unknown. Discarded or lost lines from vessels could become an entanglement hazard for listed marine mammal species. To address these sources of debris, there is a mitigation measure to ensure trash will be disposed of in accordance with state law (AS 46.06.080) and specifically ensure cutting of all unused packing straps, plastic rings, and other synthetic loops, and securing all ropes and nets, to ensure they do not blow or wash into the marine environment. These measures will help to prevent entanglement of marine wildlife. However, due to the large area of the project vessel transit routes, the extremely small number of lines expected to be lost from vessels associated with this action, and the relatively low density of cetaceans, we conclude it is unlikely that listed cetacean species will be affected by marine debris.

Increased vessel activity in the action area during construction will temporarily increase the risk of accidental fuel and lubricant spills. Accidental spills may occur from a vessel leak or if the vessel runs aground. From 1995 to 2012, approximately 400 spills (100 to 300,000 gallons) occurred in Alaska's marine waters. Most were in nearshore and shallow coastal waters and were primarily diesel (BLM 2019). Small spills combined with the dispersive action of waves and

---

[5] https://www.arcgis.com/apps/mapviewer/index.html?webmap=315240bfbaf84aa0b8272ad1cef3cad3 accessed December 26, 2023

currents likely reduces the probability of an encounter and adverse reaction of a listed species to extremely low levels.

5.5 Natural Catastrophic Changes

Steller sea lions are amphibious requiring land for breeding and resting. Steller sea lion inhabit regions of known seismic and volcanic activity and tsunami events. Earthquakes, volcanic eruptions, landslides, and tsunamis can alter the physical environment instantaneously. Catastrophic events are infrequent but have the potential to impact marine mammals by: decreasing prey abundance as a result of direct mortality; rendering habitat unsuitable (or more suitable) for marine mammals and prey species; directly removing (or creating) habitat areas (e.g., elevation changes, landslides, and tsunamis could remove (or create) haulouts and rookeries or alter access to habitat); and, degrading habitat quality (e.g., volcanic ash outfall could affect siltation and water chemistry; NMFS 2016). Western DPS Steller sea lion carcasses have been observed associated with landslides on rookeries in the Aleutian Islands. In 2016-2017, the volcanic eruption on Bolgslof Island altered the entire island (Coombs et al. 2019) and likely impacted Western DPS Steller sea lions. However, the population level implications of these and other natural catastrophes are not known.

5.6 Climate and Environmental Change

Since the 1950s the atmosphere and oceans have warmed, snow and sea ice have diminished, sea levels have risen, and concentrations of greenhouse gases have increased (IPCC 2014). There is little doubt that human influence has been the dominant cause of the observed warming since the mid-20th century (IPCC 2014). Average temperatures have increased across Alaska at more than twice the rate of the rest of the United States.[6]

In the past 60 years, average air temperatures across Alaska have increased by approximately 3°F, and winter temperatures have increased by 6°F (Chapin et al. 2014). Some of the most pronounced effects of climate change in Alaska include disappearing sea ice, shrinking glaciers, thawing permafrost, and changing ocean temperatures and chemistry (Chapin et al. 2014). Climate change is projected to have substantial direct and indirect effects on individuals, populations, species, and the structure and function of marine, coastal, and terrestrial ecosystems in the foreseeable future (Houghton 2001; McCarthy et al. 2001). The impacts of these changes and their interactions on listed species in Alaska are hard to predict.

Indirect threats associated with climate change include increased human activity as a result of regional warming. Less ice could mean increased vessel activity or construction activities with an associated increase in sound, pollution, and risk of ship strike. Human fishing pressure could change the abundance, seasonality, or composition of prey species. Fisheries in Alaska are managed with the goal of sustainability; however, not all fish stocks are assessed, and it is

[6] https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-alaska_.html accessed December 2023.

unknown whether management of fisheries for optimal returns provides sufficient densities in feeding areas for efficient foraging by ESA-listed marine mammal species.

Physical forcing affects food availability can change the structure of trophic relationships by impacting climate conditions that influence reproduction, survival, distribution, and predator-prey relationships at all trophic levels. Warmer waters could favor productivity of some species of forage fish, but the impact on recruitment of important prey fish of Steller sea lions is unpredictable. Recruitment of large year-classes of gadids (e.g., pollock) and herring has occurred more often in warm than cool years, but the distribution and recruitment of other fish (e.g., osmerids) could be negatively affected (NMFS 2008).

The Pacific marine heatwave is also likely responsible for poor growth and survival of Pacific cod, an important prey species for Steller sea lions. The 2018 Pacific cod stock assessment estimated that the female spawning biomass was at its lowest point in the 41-year time series. This assessment was conducted following three years of poor recruitment and increased natural mortality during the Gulf of Alaska marine heat wave from 2014 to 2016 (NMFS 2018a).

Populations of Steller sea lions in the Gulf of Alaska and Bering Sea have experienced large fluctuations due to environmental and anthropogenic forcing (Mueter et al. 2009). Hastings et al (2023) found the marine heatwave was associated with reduced survival of Steller sea lions in the Gulf of Alaska, a region that had positive trends in animal counts. Similarly, humpback whales have shown changes in distribution (Brower et al. 2018), body condition (Neilson and Gabriele 2020), and reproduction (Gabriele et al. 2022), likely in response to climate change.

Several unusual mortality events (UME) have occurred within Alaska with likely links to climate change and the associated changes in prey. Two UMEs involved increased gray whales stranding along the west coast of North America from Mexico through Alaska. The first gray whale UME occurred in 1999-2000 and while the cause was not determined, gray whales carcasses were observed in poor body condition suggesting starvation following the 1997-1998 El Niño (Le Boeuf et al. 2000; Gulland 2005; Moore et al. 2022). The second gray whale UME started in 2019 and continued through 2023 with the ongoing investigation identifying several likely contributors, including ecological changes and associated shifts in prey availability in the Arctic and sub-Arctic, leading to malnutrition in some whales. These changes affect the benthic and water-column-inhabiting invertebrates that gray whales feed on each summer in the Arctic and sub-Arctic (Moore et al. 2022). The changes in the structure and function of the Arctic ecosystem may help explain the ‘boom and bust’ cycles in gray populations and how future impacts of climate change may impact gray whales (Stewart et al. 2023).

There has also been two UMEs involving ice seal species. The most recent UME was located in the in the eastern Bering Sea (north of 60º) and eastern Chukchi Sea and occurred from June 1, 2018 through December 31, 2019, and is currently pending closure. The likely cause of this UME was the unprecedented ocean warming recorded in the Bering Sea during the winters of 2017 to 2018 and 2018 to 2019, which resulted in late sea ice formation and early sea ice melt. These changes likely resulted in reduced prey availability by size and species which may have led to malnutrition and poor body condition in the ice seals.

An UME of humpback and fin whales occurred in the Gulf of Alaska and British Columbia, Canada in 2015-2016. Analysis of the data did not reveal a definitive cause of the UME but it was determined that sonar/seismic testing, radiation, and predation likely did not contribute to the UME (Savage 2017). Based upon the findings from the investigation, a definitive cause of the UME was not determined although ecological factors were a contributory cause (i.e., the 2015 El Nino, Pacific marine heatwave and Pacific Coast Domoic Acid Bloom).

6 EFFECTS OF THE ACTION

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

This biological opinion relies on the best scientific and commercial information available. We try to note areas of uncertainty, or situations where data is not available. In analyzing the effects of the action, NMFS aims to minimize the likelihood of false negative conclusions (i.e. concluding that adverse effects are not likely when such effects are, in fact, likely to occur).

We organize our effects analysis using a stressor identification – exposure – response – risk assessment framework for the proposed activities.

We conclude this section with an *Integration and Synthesis of Effects* that integrates information presented in the *Status of the Species* and *Environmental Baseline* sections of this opinion with the results of our exposure and response analyses to estimate the probable risks the proposed action poses to endangered and threatened species.

NMFS identified and addressed all potential stressors; and considered all consequences of the proposed action, individually and cumulatively, in developing the analysis and conclusions in this opinion regarding the effects of the proposed action on ESA-listed species and designated critical habitat.

6.1 Project Stressors

Stressors are any physical, chemical or biological phenomena that can induce an adverse response. The effects section starts with identification of the stressors produced by the constituent parts of the proposed action. Based on our review of the data available, the proposed activities may cause these stressors:

- Acoustic disturbance from pile driving activities
- Acoustic disturbance from excavation, dredging, and screeding activities
- Vessel noise, presence, and strikes

- Sea floor disturbance and turbidity
- Effects on prey
- Trash and debris
- Pollutants and contaminants
- MEC removal and detonation

6.1.1 Minor Stressors on ESA-listed Species and Critical Habitat

Based on a review of available information, we determined the following stressors are likely to have minimal impacts on Western North Pacific DPS and Mexico DPS humpback whales, fin whales, sperm whales, and Western DPS Steller sea lions.

6.1.1.1 Vessel noise, Presence, and Strikes

Vessel traffic to Alcan Harbor on Shemya Island is not expected to increase upon completion of the fuel pier. The new structures of the fuel pier will provide safe mooring and delivery of fuel solely for the use of the Eareckson Air Station and the use of the pier is expected to be consistent with the use prior to the storm damage that initiated the need for replacement of the existing pier. No public recreation or tourism is permitted.

Project vessels are likely to generate underwater sound levels exceeding the non-impulsive threshold of 120 dB, and disturbance to listed species could occur from project vessel noise. Although some marine mammals could receive sound levels exceeding the acoustic threshold of 120 dB from the project vessels, disturbances rising to the level of harassment are extremely unlikely to occur. The nature of the exposure will be low-frequency, with much of the acoustic energy emitted by project vessels at frequencies below the best hearing ranges of listed marine mammals in the action area. In addition, the duration of the exposure to noise from transiting vessels will be temporary and brief.

The project vessels will emit continuous sound while in transit, which will alert marine mammals before the received sound level exceeds 120 dB and a startle response is not expected. Slight deflection and avoidance are expected to be common responses, in those instances where there is any response at all. Free-ranging marine mammals may engage in avoidance behavior when surface vessels move toward them, similar to their behavioral responses to predators. Animals have been observed reducing their visibility at the water surface and moving horizontally away from the source of disturbance or adopting erratic swimming strategies (Williams et al. 2002; Lusseau 2003; Lusseau 2006). Studies indicate that dive times and swimming speeds increase, vocalizations and surface active behaviors usually decrease, and individuals in groups move closer together (Kruse 1991; Evans et al. 1994). Most animals in confined spaces, such as shallow bays, moved towards more open, deeper waters when vessels approached (Kruse 1991).

Some baleen whales have adjusted their communication frequencies, intensity, and call rate to limit masking effects from anthropogenic sounds such as shipping traffic. Baleen whales may also exhibit behavioral changes in response to vessel noise. Marine mammals that have been disturbed by anthropogenic noise and vessel approaches are commonly reported to shift from resting behavioral states to active behavioral states, suggesting an energetic cost to the affected animal. Humpback cow-calf pairs significantly reduced the amount of time spent resting and milling when vessels approached, as compared to undisturbed whales (Morete et al. 2007). Responding to vessels is likely stressful to humpback whales, but the biological significance of that stress is unknown (Bauer and Herman 1986).

Potential impacts of vessel disturbance on Steller sea lions have not been well studied, and the responses will likely depend on the season and stage in the reproductive cycle (NMFS 2008). Steller sea lions are more likely to be disturbed at haulouts and near rookeries, where in-air vessel noise or visual presence could cause behavioral responses such as avoidance of the sound source, spatial displacement from the immediate surrounding area, trampling, and abandonment of pups (Calkins and Pitcher 1982; Kucey 2005). Repeated disturbances that result in abandonment or reduced use of rookeries by lactating females could negatively affect body condition and survival of pups through interruption of normal nursing cycles (NMFS 2008). Increases in ambient noise from vessel traffic, however temporary, also have the potential to mask communication between sea lions and affect their ability to detect predators (Richardson and Malme 1993; Weilgart 2007).

Marine mammals that are likely encountered in the commercial channels are likely familiar with vessel noise. If animals do respond to project vessel noise, they may exhibit slight deflection from the source, engage in low-level avoidance behavior or short-term vigilance behavior. However, these behaviors are not likely to result in adverse consequences for the animals. The nature and duration of response is not expected to disrupt, to a measurable degree, important behavioral patterns such as feeding or resting.

In summary, some marine mammals will likely be exposed to vessel noise and disturbance as a result of this action. If exposure occurs, it will be temporary and localized, and likely cause responses that are at a low energy cost to individuals. The proposed mitigation measures and the distribution and low density of listed whales in the area, as well as other factors are expected to further reduce the number of times marine mammals react to project vessels. NMFS concludes that any disturbance of marine mammals from vessel noise will be temporary and the effects to listed species from vessel noise will be extremely small.

Ship strikes can cause major wounds or death to marine mammals. An animal at the surface could be struck directly by a vessel, a surfacing animal could hit the bottom of a vessel, or a vessel propeller could injure or kill an animal below the water surface. From 1978-2011, there were 108 recorded whale-vessel collisions in Alaska, with the majority occurring in Southeast Alaska between May and September (Neilson et al. 2012). Small recreational vessels traveling at speeds over 13 knots were most commonly involved in ship strike encounters; however, all types and sizes of vessels were reported (Neilson et al. 2012). The majority of vessel strikes involved humpback whales (86 percent), and the number of humpback strikes increased by 5.8 percent annually from 1978 to 2011. The closest reported strike to the project site is over 50 km downstream, where data indicate a whale-vessel collision hotspot in the waters of southern Lynn Canal, Favorite Channel, and Saginaw Channel (Neilson et al. 2012, NMFS Alaska Regional Office Stranding Database accessed July 2023). The probability of encountering a humpback whale from the Mexico DPS in Southeast Alaska is two percent and eleven percent in the Gulf of Alaska (Wade 2021). Humpback whales from the Western North Pacific DPS are not expected to occur within Southeast Alaska and there is only a one percent probability of their occurrence within the Gulf of Alaska (Wade 2021).

Between 2000 and 2022, 85 humpback whale (69 live, 16 carcasses), seven fin whales (1 live, 6 carcasses), and two sperm whales (1 live, 1 carcass) were involved in vessel strikes that were classified as definite or probably (NMFS AKR Office Stranding dataset; (Delean et al. 2020a; Freed et al. 2022). There were three Steller sea lions (1 live, 2 carcasses) with injuries indicative of vessel strike in Alaska (NMFS Stranding dataset). Steller sea lions are likely more susceptible to ship strike mortality or injury in harbors or in areas where animals are concentrated, e.g., near rookeries or haulouts (NMFS 2008). The risk of vessel strike, however, has not been identified as a significant concern for Steller sea lions. The vast majority of reported interactions between vessels and marine mammals occurred in Southeast Alaska, followed by the Gulf of Alaska and then Southcentral Alaska. The small number of project specific vessels and transients for this project and the low numbers of listed marine mammals expected within the areas the vessels will travel through, along with the proposed mitigation measuresare expected to further reduce the probability of a vessel strike. Therefore, NMFS concludes that vessel strike is unlikely to occur.

6.1.1.2 Acoustic Disturbance from Dredging, Screening, and Underwater excavation

As described in Section 2, dredging, screening, and underwater excavation are proposed in Alcan Harbor. Effects to listed marine mammals from dredging, screening, and underwater excavation include underwater noise, and seafloor disturbance. The effects of seafloor disturbance/habitat alteration are discussed in Section 6.1.1.3.

Noise created by dredging and screeding operations is dependent on factors such as dredge type, substrate type, bathymetry, geomorphology of the waterway, site-specific hydrodynamic conditions, equipment maintenance status, and skill of the dredge operator (McQueen et al. 2019). Sound received by listed species will depend on these factors as well as the transmission loss through the water and distance from the source. Because dredging noise is broadband, with most energy below 1 kHz (Robinson et al. 2011; Reine et al. 2014; Reine and Dickerson 2014; McQueen et al. 2019) it is not likely to cause damage to the auditory systems of marine mammals (Todd et al. 2015; Suedel et al. 2019).

Based on available studies we have concluded that, beyond 300 m dredging noise will not exceed 120 dB_{rms} re 1µPa (Dickerson et al. 2001; Greene et al. 2008). This threshold distance is based upon the most commonly used dredging and screeding equipment used in Alaska, and upon our interpretation of the acoustic data available on this topic. In general, sound pressure levels from dredging activities are similar to levels reported for underwater sound associated with commercial shipping, with most energy below 1 kHz and not likely to cause damage to auditory systems (Todd et al. 2015; McQueen et al. 2019; Suedel et al. 2019). In Alaska, clam shell dredges and backhoe dredges are used most often for coastal dredging projects. The sound created by these dredges is non-continuous (Reine et al. 2014). Consequently, the sound level to 160 dB is used to calculate the shutdown zone. If the highest measured sound pressure level created by these dredgers (179 dB re 1 µPA@1m) is used to calculate the shutdown zone using the practical spreading model (15 logR), a distance of 215 m is obtained. Because the size, power, and mechanical condition of the dredgers that may be used under this consultation are unknown and the specific site characteristics are also unknown, we have conservatively assigned a shutdown zone of 300 m for all dredging activities. With this size shutdown zone, we are confident that acoustic disturbance to listed marine mammals will be insignificant.

Based on the above information and the mitigation measures discussed in section 2.1, NMFS concludes the potential exposure to sound from dredging, screening, and underwater excavation on Western North Pacific DPS humpback whales, Mexico DPS humpback whales, fin whales, sperm whales, and Western DPS Steller sea lions will be immeasurably small.

6.1.1.3 Sea Floor Disturbance and Turbidity

The proposed activities would not result in permanent impacts to habitats used directly by marine mammals and the new pier will only have a small increase in actual footprint compared to the existing fuel pier. The total seafloor area likely impacted by the project is relatively small compared to the available habitat around the project area and the Western Aleutian Islands and does not include any BIAs or other habitat of known importance. At best, the construction area provides marginal foraging habitat for marine mammals and fishes. Furthermore, pile driving at the project site occurs within the Alcan Harbor and would not obstruct movements or migration of marine mammals.

Pile driving, dredging/screening/underwater excavating activities may cause temporary and localized turbidity through sediment disturbance. Increases in turbidity levels will have temporary impacts on water quality. Turbidity plumes during pile installation and removal will be localized around the pile; turbidity associated with pile installation is localized to an approximate 7.6 m radius around the pile (Everitt et al. 1980). Shutdown mitigation measures are likely to prevent listed cetaceans from being close enough to experience effects of turbidity from pile driving, and pinnipeds could avoid localized areas of turbidity.

Due to the temporary, localized, and low levels of turbidity increases, it is not expected that turbidity would result in immediate or long-term effects to Western North Pacific DPS and Mexico DPS humpback whales, fin whales, sperm whales, or Western DPS Steller sea lions. Therefore, we consider effects from this stressor to be insignificant.

6.1.1.4 Effects on Prey

Construction activities will produce non-impulsive (i.e., vibratory pile installation and removal) and impulsive (i.e., impact pile driving) sounds. Fish react to intermittent low-frequency sounds and sounds that are especially strong. Short duration, sharp sounds can cause overt or subtle changes in fish behavior and local distribution. Hastings and Popper (2005) identified several studies that suggest fish may relocate to avoid areas with certain types of sound energy.

Impulsive sounds at received levels of 160 dB may cause subtle changes in fish behavior and SPLs of 180 dB may cause noticeable changes in behavior (Pearson et al. 1992; Skalski et al. 1992). SPLs of sufficient strength have been known to cause injury to fish and fish mortality (Popper et al. 2014a; Popper et al. 2014b). Pile driving associated barotrauma (i.e., damage to internal tissues) of fish has been found to occur at sound pressure levels of 205-215 dB re: 1

μPa_{peak} in experimental studies (Casper et al. 2012; Halvorsen et al. 2012). However, there are very few experimental examples of sound being sufficiently loud to result in death or mortal injury to fishes (Popper and Hawkins 2019).

Injury to fish depends more on the magnitude of particle motion than on sound levels as mammals perceive it (Popper and Hawkins 2019). It is likely that fish will avoid sound sources within ranges that may be harmful (McCauley et al. 2003). The most likely impact to fish from pile driving activities would be temporary behavioral avoidance of the project area. The duration of fish avoidance of this area after pile driving ceases is unknown, but a rapid return to normal recruitment, distribution, and behavior is expected.

In general, impacts to marine mammal prey species are expected to be minor and temporary, given the small area of pile driving relative to known feeding areas of listed marine mammals. We expect fish will be capable of moving away from project activities to avoid exposure to noise. Any behavioral avoidance by fish of the disturbed area would still leave significantly large areas of fish and marine mammal foraging habitat in the nearby vicinity. We expect the area in which stress, injury, temporary threshold shift (TTS), or changes in balance of prey species may occur will be limited to a few meters directly around the pile driving operations.

Studies on euphausiids and copepods, two of the more abundant and biologically important groups of zooplankton, have documented some sensitivity to sound (Chu et al. 1996; Wiese 1996); however, any effects of pile driving activities on zooplankton would be expected to be restricted to the area within a few meters of the project and would likely be sub-lethal. No appreciable adverse impact on zooplankton populations will occur due in part to large reproductive capacities and naturally high levels of predation and mortality of these populations. Any mortality or impacts on zooplankton as a result of construction operations is immaterial as compared to the naturally occurring reproductive and mortality rates of these species.

Given the short daily duration of sound associated with individual pile driving events, the relatively small areas being affected, the localized response of prey species, and the rapid return of any temporarily displaced species, pile driving activities are unlikely to have a permanent adverse effect on any prey habitat or prey species. Any impacts to marine mammal habitat are not expected to result in significant or long-term consequences for individual marine mammals, or to contribute to adverse impacts on their populations. NMFS considers potential adverse impacts to prey resources from construction activities in the action area to be immeasurably small.

Sound pressure levels generated by other activities of the proposed action (i.e., vessel traffic) may cause temporary behavioral changes of prey species at close range, such as a startle or stress response. Project-related vessel sounds are not expected to cause direct injury to fish, and will behaviorally affect fish only at close range, for a short period of time. A very small proportion of primary prey species for listed marine mammals may also be temporarily disturbed by non-acoustic sources, including boat wakes and spinning propellers. Prey species may exhibit a startle or flight response, but these forms of disturbance would be temporary, with a geographic extent much smaller than the project action area.

Based on the above information, prey species may respond to noise associated with the proposed action by avoiding the immediate area. However, the expected impact of project activities on marine mammal prey is very minor, and thus any effects to Western North Pacific DPS humpback whales, Mexico DPS humpback whales, fin whales, sperm whales, and Western DPS Steller sea lions due to project-caused prey effects will be insignificant.

6.1.1.5 Trash and Debris

The project may generate trash and debris, which could be released into the marine environment and pose risks to marine mammals. The USACE and USAF intends to comply with all applicable regulations, and will implement mitigation measures and construction best management practices to minimize, retrieve, and appropriately dispose of project-generated trash and debris. The expected impact of trash and debris is very minor, and thus effects from this stressor to ESA-listed species will be insignificant.

6.1.1.6 Pollutants and Contaminants

Marine mammals could be exposed to authorized discharges through project vessels. Discharges associated with some marine commercial vessels are covered under a National Pollution Discharge Elimination System (NPDES) Vessel General Permit (VGP) for Discharges Incidental to the Normal Operation of Vessels. Commercial vessels are covered under the VGP when discharging within the territorial sea extending three nautical miles from shore. When vessels are operating and discharging in Federal waters, the discharges are regulated under MARPOL 73/78, the International Convention for the Prevention of Pollution from Ships. The EPA completes consultation on the issuance of the VGP with the Services and receives separate biological opinions. Previously, these opinions have concluded that EPA's issuance of the VGP was not likely to jeopardize listed species or adversely modify designated or proposed critical habitat. An ESA consultation was completed for this general permit, impacts associated with marine vessel discharges were considered, and incidental take has been accounted for.

Accidental spills could occur from a vessel leak or onboard spill. The size of the spill influences the number of individuals that will be exposed and the duration of that exposure. Contact through the skin, eyes, or inhalation and ingestion could result in temporary irritation or long-term endocrine or reproductive impacts, depending on the duration of exposure. The greatest threat to cetaceans is likely from inhalation of volatile toxic hydrocarbon fractions of fresh oil, which can damage the respiratory system (Hansen 1985; Neff 1990), cause neurological disorders or liver damage (Geraci and St. Aubin 1990), have anesthetic effects (Neff 1990), and cause death (Geraci and St. Aubin 1990). However, toxic fumes from small spills are expected to rapidly dissipate into the atmosphere as fresh refined oil ages quickly, limiting the potential exposure of marine mammals.

Based on the localized nature of small spills, the relatively rapid weathering and dispersion, and the safeguards in place to avoid and minimize oil spills, NMFS concludes that exposure of Western North Pacific DPS humpback whales, Mexico DPS humpback whales, fin whales, sperm whales, and Western DPS Steller sea lions to a small oil spill is extremely unlikely to occur. If exposure were to occur, NMFS does not expect detectable responses from listed marine mammals due to the ephemeral nature of small, refined oil spills.

6.1.1.7 MEC removal and detonation

The replacement fuel pier is within a MMRP site and surveys and clearance of the Alcan Harbor Ordnance MMRP site have been completed. However, there is a limited potential that munitions and explosives of concern have migrated within the site and therefore magnetometer-based surveys for MEC will be conducted prior to ground disturbing activities, both in water and on land. It is extremely unlikely that a MEC would be discovered within in-water sediment and an even more remote chance that the MEC would been deemed unacceptable to be removed from the water and require blow-in-place disposal. Rather, if an MEC is found during in-water magnetometer-based surveys the sediment would be excavated with a clamshell bucket and transferred to an upland, low-grade staging area and all further work with the MEC would occur on land. Therefore, NMFS concludes that in-water detonation of MEC is unlikely to occur.

6.1.2 Major Stressors on ESA-Listed Species

The following sections analyze the stressors likely to adversely affect ESA-listed species due to underwater anthropogenic sound. Construction activities will produce non-impulsive (i.e., vibratory pile driving) and impulsive (i.e., impact pile driving) sounds. First, we provide a brief explanation of the sound measurements and acoustic thresholds used in the discussions of acoustic effects in this opinion.

6.1.2.1 Acoustic Thresholds

Since 1997, NMFS has used generic sound exposure thresholds to determine whether an activity produces underwater and in-air sounds that might result in impacts to marine mammals (70 FR 1871, 1872; January 11, 2005). NMFS has developed comprehensive guidance on sound levels likely to cause injury to marine mammals through onset of permanent and temporary thresholds shifts (PTS and TTS; 83 FR 28824; June 21, 2018; 81 FR 51693; August 4, 2016). NMFS is in the process of developing guidance for behavioral disruption (Level B harassment). However, until such guidance is available, NMFS uses the following conservative thresholds of underwater sound pressure levels,[7] expressed in root mean square (rms),[8] from broadband sounds that cause behavioral disturbance, and referred to as Level B harassment under section 3(18)(A)(ii) of the MMPA (16 U.S.C § 1362(18)(A)(ii)):

- impulsive sound: 160 dB_{rms} re 1 μPa

---

[7] Sound pressure is the sound force per unit micropascals (μPa), where 1 pascal (Pa) is the pressure resulting from a force of one newton exerted over an area of one square meter. Sound pressure level is expressed as the ratio of a measured sound pressure and a reference level. The commonly used reference pressure level in acoustics is 1 μPa, and the units for underwater sound pressure levels are decibels (dB) re 1 μPa.

[8] Root mean square (rms) is the square root of the arithmetic average of the squared instantaneous pressure values.

- non-impulsive sound: 120 dB_{rms} re 1μPa

Under the PTS/TTS Technical Guidance, NMFS uses the following thresholds (Table 8) for underwater sounds that cause injury, referred to as Level A harassment under section 3(18)(A)(i) of the MMPA (16 U.S.C § 1362(18)(A)(i); NMFS 2018b). Different thresholds and auditory weighting functions are provided for different marine mammal hearing groups, which are defined in the Technical Guidance (NMFS 2018b). The generalized hearing range for each hearing group is in Table 9.

Table 8. PTS Onset Acoustic Thresholds for Level A Harassment (NMFS 2018b).

Hearing Group	**PTS Onset Acoustic Thresholds[1] (Received Level)**	
	Impulsive	**Non-impulsive**
Low-Frequency (LF) Cetaceans	*L*pk,flat: 219 dB *L*E,LF,24h: 183 dB	*L*E,LF,24h: 199 dB
Mid-Frequency (MF) Cetaceans	*L*pk,flat: 230 dB *L*E,MF,24h: 185 dB	*L*E,MF,24h: 198 dB
High-Frequency (HF) Cetaceans	*L*pk,flat: 202 dB *L*E,HF,24h: 155 dB	*L*E,HF,24h: 173 dB
Phocid Pinnipeds (PW) (Underwater)	*L*pk,flat: 218 dB *L*E,PW,24h: 185 dB	*L*E,PW,24h: 201 dB
Otariid Pinnipeds (OW) (Underwater)	*L*pk,flat: 232 dB *L*E,OW,24h: 203 dB	*L*E,OW,24h: 219 dB

[1] Dual metric acoustic thresholds for impulsive sounds: Use whichever results in the largest isopleth for calculating PTS onset. If a non-impulsive sound has the potential of exceeding the peak sound pressure level thresholds associated with impulsive sounds, these thresholds should also be considered.

Note: Peak sound pressure (*L*pk) has a reference value of 1 μPa, and cumulative sound exposure level (SEL) has a reference value of $1\mu Pa^2s$. The subscript “flat” is being included to indicate peak sound pressure should be flat weighted or unweighted within the generalized hearing range. The subscript associated with cumulative SEL thresholds indicates the designated marine mammal auditory weighting function (LF, MF, and HF cetaceans, and PW and OW pinnipeds) and that the recommended accumulation period is 24 hours. The cumulative SEL thresholds could be exceeded in a multitude of ways (i.e., varying exposure levels and durations, duty cycle). When possible, it is valuable for action proponents to indicate the conditions under which these acoustic thresholds will be exceeded.

Table 9. Underwater marine mammal hearing groups (NMFS 2018b).

Hearing Group	**ESA-listed Marine Mammals in the Project Area**	**Generalized Hearing Range**[1]
Low-frequency (LF) cetaceans *(Baleen whales)*	Fin whale, Mexico DPS humpback whale, Western North Pacific DPS humpback whale	7 Hz to 35 kHz
Mid-frequency (MF) cetaceans *(dolphins, toothed whales, beaked whales)*	Sperm whale	150 Hz to 160 kHz
High-frequency (HF) cetaceans *(true porpoises)*	None	275 Hz to 160 kHz
Phocid pinnipeds (PW) *(true seals)*	None	50 Hz to 86 kHz
Otariid pinnipeds (OW) *(sea lions and fur seals)*	Western DPS Steller sea lions	60 Hz to 39 kHz

[1] Respresents the generalized hearing range for the entire group as a composite (i.e., all species within the group), where individual species' hearing ranges are typically not as broad. Generalized hearing range chosen based on ~65 db threshold from normalized composite audiogram, with the exception for lower limits for LF cetaceans (Southall et al. 2007) and PW pinniped (approximation).

These acoustic thresholds are presented using dual metrics of cumulative sound exposure level (L_E) and peak sound level (PK) for impulsive sounds and L_E for non-impulsive sounds.

Level A harassment radii can be calculated using the optional user spreadsheet[9] associated with NMFS Acoustic Guidance, or through modeling.

The MMPA defines "harassment" as: any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment]" (16 U.S.C. § 1362(18)(A)).

[9] NMFS User Spreadsheet Tool, version 2.2 (updated December 2020), available at https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance, accessed October 2023.

While the ESA does not define "harass," NMFS issued guidance interpreting the term "harass" under the ESA as to: "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering" (Wieting 2016). Exposure to sound capable of causing Level A or Level B harassment under the MMPA often, but not always constitutes "take" under the ESA. For the purposes of this consultation, we have determined construction activities that produce non-impulsive (i.e., vibratory pile driving) and impulsive (i.e., impact pile driving) underwater sounds have sound source levels capable of causing take under the MMPA and ESA.

As described below, we anticipate that exposures to listed marine mammals from noise associated with the proposed action may result in harassment and disturbance and TTS/PTS. However, no mortalities are expected.

6.2 Exposure Analysis

As discussed in the *Approach to the Assessment* section of this opinion, exposure analyses are designed to identify the listed species that are likely to co-occur with these effects in space and time and the nature of that co-occurrence. In this step of our analysis, we try to identify the number, age (or life stage), and sex of the individuals that are likely to be exposed to an action's effects and the populations or subpopulations those individuals represent.

As discussed in Section 2.1.2 above, the USACE and USAF proposed mitigation measures that should avoid or minimize exposure of Western North Pacific DPS humpback whales, Mexico DPS humpback whales, fin whales, sperm whales, and Western DPS Steller sea lions to one or more stressors from the proposed action. NMFS expects that humpback whales, sperm whale, fin whale, and Steller sea lions will be exposed to underwater noise from pile driving activities (including impact pile driving, DTH, vibratory pile installation and removal).

6.2.1 Exposure Assumptions

- Because pile driving and pile removal produce similar sound profiles and levels (MacGillivray et al. 2015), vibratory pile driving sound estimates will be used as a proxy for vibratory pile removal sound levels.
- Exposures are based on total number of days that pile driving could occur and that animals might occur in the ensonified area.
- One day equates to any length of time that piles are driven whether it is a partial day or a 24-hour period.
- All listed marine mammals occurring in the Level B ensonified zones are assumed to be incidentally taken. Animals occurring in a Level A zone will be assumed to have been taken by Level A harassment/harm unless it can be demonstrated that the animal did not actually incur level A take according to NMFS acoustic guidance (generally by not remaining in the level A zone sufficiently long enough to incur take).
- Level A harassment of low frequency species is requested only during DTH. We based take estimates on the planned duration for DTH pile driving activities. Although the

shutdown zone is larger than the Level A zone, it could become more challenging to detect low frequency species beyond 2,000 m, we accounted for the proportion of the DTH level A zone beyond 2,000 m when calculating Level A take for low frequency species.

- An individual animal can only be counted as taken once during a 24-hour period.
- For animals that may occur in groups, each individual in the group would be considered taken.

6.2.2 Ensonified Area

This section describes the operational and environmental parameters of each construction activity that allow NMFS to estimate the area ensonified above the acoustic behavioral thresholds, based on only a single construction activity occurring at a time, as proposed by USACE and USAF.

The sound field in the action area is the existing background noise plus additional construction noise from the proposed project. Marine mammals may be affected via sound generated by the primary components of the project (i.e., impact pile driving, DTH, vibratory pile installation and removal). NMFS used acoustic monitoring data from other locations to develop the source levels used to calculate distances to the Level A and Level B thresholds for different sizes of piles and installation/removal methods. The values used and the source from which they were derived are summarized in Table 10.

Transmission loss (TL) is the decrease in acoustic intensity as an acoustic pressure wave propagates out from a source. TL parameters vary with frequency, temperature, sea conditions, current, source and receiver depth, water depth, water chemistry, and bottom composition and topography. The general formula for underwater TL is:

$$TL = B * \text{Log10}\ (R1/R2), \text{ where}$$

TL = transmission loss in dB

B = transmission loss coefficient

R1 = the distance of the modeled SPL from the driven pile

R2 = the distance from the driven pile of the initial measurement

When site-specific transmission loss measurements are unavailable, NMFS recommended TL coefficient for most nearshore environments is the default practical spreading value of 15[10]. This value results in an expected propagation environment that would lie between spherical and cylindrical spreading loss conditions, which is the most appropriate assumption for the proposed activity.

[10] https://www.fisheries.noaa.gov/resource/data/multi-species-pile-driving-calculator-tool

Though significantly driven by received level, the onset of behavioral disturbance from anthropogenic noise exposure is also informed to varying degrees by other factors related to the source (e.g., frequency, predictability, duty cycle), the environment (e.g., bathymetry), and the receiving animals (hearing, motivation, experience, demography, behavioral context) and can be difficult to predict (Southall et al. 2007; Ellison et al. 2012). Based on the available science and the practical need to use a threshold that is both predictable and measurable for most activities, NMFS uses a generalized acoustic threshold based on received level to estimate the onset of behavioral harassment. NMFS predicts that marine mammals are likely to be behaviorally harassed in a manner we consider Level B harassment when exposed to underwater anthropogenic noise above received levels of 120 dB re 1 μPa rms for non-impulsive sources (e.g., vibratory pile-driving) and above 160 dB re 1 μPa rms for non-explosive, impulsive (e.g., impact pile-driving) or intermittent sources.

The proposed construction activity for the Eareckson Air Station fuel pier project includes the use of non-impulsive and impulsive sources, and therefore the 120 and 160 dB re 1 μPa rms thresholds for Level B behavioral harassment are applicable. Using a practical spreading loss model, resulting Level B thresholds are shown in Table 11.

To help implement the 2018 Technical Guidance (NMFS 2018b), NMFS developed a spreadsheet tool that incorporates the duration of an activity into the estimation of a distance to the Level A isopleth. This estimation can then be used in conjunction with marine mammal density or occurrence to help predict exposures. The isopleths may be overestimates and the resulting Level A harassment numbers almost certainly overestimate how many marine mammals actually experience PTS if they cross the Level A isopleth for fairly brief amounts of time; this is due to some of the assumptions included in the methods of these tools. Until more sophisticated modeling methods are widely available, these tools offer the best available way to conservatively predict appropriate isopleths. NMFS continues to quantitatively refine these tools, and will qualitatively address the output where appropriate. For stationary sources such as vibratory and impact pile driving, the NMFS User Spreadsheet predicts the distance at which a marine mammal would incur PTS if it remained at that distance for the duration of the activity.

Inputs used in the User Spreadsheet are shown in Table 10, and the resulting Level A isopleths are shown in Table 11**.**. Level A harassment thresholds for impulsive sound sources are defined for both cumulative SELs and peak sound pressure level (SPLPK), with the threshold that results in the largest modeled isopleth for each marine mammal hearing group used to establish the Level A harassment isopleth.

Table 10. NMFS User Spreadsheet Inputs during Vibratory and Impact Pile Installation, Drilling and Vibratory Pile Removal, and DTH for Calculating Level A and Level B isopleths[11].

Method	Pile Size Type	# of Piles[12]	Max # Piles per Day	Duration/ Impacts per Pile	Sound Source Level at 10 m	Reference
Impact	30-inch, permanent	44	4	30 min 900 strikes	191 dB rms 177 dB SEL 212 dB peak	(CalTrans 2020)
Vibratory	30-inch, Temporary Install/ Removal	60	4	15 min	166 dB rms	SE Alaska Analysis
DTH	30-inch, permanent	6	3	150 min	174 dB rms 164 dB SEL 194 dB peak	(Denes et al. 2019; Reyff and Heyvaert 2019; Reyff 2020)
Impact	42- inch, permanent	208	4	45 min 1,800 strikes	192 dB rms 179 dB SEL 213 dB peak	(CalTrans 2020)
Vibratory	42-inch piles, permanent	208	4	30 min	168.2 dB rms	(Austin et al 2016; Table 16)
DTH	42-inch Steel piles, permanent	208	3	180 min	174 dB rms 164 dB SEL 194 dB peak	(Denes et al. 2019; Reyff and Heyvaert 2019; Reyff 2020)

[11] All calculations use a transmission loss value of 15.

[12] In total, there are 208 42-inch permanent piles, 60 30-inch temporary piles.

Table 11. Level A and Level B Harassment Isopleths for Pile Driving Activities.

Method	Pile Size/ Type	Level A Harassment (m)			Level B Harassment (m)
		LF Cetaceans	MF Cetaceans	Otariids	
Impact	30-inch piles, permanent	933.8	33.2	36.4	1,166
Vibratory	30-inch piles, Temporary Install/ Removal	5	1.3	0.2	11,659
DTH	30-inch piles, permanent	2,257.6	80.3	88	39,811
Impact	42-inch piles, permanent	2,015.1	71.7	36.4	1,359
Vibratory	42-inch piles, permanent	32.7	2.9	1.4	16,343
DTH	42-inch piles, permanent	2,549.4	90.7	99.3	39,811

6.2.3 Marine Mammal Occurrence and Exposure Estimates

Scientific literature, monitoring reports from previous repairs on the Eareckson Air Station fuel pier, and stranding reports were referenced to estimate marine mammal occurrence and abundance in Alcan Harbor and the expected ensonified zone. Density estimates were not available for the project area. We used three data sets to inform the occurrence estimates. The datasets included: 1) The USACE Engineer Research Development Center conducted island-wide faunal surveys between 2016 and 2020 with additional Steller sea lion surveys in summer and fall 2021 (Neipert and Fischer, 2019a, 2019b, 2020 and 2021); 2) PSO monitoring reports from the 2021 emergency repair of the Eareckson Air Station fuel Pier which included 60 days of observations between June 24 and August 23, 2021; and 3) USACE Civil Works Environmental Resource Section conducted marine mammal surveys, specifically for this application's project during the months of May through October 2021 at Earckson Air Station, Shemya Island, Alaska. Below we outline how we estimated Level A and B take for species with and without observational data available.

6.2.3.1.1 Level B Take

The values used in these calculations and the estimated Level B takes are provided in Table 12. Observations were available for humpback whales and Steller sea lions while fin whales and sperm whales were not observed in the three datasets available. We therefore took two approaches.

1. Humpback whales and Steller sea lions: Level B take was estimated using the hourly group sighting estimate from the datasets multiplied by estimated group size from the literature (Table 12) multiplied by 624 hours (all pile driving activities).

2. Fin and sperm whales: Level B take was estimated based on monthly group sighting occurrence estimate multiplied by estimated group size from the literature (Table 12) multiplied by the number of construction months.

6.2.3.1.2 Level A Take

No take by Level A harassment of Western DPS Steller sea lions or sperm whales is proposed for authorization or expected to occur due to their large size and ability to be visibly detected in the project area if an animal should approach the Level A harassment zone.

Level A take is only requested for humpback and fin whales during the DTH pile driving. DTH pile driving is planned for 70 construction days (Table 1). For 42-inch DTH pile driving for the Level A zone is larger than the Level B zone and therefore take within the larger Level A harassment zone could be in the form of Level A or Level B harassment. We used the same calculations as used for the Level B harassment discussed above. We then estimated the proportion of the Level A harassment zone (0.33) beyond 2,000 m, as there is a potential of a humpback or fin whale entering the Level A harassment zone before being able to shut down (beyond 2,000 m).

Table 12. Exposure estimates for ESA-listed marine mammal species from Eareckson Air Station fuel pier repair and replacement activities. Exposure estimates are rounded to the nearest whole number.

Species	**DPS**	**Hourly Group Occurrence Estimate**	**Estimated Group Size**	**Estimated Exposures**	
				Level A	**Level B**
Humpback whale	Hawaii[13]	0.07	2[14]	26	113
	Mexico			2	9
	Western North Pacific			1	3
Fin whale		0.002	1 group of 8[15] every 2 months	3	18
Sperm whale		0.006	2 groups of 4[12] every month	0	40
Steller sea lion	Western	0.09	1	0	99

[13] Hawaii DPS humpback whale is not listed under the ESA but take is authorized in the IHA under the MMPA.

[14] Muto et al. 2021. Alaska marine mammal stock assessments, 2020. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center, Seattle, WA, July 2021. NOAA Technical Memorandum NMFS-AFSC-421, 398 p.

[15] https://www.adfg.alaska.gov/static/education/wns/fin_whale.pdf

6.2.3.1.3 Humpback whales

NMFS expects it is likely that up to 154 humpback whales may occur in the ensonified area during pile driving activities. Here we assume that if an animal is present in the ensonified area, it will be exposed to acoustic harassment, acknowledging that not all animals within the action area will be so exposed. Of the 154 humpback whales that may occur in the ensonified area during pile driving activities, 29 Level A takes are authorized should a humpback whale go undetected by a protected species observer and later be observed within the Level A harassment zone. The 29 takes by Level A harassment is proposed or expected to occur as the largest Level A isopleth calculated was 2,600 m during DTH driving of the 30-inch and 42-inch piles. TTS and PTS may occur if a listed species is within the Level B or Level A harassment zone, respectively; however, the severity of TTS and PTS depends on the duration, frequency, sound pressure, and rise time of a sound (Finneran and Schlundt 2013). The mitigation measures (including shutdowns), make it less likely that an animal would accumulate enough exposure for PTS to occur.

Within the project area three humpback whale DPSs are likely to occur with varying probability including the non-listed Hawaii DPS, the threatened Mexico DPS, and the endangered North West Pacific DPS (Wade 2021). Any humpback whale observed in the project area has 7 percent probability of being from the Mexico DPS and a 2 percent being from the Western North Pacific DPS. We applied these probabilities to the total Level A and B takes to estimate the number of takes for each listed DPS (Table 12). NMFS expects it is likely that up to 11 humpback whales from the Mexico DPS and four humpback whales from the Western North Pacific DPS may occur in the ensonified area during pile driving activities.

6.2.3.1.4 Fin Whales

NMFS expects it is likely that up to 21 fin whales may occur in the ensonified area during pile driving activities. Here we assume that if an animal is present in the ensonified area, it will be exposed to acoustic harassment, acknowledging that not all animals within the action area will be so exposed. Of the 21 fin whales that may occur in the ensonified area during pile driving activities, 3 Level A takes are authorized should a fin whale go undetected (Table 12) by a protected species observer and later be observed within the Level A harassment zone. The 3 takes by Level A harassment is proposed or expected to occur as the largest Level A isopleth calculated was 2,600 m during DTH driving of the 30-inch and 42-inch piles. TTS and PTS may occur if a listed species is within the Level B or Level A harassment zone, respectively; however, the severity of TTS and PTS depends on the duration, frequency, sound pressure, and rise time of a sound (Finneran and Schlundt 2013). The mitigation measures (including shutdowns), make it less likely that an animal would accumulate enough exposure for PTS to occur.

6.2.3.1.5 Steller Sea Lions

NMFS expects that it is likely that up to 99 Western DPS Steller sea lions may occur in the ensonified area during pile driving activities. Here we assume that if an animal is present in the ensonified area, it will be exposed to acoustic harassment, acknowledging that not all animals within the action area will be so exposed. Should a Steller sea lion go undetected, initially, by a protected species observer and later be observed within the Level A harassment zone, the mitigation measures (including shutdowns), make it unlikely that an animal would accumulate enough exposure for PTS to occur. Therefore, no take by Level A harassment is proposed or expected to occur as the largest Level A isopleth calculated was 99.3 m during DTH driving of the 42-inch piles.

6.2.3.1.6 Sperm Whales

NMFS expects that it is likely that up to 40 sperm whales may occur in the ensonified area during pile driving activities. Here we assume that if an animal is present in the ensonified area, it will be exposed to acoustic harassment, acknowledging that not all animals within the action area will be so exposed. Should a sperm whale go undetected, initially, by a protected species observer and later be observed within the Level A harassment zone, the mitigation measures (including shutdowns), make it unlikely that an animal would accumulate enough exposure for PTS to occur. Therefore, no take by Level A harassment is proposed or expected to occur as the largest Level A isopleth calculated was 90.7 m during DTH driving of the 42-inch piles.

6.3 Response Analysis

As discussed in the *Approach to the Assessment* section of this opinion, response analyses determine how listed species / critical habitats are likely to respond after being exposed to an action's effects on the environment or directly on listed species themselves. Our assessments try to detect the probability of lethal responses, physical damage, physiological responses (particular stress responses), behavioral responses, and social responses that might result in reducing the fitness of listed individuals. Ideally, our response analyses consider and weigh evidence of adverse consequences, beneficial consequences, or the absence of such consequences.

Loud underwater noise can result in physical effects on the marine environment that can affect marine organisms. Possible responses by Mexico DPS and Western North Pacific DPS humpback whales, fin whales, sperm whales, and Western DPS Steller sea lions to the impulsive and non-impulsive sound produced by pile installation and removal include:

- Physical Response
  - Temporary or permanent hearing impairment (threshold shifts)
  - Non-auditory physiological effects
- Behavioral responses
  - Auditory interference (masking)
  - Tolerance or habituation
  - Change in dive, respiration, or feeding behavior
  - Change in vocalizations
  - Avoidance or displacement
  - Vigilance
  - Startle or fleeing/flight

6.3.1 Response to sound from Pile Driving activities

As described in the *Exposure Analysis*, Western North Pacific DPS humpback whales, Mexico DPS humpback whales, fin whales, sperm whales, and Western DPS Steller sea lions are expected to occur in the action area and to overlap with noise associated with pile installation and removal activities. We assume that some individuals are likely to be exposed and respond to these impulsive and non-impulsive noise sources.

The expected level A and B take for Mexico DPS humpback whales, Western North Pacific DPS humpback whales, fin whales, sperm whales, and Western DPS Steller sea lions are presented in Table 12. All level B instances of take are expected to occur at received levels greater than 120 dB and 160 dB for non-impulsive and impulsive noise sources, respectively.

The introduction of anthropogenic noise into the aquatic environment from pile driving activities is the primary means by which marine mammals may be harassed from project activities covered in this opinion. In general, animals exposed to natural or anthropogenic sound may experience physical and physiological effects, ranging in magnitude from none to severe (Southall et al. 2007). Exposure to anthropogenic noise can also lead to non-observable physiological responses such an increase in stress hormones. Additional noise in a marine mammal's habitat can mask acoustic cues used by marine mammals to carry out daily functions such as communication and predator and prey detection.

Exposure to pile driving and removal noise has the potential to result in auditory threshold shifts and behavioral reactions (e.g., avoidance, temporary cessation of foraging and vocalizing, changes in dive behavior). The effects of pile driving and removal noise on marine mammals are dependent on several factors, including, but not limited to, sound type (e.g., impulsive vs. non-impulsive), the species, age and sex class (e.g., adult male vs. cow with calf), duration of exposure, the distance between the pile and the animal, received levels, behavior at time of exposure, and previous history with exposure (Wartzok et al. 2003; Southall et al. 2007). Here we discuss physical auditory (threshold shifts) and non-auditory effects followed by behavioral effects.

6.3.1.1 Threshold Shifts

NMFS defines a noise-induced threshold shift (TS) as a change, usually an increase, in the threshold of audibility at a specified frequency or portion of an individual's hearing range above a previously established reference level (NMFS 2018b). In other words, a threshold shift is a hearing impairment, and may be temporary (such as ringing in your ears after a loud rock concert) or permanent (such as the loss of the ability to hear certain frequencies or partial or complete deafness). There are numerous factors to consider when examining the consequence of TS, including: the signal’s temporal pattern (e.g., impulsive or non-impulsive); likelihood an individual would be exposed for a long enough duration or to a high enough level to induce a TS; the magnitude of the TS; time to recovery; the frequency range of the exposure (i.e., spectral content); the hearing and vocalization frequency range of the exposed species relative to the signal's frequency spectrum (i.e., how and animal uses sound within the frequency band of the signal; Kastelein et al. 2014); and, the overlap between the animal and the sound (e.g., spatial, temporal, and spectral; NMFS 2018b). The amount of threshold shift is customarily expressed in dB.

Temporary Threshold Shift

Temporary threshold shift (TTS) is the mildest form of hearing impairment that can occur during exposure to a strong sound (Kryter 1970). While experiencing TTS, the hearing threshold rises, and a sound must be stronger in order to be heard. In terrestrial mammals, TTS can last from minutes to days (in cases of strong TTS). For sound exposures at or somewhat above the TTS threshold, hearing sensitivity in both terrestrial and marine mammals recovers rapidly after exposure to the sound ends. Few data exist on the sound levels and durations necessary to elicit mild TTS in marine mammals, and none of the published data describe TTS elicited by exposure to multiple pulses of sound. Available data on TTS in marine mammals are summarized in (Southall et al. 2007).

Although some Level B exposures may occur during the course of the proposed action, not all instances of Level B take will result in TTS because the estimated noise thresholds for the onset of TTS are conservative. If TTS does occur, it is expected to be mild and temporary and not likely to affect the long term fitness of the affected individuals.

Permanent Threshold Shift

When permanent threshold shift (PTS) occurs, there is physical damage to the sound receptors in the ear. The animal will have an impaired ability to hear sounds in specific frequency ranges, and there can be total or partial deafness in severe cases (Kryter 1985). There is no specific evidence that exposure to pulses of sound can cause PTS in any marine mammal. However, given the possibility that mammals close to a sound source can incur TTS, it is possible that some individuals will incur PTS. Single or occasional occurrences of mild TTS are not indicative of permanent auditory damage, but repeated or (in some cases) single exposures to a level well above that causing the onset of TTS might elicit PTS.

Relationships between TTS and PTS thresholds have not been studied in marine mammals but are assumed to be similar to those in humans and other terrestrial mammals, based on anatomical similarities. PTS might occur at a received sound level at least several decibels above that which induces mild TTS, if the animal were exposed to strong sound pulses with rapid rise time. For non-impulsive exposures (i.e., vibratory pile driving), a variety of terrestrial and marine mammal data sources indicate that threshold shift up to 40 to 50 dB may be induced without PTS, and that 40 dB is a conservative upper limit for threshold shift to prevent PTS. An exposure causing 40 dB of TTS is, therefore, considered equivalent to PTS onset (NMFS 2018b).

The shutdown zones to be implemented are larger than the calculated isopleths to reduce the potential of a marine mammal entering the zone before it is observed, however there is a potential that a humpback or fin whale could enter the shutdown zones greater than 2,000 m before shutdown mitigations can be completed which could expose these species to noise levels that could cause PTS or other Level A disturbance.

6.3.1.2 Non-auditory Physiological Effects

Non-auditory physiological effects or injuries that theoretically might occur in marine mammals exposed to strong underwater sound include stress, neurological effects, internal bubble formation, resonance effects, and other types of organ or tissue damage (Cox et al. 2006; Southall et al. 2007). Studies examining such effects are limited. In general, little is known about the potential for pile driving activities to cause auditory impairment or other physical effects in marine mammals. Available data suggest that such effects, if they occur at all, would presumably be limited to short distances from the sound source and to activities that extend over a prolonged period of time. The available data do not allow identification of a specific exposure level above which non-auditory effects can be expected (Southall et al. 2007) or any meaningful quantitative predictions of the numbers (if any) of marine mammals that might be affected in those ways. Marine mammals that show behavioral avoidance of pile driving are especially unlikely to incur auditory impairment or non-auditory physical effects.

An animal's perception of a threat may be sufficient to trigger stress responses consisting of some combination of behavioral responses, autonomic nervous system responses, neuroendocrine responses, or immune responses (Moberg 2000). In many cases, an animal's first, and sometimes most economical (in terms of energetic costs), response is behavioral avoidance of the potential stressor. Autonomic nervous system responses to stress typically involve changes in heart rate, blood pressure, and gastrointestinal activity. These responses have a relatively short duration and may or may not have a significant long-term effect on an animal's fitness.

The primary distinction between stress (which is adaptive and does not normally place an animal at risk) and "distress" is the cost of the response. During a stress response, an animal uses glycogen stores that can be quickly replenished once the stress is alleviated. In such circumstances, the cost of the stress response would not pose serious fitness consequences. However, when an animal does not have sufficient energy reserves to satisfy the energetic costs of a stress response, energy resources must be diverted from other functions. This state of distress will last until the animal replenishes its energetic reserves sufficient to restore normal function.

Relationships between these physiological mechanisms, animal behavior, and the costs of stress responses are well-studied through controlled experiments and for both laboratory and free-ranging animals (Jessop et al. 2003; Lankford et al. 2005; Crespi et al. 2013). Stress responses due to exposure to anthropogenic sounds or other stressors and their effects on marine mammals have also been reviewed (Fair and Becker 2000; Romano et al. 2002) and, more rarely, studied in wild populations (Romano et al. 2002). For example, noise reduction from reduced ship traffic in the Bay of Fundy following September 11, 2001 was linked to a significant decline in fecal stress hormones in North Atlantic right whales, suggesting that chronic exposure to increased noise levels, although not acutely injurious, can produce stress (Rolland et al. 2012). These stress hormones returned to their previous level within 24 hours after the resumption of shipping traffic. Exposure to loud noise can also adversely affect reproductive and metabolic physiology (Kight and Swaddle 2011). In a variety of factors, including behavioral and physiological responses, females appear to be more sensitive or respond more strongly than males (Kight and Swaddle 2011).

These and other studies lead to a reasonable expectation that some marine mammals will experience physiological stress responses upon exposure to acoustic stressors and that it is possible that some of these would be classified as “distress”. In addition, any animal experiencing TTS would likely also experience stress responses (NRC 2003).

The estimated 196 days of pile driving activities will be staggered between the months of October and March, and will occur for a limited amount of time on each day of in-water work, thus limiting the potential for chronic stress. The mitigation measures in place will prevent exposure of listed species to sound at a level leading to take during the majority of pile driving activities. However, Level A and B is authorized for ESA listed species including the Mexico DPS and Western North Pacific DPS humpback whales and fin whale while Level B take is authorized for ESA listed species including sperm whale and Steller sea lion during the 70 days of DTH drilling. Marine mammals that show behavioral avoidance of pile driving are especially unlikely to incur auditory impairment or non-auditory physical effects because they will be limiting the duration of their exposure.

6.3.1.3 Behavioral Disturbance Reactions

Behavioral responses are influenced by an animal’s assessment of whether a potential stressor poses a threat or risk. Behavioral responses may include: changing durations of surfacing and dives, number of blows per surfacing, or changing direction and/or speed; reduced/increased vocal activities; changing/cessation of certain behavioral activities (such as socializing or feeding); visible startle response or aggressive behavior (such as tail/fluke slapping or jaw clapping); avoidance of areas where sound sources are located; and/or, flight responses.

Disturbance includes a variety of effects, including subtle changes in behavior, more conspicuous changes in activities, and displacement. Behavioral responses to sound are highly variable and context-specific, and reactions, if any, depend on species, state of maturity, experience, current activity, reproductive state, auditory sensitivity, time of day, and many other factors (Southall et al. 2007).

Habituation can occur when an animal's response to a stimulus wanes with repeated exposure, usually in the absence of unpleasant associated events (Wartzok et al. 2003). Animals are most likely to habituate to sounds that are predictable and unvarying. The opposite process is sensitization, when an unpleasant experience leads to subsequent responses, often in the form of avoidance, at a lower level of exposure. Behavioral state may affect the type of response as well. For example, animals that are resting may show greater behavioral change in response to disturbing sound levels than animals that are highly motivated to remain in an area for feeding (Richardson et al. 1995; NRC 2003; Wartzok et al. 2003).

Controlled experiments with captive marine mammals showed pronounced behavioral reactions, including avoidance of loud sound sources (Ridgway et al. 1997; Finneran et al. 2003). Observed responses of wild marine mammals to loud pulsed sound sources (typically seismic guns or acoustic harassment devices, but also including pile driving) have been varied but often consist of avoidance behavior or other behavioral changes, suggesting discomfort (Morton and Symonds 2002; Wartzok et al. 2003; Thorson and Reyff 2006; Nowacek et al. 2007). Responses to non-impulsive sound, such as vibratory pile installation, have not been documented as fully as responses to pulsed sounds.

The biological significance of many of these behavioral disturbances is difficult to predict, especially if the detected disturbances appear minor. However, the consequences of behavioral modification could be biologically significant if the change affects growth, survival, or fitness. Significant behavioral modifications that could potentially lead to effects on growth, survival, or fitness include:

- Drastic changes in diving/surfacing patterns;
- Longer-term habitat abandonment due to loss of desirable acoustic environment;
- Longer-term cessation of feeding or social interaction; and,
- Cow/calf separation.

The onset of behavioral disturbance from anthropogenic sound depends on both external factors (characteristics of sound sources and their paths) and the specific characteristics of the receiving animals (hearing, motivation, experience, demography), and is difficult to predict (Southall et al. 2007).

6.3.1.4 Auditory Masking

Natural and artificial sounds can disrupt behavior by masking, or interfering with, a marine mammal's ability to hear other sounds. Masking occurs when the receipt of a sound is interfered with by another coincident sound at similar frequencies and at similar or higher levels. Chronic exposure to excessive, though not high-intensity, sound could cause masking at particular frequencies for marine mammals that utilize sound for vital biological functions. Masking can interfere with detection of acoustic signals such as communication calls, echolocation sounds, and environmental sounds important to marine mammals. Therefore, under certain circumstances, marine mammals whose acoustical sensors or environment are being severely masked could also be impaired from maximizing their performance or fitness in survival and reproduction. If the coincident (masking) sound were anthropogenic, it could be potentially harassing if it disrupted hearing-related behavior.

It is important to distinguish TTS and PTS, which persist after the sound exposure, from masking, which occurs only during the sound exposure. Because masking (without resulting in threshold shift) is not associated with abnormal physiological function, it is not considered a physiological effect, but rather a potential behavioral effect.

Masking occurs at the frequency band the animals utilize, so the frequency range of the potentially masking sound is important in determining any potential behavioral impacts. Lower frequency man-made sounds are more likely to affect detection of communication calls and other potentially important natural sounds such as surf and prey sound. Anthropogenic sounds may also affect communication signals when both occur in the same sound band and thus reduce the communication space of animals (Clark et al. 2009), and cause increased stress levels (Foote et al. 2004; Holt et al. 2009).

Masking has the potential to affect species at the population or community levels as well as at individual levels. Masking affects both senders and receivers of the signals and can potentially have long-term chronic effects on marine mammal species and populations. Recent research suggests that low frequency ambient sound levels have increased by as much as 20 dB (more than a three-fold increase in terms of SPL) in the world's ocean from pre-industrial periods, and that most of these increases are from distant shipping (Hildebrand 2009). All anthropogenic sound sources, such as those from vessel traffic, pile driving, and dredging activities, contribute to the elevated ambient sound levels, thus intensifying masking.

Noise from pile driving activities is relatively short-term. It is possible that pile driving noise or vessel noise resulting from this proposed action may mask acoustic signals important to Mexico DPS and Western North Pacific DPS humpback whales and Western DPS Steller sea lions. However, the limited affected area and infrequent occurrence of humpback whales in the action area would result in insignificant impacts from masking.

Masking is likely less of a concern for Steller sea lions, which vocalize both in air and water and do not echolocate or communicate with complex underwater “songs”. Any masking event that could possibly rise to MMPA Level B harassment of sea lions would occur concurrently within the zones of behavioral harassment already estimated for pile driving activities, which have already been taken into account in the Exposure Analysis.

6.3.2 Response Analysis Summary

Probable responses of humpback whales, fin whales, sperm whales, and Steller sea lions to pile removal, installation, and DTH include TTS/PTS, increased stress, and/or short-term behavioral disturbance reactions such as changes in activity and vocalizations, masking, avoidance or displacement, or tolerance. These reactions and behavioral changes are expected to be largely temporary and subside quickly when the exposure ceases, though a small number of humpback whales and fin whales may experience PTS. The mitigation measures (including shutdowns), make it less likely that an animal would accumulate enough exposure for PTS to occur. The primary mechanism by which behavioral changes may affect the fitness of individual animals is through the animals’ energy budget, time budget, or both (the two are related because foraging requires time). We expect most animals would leave the area during pile driving activities if they were disturbed. The individual and cumulative energy costs of the behavioral responses we have discussed are not likely to increase the energy budgets of humpback whales, fin whales, sperm whales, and Steller sea lions, and their probable exposure to sound sources are not likely to reduce their fitness.

7 CUMULATIVE EFFECTS

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area (50 CFR § 402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

We searched for information on non-Federal actions reasonably certain to occur in the action area. We did not find any information about non-Federal actions other than what has already been described in the Environmental Baseline (Section 5), however we go into further detail regarding the future activities for vessel traffic, fisheries, and pollution below.

Some continuing non-Federal activities are reasonably certain to contribute to climate change within the action area. However, it is difficult if not impossible to distinguish between the actions area's future environmental conditions cause by global climate change that are properly part of the environmental baseline versus cumulative effects. Therefore, all relevant future climate-related environmental condition in the action area are described in the Statues of the Species and Environmental Baseline (Sections 4 and 5).

7.1.1 Vessel Traffic and Shipping

Vessel traffic, including shipping, is expected to continue in along the Aleutians, Gulf of Alaska, and Southeast Alaska. As a result, there will be continued and similar risk to marine mammals of ship strikes, exposure to vessel noise and presence, and small spills.

7.1.2 Fisheries

Fishing, a major industry in Alaska, is expected to continue at a similar rate throughout the action area. As a result, there will be continued risk to marine mammals of prey competition, ship strikes, harassment, and entanglement in fishing gear. Further, federal fisheries are subject to ESA consultation and major changes to these fisheries in the future would undergo Section 7 consultation.

7.2.3 Pollution, Trash, and Debris

Hazardous materials are released into Alaska waters from vessels, aircraft, and other anthropogenthic runoff. Oil spills could occur from vessels traveling within the action area. In addition, oil spilled from outside the action area could migrate into the action area. There are many nonpoint sources of pollution within the action area. The EPA and the ADEC will continue to regulate the amount of pollutants that enter Alaska waters from point and nonpoint sources through NPDES/APDES permits. As a result, permittees will be required to renew their permits, verify they meet permit standards, and potentially upgrade facilities. However, pollutants of emerging concern such as flame retardants and estrogen mimics are unregulated and are not monitored.

Exposure to non-biodegradable marine debris, specifically to debris that can cause entanglement, remains an unquantifiable risk. Discarded or lost lines from vessels are expected to be a continued entanglement hazard for listed marine mammal species.

8 INTEGRATION AND SYNTHESIS

The Integration and Synthesis section is the final step of NMFS's assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action (Section 6) to the environmental baseline (Section 5) and the cumulative effects (Section 7) to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) result in appreciable reductions in the likelihood of both the survival or recovery of the species in the wild by reducing its numbers, reproduction, or distribution; or (2) result in the adverse modification or destruction of critical habitat as measured through direct or indirect alterations that appreciably diminish the value of designated critical habitat as a whole for the conservation of the species. These assessments are made in full consideration of the status of the species (Section 4).

As we discussed in the *Approach to the Assessment* section of this opinion, we begin our risk analyses by asking whether the probable physical, physiological, behavioral, or social responses of endangered or threatened species are likely to reduce the fitness of endangered or threatened individuals or the growth, annual survival or reproductive success, or lifetime reproductive success of those individuals.

As part of our risk analyses, we identified and addressed all potential stressors and considered all consequences of exposing listed species to all the stressors associated with the proposed action, individually and cumulatively, given that the individuals in the action area for this consultation are also exposed to other stressors in the action area and elsewhere in their geographic range.

8.1 Humpback and Fin Whale Risk Analysis

Based on the results of the *Exposure Analysis*, we expect a maximum of 154 humpback whales may be exposed to noise from pile driving; seven percent, or a maximum of 11 of these whales, are expected to be from the Mexico DPS and two percent, or a maximum of four of these whales, are expected to be from the Western North Pacific DPS. Based on the results of the exposure analysis, we expect a maximum of 21 fin whales may be exposed to noise from pile driving.

Exposure to project-related vessel noise and risk of vessel strike may occur, but adverse effects from vessel disturbance and noise are likely to be insignificant due to the small marginal increase in such activities relative to the environmental baseline, the transitory nature of project-related vessel traffic, and the likely habituation of marine mammals that frequent this moderately trafficked area. Adverse effects from vessel strikes are considered extremely unlikely because of the few additional vessels introduced during the action, slow speeds at which these vessels will operate, and existing regulations regarding approaching whales. Further there is no projected increase of future vessel traffic associated with repairs to the fuel Pier.

Disturbance to seafloor, habitat, and prey resources are not expected to adversely affect humpback whales or fin whales because these disturbances are temporary, and the action area is not important habitat to humpback whales or fin whales for foraging, migrating, breeding, or other essential life functions. Mitigation measures and adherence to Clean Water Act regulations are expected to minimize the risk of exposure of humpback whales and fin whales to the potential introduction of pollutants into the action area.

The stressor likely to adversely affect fin whales and humpbacks whales is noise from to pile driving activities. The most likely responses from humpback and fin whales to noise from pile driving activities include brief startle reactions or short-term behavioral modification. These reactions are expected to subside quickly when the exposure to pile driving noise ceases. The primary mechanism by which the behavioral changes we have discussed affect the fitness of individual animals is through the animals' energy and time budget. Large whales such as fin and humpbacks have an ability to survive for months on stored energy during migration and while in their wintering areas, and their feeding patterns allow them to acquire energy at high rates. The individual and cumulative energy costs of the behavioral responses we have discussed are not likely to reduce the energy budgets of humpback and fin whales, and their probable exposure to project-related noise is not likely to reduce their fitness.

As mentioned in the *Environmental Baseline* section, fin whales, Western North Pacific DPS humpback whales and Mexico DPS humpback whales, may be impacted by a number of anthropogenic activities present in the project area. The high degree of vessel activities along the Aleutian Islands including shipping and fisheries activities, pollution including marine debris and discharge and other anthropogenic threats. These threats include sound pollution, water pollution, prey reduction, fisheries, direct mortalities, and research, in addition to factors operating on a larger scale such as predation, disease, and climate change. As discussed in the *Cumulative Effects* section, non-Federal actions are reasonably certain to occur in the action area and include vessel traffic including shipping and fisheries, pollution and debris.

The implementation of mitigation measures (including shutdown zones) to reduce exposure to high levels of sound decrease the likelihood of a behavioral response that may affect vital functions, or cause TTS or PTS of fin whales and humpback whales. Based on the best information currently available, the proposed action is not expected to appreciably reduce the likelihood of survival and recovery of fin whales, Mexico DPS humpback whales or Western North Pacific DPS humpback whales. Therefore, the exposures from this action are not likely to reduce the abundance, reproduction rates, or growth rates (or significantly increase variance in one or more of these rates) of the fin whale or the humpback whale populations in the action area.

8.2 Sperm Whale Risk Analysis

Based on the results of the exposure analysis, we expect a maximum of 40 sperm whales may be exposed to noise from pile driving. Exposure to project-related vessel noise and risk of vessel strike may occur, but adverse effects from vessel disturbance and noise are likely to be insignificant due to the small marginal increase in such activities relative to the environmental baseline, the transitory nature of project-related vessel traffic, and the likely habituation of marine mammals that frequent this moderately trafficked area. Adverse effects from vessel strikes are considered extremely unlikely because of the few additional vessels introduced during the action, slow speeds at which these vessels will operate, and existing regulations regarding approaching whales. There is no projected increase of future vessel traffic associated with repairs to the fuel Pier.

Exposure to non-biodegradable marine debris, specifically to debris that can cause entanglement, remains an unquantifiable risk, but associated effects from this project would be minimal. Best practices regarding waste management (cutting loops prior to disposal) will further reduce the impact of debris on sperm whales. Any increases in turbidity or seafloor disturbance would be temporary, localized, and minimal. Based on the localized nature of small oil spills, the relatively rapid weathering expected, and the safeguards in place to avoid and minimize oil spills, we conclude that the probability of the proposed action causing a small oil spill and exposing sperm is extremely small, and thus the effects are considered highly unlikely to occur.

As mentioned in the *Environmental Baseline* section, sperm whales may be impacted by a number of anthropogenic activities present in the project area. The high degree of vessel activities along the Aleutian Islands including shipping and fisheries activities, pollution including marine debris and discharge and other anthropogenic threats. These threats include sound pollution, water pollution, prey reduction, fisheries, direct mortalities, and research, in addition to factors operating on a larger scale such as predation, disease, and climate change. As discussed in the *Cumulative Effects* section, non-Federal actions are reasonably certain to occur in the action area and include vessel traffic including shipping and fisheries, pollution and debris.

The stressor likely to adversely affect sperm whales is noise from to pile driving activities. The most likely responses from sperm whales to noise from pile driving activities include brief startle reactions or short-term behavioral modification. These reactions are expected to subside quickly when the exposure to pile driving noise ceases. The primary mechanism by which the behavioral changes we have discussed affect the fitness of individual animals is through the animals' energy and time budget. The individual and cumulative energy costs of the behavioral responses we have discussed are not likely to reduce the energy budgets of sperm whales, and their probable exposure to project-related noise is not likely to reduce their fitness.

The implementation of mitigation measures (including shutdown zones) to reduce exposure to high levels of sound decrease the likelihood of a behavioral response that may affect vital functions, or cause TTS of sperm whales. Based on the best information currently available, the proposed action is not expected to appreciably reduce the likelihood of survival or recovery of sperm whales. Therefore, the exposures from this action are not likely to reduce the abundance, reproduction rates, or growth rates (or significantly increase variance in one or more of these rates) of the sperm whale population.

8.3 Steller Sea Lion Risk Analysis

Based on the results of the exposure analysis, we expect that 99 Western DPS Steller sea lions may be exposed to pile removal and installation at the Fuel Pier on Shemya Island. This estimate represents the maximum number of takes that may be expected to occur, but not necessarily the number of individuals taken, as a single individual may be taken multiple times over the course of the proposed action. Sound from pile removal and installation activities is likely to cause some individual Steller sea lions to experience changes in their behavioral states that might have adverse consequences (Frid and Dill 2002). However, these responses are not likely to alter the physiology, behavioral ecology, or social dynamics of individual Steller sea lions in ways or to a degree that would reduce their fitness.

As mentioned in the *Environmental Baseline* section, Western DPS Steller sea lions may be impacted by a number of anthropogenic activities present in the project area. The high degree of vessel activities along the Aleutian Islands including fisheries activities, the potential pollution including marine debris and discharge. Additional anthropogenic threats include sound pollution, water pollution, prey reduction, fisheries, direct mortalities, and research, in addition to factors operating on a larger scale such as predation, disease, and climate change. Further, Steller sea lions face the risk of natural catastrophes, particularly when hauled out on land, including volcanic eruption and landslides. As discussed in the *Cumulative Effects section*, non-Federal actions are reasonably certain to occur in the action area and include vessel traffic including shipping and fisheries, pollution and debris. Steller sea lions may be affected by multiple threats at any given time, compounding the impacts of the individual threats.

Commercial fishing likely affects prey availability throughout much of the WDPS's range, and causes a small number of direct mortalities each year. Predation has been considered a threat to this DPS, and may remain so in the future. Subsistence hunting occurs at fairly low levels for this DPS, especially in the Western Aleutian Islands where the human population is very small and in very few and discrete areas. Illegal shooting is also a continuing threat, but the number of illegally shot sea lions found in the region to date is relatively low and has not precluded or measurably delayed recovery of the species.

Exposure to non-biodegradable marine debris, specifically to debris that can cause entanglement, remains an unquantifiable risk, but associated effects from this project would be minimal. Best practices regarding waste management (cutting loops prior to disposal) will further reduce the impact of debris on Steller sea lions. Any increases in turbidity or seafloor disturbance would be temporary, localized, and minimal. Based on the localized nature of small oil spills, the relatively rapid weathering expected, and the safeguards in place to avoid and minimize oil spills, we conclude that the probability of the proposed action causing a small oil spill and exposing Western DPS Steller sea lions is extremely small, and thus the effects are considered highly unlikely to occur.

Exposure to vessel noise and presence, marine debris, seafloor disturbance and turbidity, and small oil spills may occur, but such exposure would have a very small impact, and we conclude that these stressors are not likely to result in take of Steller sea lions. The increase in ship traffic due to the project specific vessels is unlikely to result in a vessel strike. Project vessels will be traveling at slow speeds, the increase in vessel traffic will be small, and vessel strike is not considered a significant concern for Steller sea lions (only three reports of potential vessel strikes involving Steller sea lions have been reported in Alaska).

It is difficult to estimate the behavioral responses, if any, that WDPS Steller sea lions may exhibit to underwater sounds generated by project activities. Though the sounds produced during project activities may not greatly exceed levels that Steller sea lions already experience in the Western Aleutian Islands, the sources proposed for use in this project are not among sounds to which they are commonly exposed. In response to project-related sounds, some Steller sea lions may move out of the area or change from one behavioral state to another, while other Steller sea lions may exhibit no apparent behavioral changes at all.

The probable responses (i.e., tolerance, avoidance, short-term masking, and short-term vigilance behavior) to close approaches by vessel operations and their probable exposure to noise from pile driving are not likely to reduce the current or expected future reproductive success or reduce the rates at which Steller sea lions grow, mature, or become reproductively active. Therefore, these exposures are not likely to reduce the abundance, reproduction rates, or survival and growth rates of the population those individuals represent.

The stressor likely to adversely affect Steller sea lions is noise from to pile driving activities. It is difficult to estimate the behavioral responses, if any, that Western DPS Steller sea lions in the action area may exhibit to underwater sounds generated by project activities. Though the sounds produced during project activities may not greatly exceed levels that Steller sea lions already experience in the area, the sources proposed for use in this project are not among sounds to which they are commonly exposed. In response to project-related sounds, some Steller sea lions may move out of the area or change from one behavioral state to another, while other Steller sea lions may exhibit no apparent behavioral changes at all.

The primary mechanism by which the behavioral changes may affect the fitness of individual animals is through the animal's energy budget, time budget, or both. Most adult Steller sea lions occupy rookeries during the pupping and breeding season, which extends from late May to early July (NMFS 2008). The closest rookeries are on Agattu Island and is approximately 50 km southwest of the proposed construction site. There are three major haulouts (Shemya, Nizki, and Alaid) are located on or near Shemya Island. The individual and cumulative energy costs of the behavioral responses we have discussed are not likely to measurably reduce the energy budgets of Steller sea lions in the action area.

The implementation of mitigation measures (including shutdown zones) to reduce exposure to high levels of sound decrease the likelihood of a behavioral response that may affect vital functions, or cause TTS or PTS of Steller sea lions. Based on the best information currently available, the proposed action is not expected to appreciably reduce the likelihood of survival or recovery of Western DPS Steller sea lions.

As a result of all of the above factors, this project is not likely to appreciably reduce Western DPS Steller sea lions' likelihood of surviving or recovering in the wild. Additionally, the project is not likely to measurably impact Steller sea lion critical habitat.

9 CONCLUSION

After reviewing the current status of the listed species, the environmental baseline within the action area, the effects of the proposed action, and cumulative effects, it is NMFS's biological opinion that the proposed action is not likely to jeopardize the continued existence of the Mexico DPS humpback whale, Western North Pacific DPS humpback whale, fin whale, sperm whale, or Western DPS Steller sea lion. NMFS also concludes that the proposed action is not likely to adversely affect the blue whale, Central America DPS humpback whale, North Pacific right whale, sei whale, Western North Pacific DPS gray whales, Southern Resident DPS killer whale, Cook Inlet beluga whale, or the proposed threatened sunflower sea star or to destroy or adversely modify designated critical habitat for the Mexico DPS humpback whale, WNP DPS humpback whale, Central America DPS humpback whale, North Pacific right whale, Southern Resident killer whale, Cook Inlet beluga whale, or Steller sea lion. No critical habitat has been designated or proposed for the blue whale, fin whale, sei whale, sperm whale, Western North Pacific DPS gray whales or the proposed sunflower sea star, therefore, none will be affected.

10 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA prohibits the take of endangered species unless there is a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct (16 U.S.C. § 1532(19)). "Incidental take" is defined as take that results from, but is not the purpose of, the carrying out of an otherwise lawful activity conducted by the action agency or applicant (50 CFR § 402.02). Based on NMFS guidance, the term "harass" under the ESA means to: "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering" (Wieting 2016). The MMPA defines "harassment" as: any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment] (16 U.S.C. § 1362(18)(A)(i) and (ii)). For this consultation, the USACE, USAF, and NMFS Permits Division anticipates that take will be by Level B and Level A harassment.

The ESA does not prohibit the take of threatened species unless special regulations have been promulgated, pursuant to ESA section 4(d), to promote the conservation of the species. Federal regulations promulgated pursuant to section 4(d) of the ESA extend the section 9 prohibitions to the take of Mexico DPS humpback whales (50 C.F.R. § 223.213). Under the terms of section 7(b)(4) and section 7(o)(2) of the ESA, taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA, provided that such taking is in compliance with the terms and conditions of an Incidental Take Statement (ITS).

Section 7(b)(4)(C) of the ESA provides that if an endangered or threatened marine mammal is involved, the taking must first be authorized by section 101(a)(5) of the MMPA. **Accordingly,**

the terms of this incidental take statement and the exemption from section 9 of the ESA become effective only upon the issuance of MMPA authorization to take the marine mammals identified here. Absent such authorization, this incidental take statement is inoperative.

In order to be exempt from the prohibitions of section 9 of the ESA, the Federal action agency must comply (or must ensure that any applicant complies) with the following terms and conditions. USACE, USAF, and NMFS Permits Division have a continuing duty to regulate the activities covered by this ITS. In order to monitor the impact of incidental take, USACE and USAF must monitor and report on the progress of the action and its impact on the species as specified in the ITS (50 CFR § 402.14(i)(3)). If USACE and USAF (1) fails to require the permit holder to adhere to the terms and conditions of the ITS through enforceable terms that are added to the authorization, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

10.1 Amount or Extent of Take

Section 7 regulations require NMFS to estimate the number of individuals that may be taken by proposed actions or utilize a surrogate (e.g., other species, habitat, or ecological conditions) if we cannot assign numerical limits for animals that could be incidentally taken during the course of an action (50 CFR § 402.14(i)(1); see also 80 FR 26832; May 11, 2015).

The taking of Mexico DPS and Western North Pacific DPS humpback whales and fin whales may be by Level B or Level A harassment. The taking of sperm whales and WDPS Steller sea lions will be by incidental harassment only. The taking by death is prohibited and will result in the modification, suspension, or revocation of the ITS. Table 12 lists the amount of authorized take for this action by species and exposure levels. The method for estimating the number of listed species exposed to sound levels expected to result in Level A and Level B harassment is described in Section 6.2. NMFS expects that 145 instances of Level B harassment and 29 instances of Level A of humpback whales may occur. While we are only authorizing two Level A and nine Level B takes of Mexico DPS humpback whale and one Level A and three Level B takes under the ESA, we will consider the ESA-authorized take limit to be exceeded when the MMPA-authorized limit on Level B and Level A takes of humpback whales is exceeded, as it is impossible to distinguish between DPSs in the field. NMFS expects three level A and 18 Level B takes of fin whales.

NMFS expects that 99 instances of Level B harassment of Western DPS Steller sea lions and 40 instances of B harassment of sperm whales may occur. Pile driving and DTH activities will be halted as soon as possible when it appears a Steller sea lion or sperm whale is approaching the Level A shutdown zone and before it reaches the Level A isopleth.

Table 13. Summary of instances of exposure associated with the proposed pile driving/removal resulting in incidental take of ESA-listed species by Level A and Level B harassment.

Species	Authorized Level A Takes	Authorized Level B Takes
Western DPS Steller sea lion	0	99
Sperm whale	0	40
Fin whale	3	18
Mexico DPS Humpback whale	2	9[16]
Western North Pacific	1	3

10.2 Effect of the Take

In Section 9 of this opinion, NMFS determined that the level of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

Although the biological significance of the expected behavioral responses of Mexico DPS humpback whales, Western North Pacific DPS humpback whales, sperm whales, fin whales, and Western DPS Steller sea lions remains unknown, this consultation has assumed that exposure to disturbances associated with the proposed project activities might disrupt one or more behavioral patterns that are essential to an individual animal's life history. However, any behavioral responses of these whales and pinnipeds to major noise sources, and any associated disruptions, are not expected to measurably affect the reproduction, survival, or recovery of these species.

10.3 Reasonable and Prudent Measures

"Reasonable and prudent measures" are measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take." (50 CFR 402.02). Failure to comply with

[16] The proposed IHA (88 FR 74451) indicated a requested Level A take of 29 humpback whales, and a Level B take of 125 humpback whales. Humpback whales in the Aleutian Islands include individuals from three DPSs. Of the proposed takes, 7 percent are anticipated to occur to ESA-listed Mexico DPS animals and 2 percent to ESA-listed Western North Pacific. The basis for this apportionment is described in Section 4.3.2.

RPMs (and the terms and conditions that implement them) may invalidate the take exemption and result in unauthorized take.

RPMs are distinct from the mitigation measures that are included in the proposed action (described in Section 2.2). We presume that the mitigation measures will be implemented as described in this opinion. The failure to do so will constitute a change to the action that may require reinitiation of consultation pursuant to 50 CFR § 402.16.

The RPMs included below, along with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. NMFS concludes that the following RPMs are necessary and appropriate to minimize or to monitor the incidental take of Western North Pacific DPS humpback whales, Mexico DPS humpback whales, sperm whales, fin whales, and Western DPS Steller sea lions resulting from the proposed action.

1. The NMFS Permits Division, USACE, and USAF must monitor and report all authorized and unauthorized takes, and monitor and report the effectiveness of mitigation measures incorporated as part of the proposed authorization for the incidental taking of ESA-listed marine mammals pursuant to section 101(a)(5)(D) of the MMPA. In addition, they must submit a report to NMFS AKR that evaluates the mitigation measures and reports the results of the monitoring program.

10.4 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Federal action agency must comply (or must ensure that any applicant complies) with the following terms and conditions. These terms and conditions are in addition to the mitigation measures included in the proposed action, as set forth in Section 2.1.2 of this opinion. The USACE, USAF, and Permits Divisionhas a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this incidental take statement (50 CFR § 402.14(i)(3))).

Any taking that is in compliance with these terms and conditions is not prohibited under the ESA (50 CFR § 402.14(i)(5)). As such, partial compliance with these terms and conditions may invalidate this take exemption and result in unauthorized, prohibited take under the ESA. If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the action may lapse.

These terms and conditions constitute no more than a minor change to the proposed action because they are consistent with the basic design of the proposed action.

To carry out the RPM, NMFS Permits Division, USACE, or USAF must:

1. Provide NMFS AKR with written and photographic (if applicable) documentation of any effects of the proposed actions on listed marine mammals and implementation of the mitigation measures specified in Section 2.1.2 of the biological opinion.

11 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR § 402.02).

1. Without approaching whales, project vessel crews should attempt to photograph humpback whale flukes and record GPS coordinates of the sightings during transit. These data should be included in the final report submitted to NMFS AKR.
2. Without approaching whales, project vessel crews should attempt to photograph and/or video North Pacific right whales and record GPS coordinates of the sightings during transit. These data should be submitted to NMFS AKR as soon as possible.
3. Without approaching sea lions, project vessel crews should attempt to photograph Steller sea lions when brand numbers are visible and record GPS coordinates of the sightings during transit. These data should be included in the final report submitted to NMFS AKR.
4. In order to keep NMFS's Protected Resources Division informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, USACE and USAF should notify NMFS of any conservation recommendations they implement in their final action.

12 REINITIATION OF CONSULTATION

As provided in 50 CFR § 402.16, reinitiation of consultation is required where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and if: (1) the amount or extent of incidental take is exceeded, (2) new information reveals effects of the agency action on listed species or designated critical habitat in a manner or to an extent not considered in this opinion, (3) the agency action is subsequently modified in a manner that causes an effect on the listed species or critical habitat not considered in this opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount of incidental take is exceeded, section 7 consultation must be reinitiated immediately (50 CFR § 402.14(i)(4)).

13 DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

Section 515 of the Treasury and General Government Appropriations Act of 2001 (Public Law 106-554) (Data Quality Act (DQA)) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the opinion addresses these DQA components, documents compliance with the DQA, and certifies that this opinion has undergone pre-dissemination review.

13.1 Utility

This document records the results of an interagency consultation. The information presented in this document is useful to NMFS, USACE, US Air Force, and the general public. These consultations help to fulfill multiple legal obligations of the named agencies. The information is also useful and of interest to the general public as it describes the manner in which public trust resources are being managed and conserved. The information presented in these documents and used in the underlying consultations represents the best available scientific and commercial information and has been improved through interaction with the consulting agency.

This consultation will be posted on the NMFS Alaska Region website http://alaskafisheries.noaa.gov/pr/biological-opinions/. The format and name adhere to conventional standards for style.

13.2 Integrity

This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

13.3 Objectivity

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the ESA Consultation Handbook, ESA Regulations, 50 CFR § 402.01 et seq.

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the literature cited section. The analyses in this opinion contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA implementation, and reviewed in accordance with Alaska Region ESA quality control and assurance processes.

14 REFERENCES

Aguilar, A. 1987. Using organochlorine pollutants to discriminate marine mammal populations: A revew and critique of the methods. Marine Mammal Science 3(3):242-262.

Aguilar, A., and A. Borrell. 1988. Age- and sex-related changes in organochlorine compound levels in fin whales (*Balaenoptera physalus*) from the eastern North Atlantic. Marine Environmental Research 25(3):195-211.

Allen, B. M., and R. P. Angliss. 2011. Alaska marine mammal stock assessments, 2010. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center, Seattle, WA, May 2011. NOAA Technical Memorandum NMFS-AFSC-223, 292 p.

Allen, B. M., and R. P. Angliss. 2014. Alaska marine mammal stock assessments, 2013. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center, Seattle, WA, July 2014. NOAA Technical Memorandum NMFS-AFSC-277, 294 p.

Angliss, R. P., and R. B. Outlaw. 2005. Alaska marine mammal stock assessments, 2005. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center, Seattle, WA, December 2005. NOAA Technical Memorandum NMFS-AFSC-161.

Arctic Council. 2009. Arctic marine shipping assessment 2009 report. Pages 187 *in*. Arctic Council, Tromsø, Norway.

Barbeaux, S., K. Aydin, B. Fissel, K. Holsman, W. Palsson, K. Shotwell, Q. Yang, and S. Zador. 2017. Assessment of the Pacific cod stock in the Gulf of Alaska. November 2017 Council Draft.

Bates, N. R., J. T. Mathis, and L. W. Cooper. 2009. Ocean acidification and biologically induced seasonality of carbonate mineral saturation states in the western Arctic Ocean. Journal of Geophysical Research 114(C11007).

Bauer, G. B., and L. M. Herman. 1986. Effects of vessel traffic on the behavior of humpback whales in Hawaii. University of Hawaii, Kewalo Basin Marine Mammal Laboratory, Final report to the National Marine Fisheries Service, Honolulu, Hawaii, February 14, 1986, 151 p.

Baulch, S., and C. Perry. 2014. Evaluating the impacts of marine debris on cetaceans. Marine Pollution Bulletin 80(1-2):210-221.

Beck, C. A., L. D. Rea, S. J. Iverson, J. M. Kennish, K. W. Pitcher, and B. S. Fadely. 2007. Blubber fatty acid profiles reveal regional, seasonal, age-class and sex differences in the diet of young Steller sea lions in Alaska. Marine Ecology Progress Series 338:269-280.

Beckmen, K. B., J. E. Blake, G. M. Ylitalo, J. L. Stott, and T. M. O'Hara. 2003. Organochlorine contaminant exposure and associations with hematological and humoral immune functional assays with dam age as a factor in free-ranging northern fur seal pups (*Callorhinus ursinus*). Marine Pollution Bulletin 46(5):594-606.

Bettridge, S., C. S. Baker, J. Barlow, P. Clapham, M. Ford, D. Gouveia, D. Mattila, R. Pace, P. E. Rosel, G. K. Silber, and P. Wade. 2015. Status review of the humpback whale (*Megaptera novaeangliae*) under the Endangered Species Act. U.S. Dept. Commer., NOAA, NMFS, SWFSC, March 2015. NOAA Technical Memorandum NMFS-SWFSC-540, 263 p.

BLM. 2019. Biological Evaluation for the Implementation of the Oil and Gas Lease Sales for the Arctic Wildlife Refuge Coastal Plain. Submitted to NMFS Alaska Region, Anchorage, AK, May 10, 2019.

Bond, N. A., M. F. Cronin, H. Freeland, and N. Mantua. 2015. Causes and impacts of the 2014 warm anomaly in the NE Pacific. Geophysical Research Letters 42(9):3414-3420.

Borrell, A., and A. Aguilar. 1987. Variations in DDE percentage correlated with total DDT burden in the blubber of fin and sei whales. Marine Pollution Bulletin 18(2):70-74.

Braham, H. W. 1991. Endangered whales: status update. A report on the 5-year status of stocks review under the 1978 amendments to the U.S. Endangered Species Act by the U. S. Dept. of Commerce, NOAA, NMFS, Alaska Fisheries Science Center, National Marine Mammal Laboratory, Seattle, WA, June 1991, 52 p.

Breiwick, J. M. 2013. North Pacific marine mammal bycatch estimation methodology and results, 2007-2011. U. S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center, Seattle, WA, December 2013. NOAA Technical Memorandum NMFS-AFSC-260, 49 p.

Brodie, P. F. 1993. Noise generated by the jaw actions of feeding fin whales. Canadian Journal of Zoology 71(12):2546-2550.

Brower, A., M. Ferguson, J. Clarke, E. Fujioka, and S. DeLand. 2022. Biologically Important Areas II for cetaceans within US and adjacent waters–Aleutian Islands and Bering Sea Region. Frontiers in Marine Science 9:1055398.

Brower, A. A., J. T. Clarke, and M. C. Ferguson. 2018. Increased sightings of subArctic cetaceans in the eastern Chukchi Sea, 2008–2016: population recovery, response to climate change, or increased survey effort? Polar Biology 41(5):1033-1039.

Burek, K. A., K. Beckmen, T. Gelatt, W. Fraser, A. J. Bracht, K. A. Smolarek, and C. H. Romero. 2005. Poxvirus infection of Steller sea lions (*Eumetopias jubatus*) in Alaska. Journal of Wildlife Diseases 41(4):745-52.

Burek, K. A., F. Gulland, and T. M. O'Hara. 2008a. Effects of climate change on Arctic marine mammal health. Ecological Applications 18(2):S126-S134.

Burek, K. A., F. Gulland, and T. M. O'Hara. 2008b. Effects of climate change on Arctic marine mammal health. Ecological Applications 18(sp2).

Burkanov, V. N., and T. R. Loughlin. 2005. Distribution and abundance of Steller sea lions, *Eumetopias jubatus*, on the Asian coast, 1720's-2005. Marine Fisheries Review 67(2):1-62.

Calkins, D. G., and E. Goodwin. 1988. Investigation of the declining sea lion population in the Gulf of Alaska. Alaska Dept. of Fish and Game, Anchorage, AK, August 1988, 76 p.

Calkins, D. G., and K. W. Pitcher. 1982. Population assessment, ecology and trophic relationships of Steller sea lions in the Gulf of Alaska. Pages 447-546 *in* Environmental assessment of the Alaska continental shelf. Prepared by the Alaska Department of Fish and Game for the Outer Continental Shelf Environmental Assessment Program, Final Report: Research Unit 243, ACE 8094521, Anchorage, AK.

Call, K. A., and T. R. Loughlin. 2005. An ecological classification of Alaskan Steller sea lion (*Eumetopias jubatus*) rookeries: A tool for conservation/management. Fisheries Oceanography 14(Supplement 1):212-222.

CalTrans. 2020. Technical guidance for the assessment of hydroacoustic effects of pile driving on fish: Appendix I – Compendium of pile driving sound data. Division of Environmental Analysis, California Department of Transportation, Report Number: CTHWANP-RT-20-365.01.04, Sacramento, CA, October 2020.

Carder, D. A., and S. H. Ridgway. 1990. Auditory brainstem response in a neonatal sperm whale, *Physeter spp.* The Journal of the Acoustical Society of America 88(S4 (1990)).

Carretta, J. V., K. A. Forney, M. S. Lowry, J. Barlow, J. Baker, B. Hanson, and M. M. Muto. 2007. U.S. Pacific marine mammal stock assessments, 2007, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center, December 2007. NOAA Tech. Memo. NMFS-SWFSC-414.

Carretta, J. V., and A. G. Henry. 2022. Risk assessment of whale entanglement and vessel strike injuries from case narratives and classification trees. Frontiers in Marine Science 9:863070.

Carretta, J. V., E. M. Oleson, K. A. Forney, M. M. Muto, D. W. Weller, A. R. Lang, J. Baker, B. Hanson, A. J. Orr, J. Barlow, J. E. Moore, and R. L. Brownell, Jr. 2022. U.S. Pacific marine mammal stock assessments: 2021. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center, La Jolla, CA, July 2022. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-663.

Carretta, J. V., E. M. Oleson, K. A. Forney, M. M. Muto, D. W. Weller, A. R. Lang, J. Baker, B. Hanson, A. J. Orr, J. Barlow, J. E. Moore, and R. L. Brownell, Jr. 2023. Draft U.S. Pacific marine mammal stock assessments: 2022. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center, La Jolla, CA. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-XX.

Casper, B. M., A. N. Popper, F. Matthews, T. J. Carlson, and M. B. Halvorsen. 2012. Recovery of barotrauma injuries in Chinook salmon, *Oncorhynchus tshawytscha* from exposure to pile driving sound. PLoS One 7(6):e39593.

Cavole, L. M., A. M. Demko, R. E. Diner, A. Giddings, I. Koester, C. M. Pagniello, M.-L. Paulsen, A. Ramirez-Valdez, S. M. Schwenck, and N. K. Yen. 2016. Biological impacts of the 2013–2015 warm-water anomaly in the Northeast Pacific: winners, losers, and the future. Oceanography 29(2):273-285.

Chapin, F. S., III, S. F. Trainor, P. Cochran, H. Huntington, C. Markon, M. McCammon, A. D. McGuire, and M. Serreze. 2014. Ch. 22: Alaska. Pages 514-536 *in* J. M. Melillo, T. C. Richmond, and G. W. Yohe, editors. Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program.

Chen, J.-M., P.-H. Tan, J.-S. Liu, C.-M. Hsieh, H.-S. Chen, L.-H. Hsu, and J.-L. Huang. 2014. Seasonal climate associated with major shipping routes in the North Pacific and North Atlantic. Terrestrial, Atmospheric & Oceanic Sciences 25(3).

Cheng, L., J. Abraham, J. Zhu, K. E. Trenberth, J. Fasullo, T. Boyer, R. Locarnini, B. Zhang, F. Yu, L. Wan, X. Chen, X. Song, Y. Liu, and M. E. Mann. 2020. Record-setting ocean warmth continued in 2019. Advances in Atmospheric Sciences 37(2):137-142.

Chu, K., C. Sze, and C. Wong. 1996. Swimming behaviour during the larval development of the shrimp *Metapenaeus ensis* (De Haan, 1844)(Decapoda, Penaeidae). Crustaceana 69(3):368-378.

Citta, J. J., J. J. Burns, L. T. Quakenbush, V. Vanek, J. C. George, R. J. Small, M. P. Heide-Jørgensen, and H. Brower. 2014. Potential for bowhead whale entanglement in cod and crab pot gear in the Bering Sea. Marine Mammal Science 30(2):445-459.

Clapham, P. J. 1993. Social organization of humpback whales on a North Atlantic feeding ground. Pages 131-145 *in*.

Clark, C. W., W. T. Ellison, B. L. Southall, L. Hatch, S. M. Van Parijs, A. Frankel, and D. Ponirakis. 2009. Acoustic masking in marine ecosystems: intuitions, analysis, and implication. Marine Ecology Progress Series 395:201-222.

Clarke, J., A. Brower, M. Ferguson, A. Willoughby, and A. Rotrock. 2020. Distribution and relative abundance of marine mammals in the eastern Chukchi Sea, eastern and western Beaufort Sea, and Amundsen Gulf, 2019 annual report. U.S. Dept. of Interior, Bureau of Ocean Energy Management (BOEM), Alaska OCS Region, Anchorage, AK, June 2020. OCS Study BOEM 2020-027 prepared under Interagency Agreement M17PG00031 by the NOAA, Alaska Fisheries Science Center, Marine Mammal Laboratory.

Cooke, J. G. 2020. Population assessment update for Sakhalin gray whales, Paper WGWAP-21/13 at the 21st meeting of the Western Gray Whale Advisory Panel, 10 p.

Coombs, M., K. Wallace, C. Cameron, J. Lyons, A. Wech, K. Angeli, and P. Cervelli. 2019. Overview, chronology, and impacts of the 2016–2017 eruption of Bogoslof volcano, Alaska. Bulletin of Volcanology 81(11):62.

Cox, T. M., T. Ragen, A. Read, E. Vos, R. Baird, K. Balcomb, J. Barlow, J. Caldwell, T. Cranford, and L. Crum. 2006. Understanding the impacts of anthropogenic sound on beaked whales. Journal of Cetacean Research and Management 7(3):177-187.

Cranford, T. W., M. Amundin, and K. S. Norris. 1996. Functional morphology and homology in the odontocete nasal complex: Implications for sound generation. Journal of Morphology 228(3):223-285.

Cranford, T. W., and P. Krysl. 2015. Fin whale sound reception mechanisms: skull vibration enables low-frequency hearing. PLoS One 10(1):e0116222.

Crespi, E. J., T. D. Williams, T. S. Jessop, and B. Delehanty. 2013. Life history and the ecology of stress: how do glucocorticoid hormones influence life-history variation in animals? Functional Ecology 27(1):93-106.

Croll, D. A., C. W. Clark, J. Calambokidis, W. T. Ellison, and B. R. Tershy. 2001. Effect of anthropogenic low-frequency noise on the foraging ecology of *Balaenoptera* whales. Animal Conservation 4(1):13-27.

Crowley, T. J. 2000. Causes of climate change over the past 1000 years. Science 289(5477):270-277.

D'Vincent, C. G., R. M. Nilson, and R. E. Hanna. 1985. Vocalization and coordinated feeding behavior of the humpback whale in southeastern Alaska. Scientific Reports of the Whales Research Institute 36:41–47.

Damon-Randall, K. 2023. Occurrence and distribution of Eastern North Pacific and Western North Pacific populations of gray whales in the North Pacific Ocean. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources, Silver Spring, MD, October 16, 2023. Memorandum and internal guidance for Office of Protected Resources, Alaska Regional Office, and West Coast Regional Office.

De Stephanis, R., J. Giménez, E. Carpinelli, C. Gutierrez-Exposito, and A. Cañadas. 2013. As main meal for sperm whales: plastics debris. Marine Pollution Bulletin 69(1-2):206-214.

DeGrandpre, M., W. Evans, M.-L. Timmermans, R. Krishfield, B. Williams, and M. Steele. 2020. Changes in the Arctic Ocean carbon cycle with diminishing ice cover. Geophysical Research Letters 47(12):e2020GL088051.

Delean, B. J., V. T. Helker, M. Muto, K. Savage, S. F. Teerlink, L. A. Jemison, K. Wilkinson, J. Jannot, and N. C. Young. 2020a. Human-caused mortality and injury of NMFS-managed Alaska marine mammal stocks 2013-2017. NOAA Technical Memo. NMFS-AFSC-401. National Marine Fisheries Service. 95 pp.

Delean, B. J., V. T. Helker, M. M. Muto, K. Savage, S. Teerlink, L. A. Jemison, K. Wilkinson, J. E. Jannot, and N. C. Young. 2020b. Human-caused mortality and injury of NMFS-managed Alaska marine mammal stocks, 2013-2017. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center, Seattle, WA, January 2020. NOAA Tech. Memo. NMFS-AFSC-401, 86 p.

Denes, S. L., J. Vallarta, and D. G. Zeddies. 2019. Sound source characterization of down-the-hole hammering, Thimble Shoal, Virginia. Technical report by JASCO Applied Sciences for Chesapeake Tunnel Joint Venture, Document 00188, Version 1.0, 10 September 2019.

Dickerson, C., K. J. Reine, and D. G. Clarke. 2001. Characterization of underwater sounds produced by bucket dredging operations. U.S. Army Corps of Engineers Dredging Operations and Environmental Research, Vicksburg, MS, August 2001. DOER Technical Notes Collection ERDC TN-DOER-E14.

Dietrich, K. S., V. R. Cornish, K. S. Rivera, and T. A. Conant. 2007. Best practices for the collection of longline data to facilitate research and analysis to reduce bycatch of protected species: report of a workshop held at the International Fisheries Observer Conference Sydney, Australia, November 8, 2004. NOAA Technical Memorandum NMFS-OPR-35.

Diogou, N., D. M. Palacios, J. A. Nystuen, E. Papathanassiou, S. Katsanevakis, and H. Klinck. 2019. Sperm whale (*Physeter macrocephalus*) acoustic ecology at Ocean Station PAPA in the Gulf of Alaska–Part 2: oceanographic drivers of interannual variability. Deep Sea Research Part I: Oceanographic Research Papers 150:103044.

Doney, S. C., M. Ruckelshaus, J. E. Duffy, J. P. Barry, F. Chan, C. A. English, H. M. Galindo, J. M. Grebmeier, A. B. Hollowed, N. Knowlton, J. Polovina, N. N. Rabalais, W. J. Sydeman, and L. D. Talley. 2012. Climate change impacts on marine ecosystems. Annual Reviews in Marine Science 4:11-37.

Eco49. 2022. ESA Section 7 Biological Assessment for fisheries research conducted and funded by the Alaska Fisheries Science Center and the International Halibut Commission. Eco49 Consulting, Contract analysis prepared for the National Marine Fisheries Service, Bend, OR, June 2022, 127 p.

Ellison, W., B. Southall, C. Clark, and A. Frankel. 2012. A new context-based approach to assess marine mammal behavioral responses to anthropogenic sounds. Conservation Biology 26(1):21-28.

Esquible, J., and S. Atkinson. 2019. Stranding trends of Steller sea lions *Eumetopias jubatus* 1990 2015. Endangered Species Research 38:177-188.

Esquible, J., K. Burek-Huntington, S. Atkinson, A. Klink, E. Bortz, T. Goldstein, K. Beckmen, K. Pabilonia, and R. Tiller. 2019. Pathological findings and survey for pathogens associated with reproductive failure in perinatal Steller sea lions Eumetopias jubatus. Diseases of Aquatic Organisms 137(2):131-144.

Evans, K., M. Hindell, and G. Hince. 2004. Concentrations of organochlorines in sperm whales (Physeter macrocephalus) from Southern Australian waters. Marine Pollution Bulletin 48(5-6):486-503.

Evans, P. G. H., Q. Carson, P. Fisher, W. Jordan, R. Limer, and I. Rees. 1994. A study of the reactions of harbour porpoises to various boats in the coastal waters of southeast Shetland. European Research on Cetaceans 8:60-64.

Everitt, R. D., C. H. Fiscus, and R. L. DeLong. 1980. Northern Puget Sound marine mammals. U.S. Dept. of Commerce and U.S. Environmental Protection Agency, Interagency energy/environment R&D Program Report No. EPA 600/7-80-139 prepared by the NOAA NMFS National Marine Mammal Laboratory for the Marine Ecosytems Analysis Puget Sound Project, Washington, D.C., February 1980.

Fabry, V. J., J. B. McClintock, J. T. Mathis, and J. M. Grebmeier. 2009. Ocean acidification at high latitudes: the Bellweather. Oceanography 22(4):160-171.

Fabry, V. J., B. A. Seibel, R. A. Feely, and J. C. Orr. 2008. Impacts of ocean acidification on marine fauna and ecosystem processes. ICES Journal of Marine Science 65:414-432.

Fadely, B., and M. Lander. 2012. Satellite tracking of adult female Steller sea lions in the Western-Central Aleutian Islands reveals diverse foraging behaviors. National Marine Fisheries Service, Alaska Fisheries Science Center, October-December 2012. Alaska Fisheries Science Center Quarterly Report: Attributes of the Eastern Chukchi Sea Food Web With Comparisons to Three Northern Marine Ecosystems, Pages 24-25.

Fair, P. A., and P. R. Becker. 2000. Review of stress in marine mammals. Journal of Aquatic Ecosystem Stress and Recovery 7(4):335-354.

Fay, V. 2002. Alaska Aquatic Nuisance Species Management Plan. Alaska Department of Fish and Game Publication. Juneau, AK.

Fearnbach, H., J. W. Durban, S. A. Mizroch, S. Barbeaux, and P. R. Wade. 2012. Winter observations of a group of female and immature sperm whales in the high-latitude waters near the Aleutian Islands, Alaska. Marine Biodiversity Records 5:e13.

Feely, R. A., S. C. Doney, and S. R. Cooley. 2009. Ocean acidification: present conditions and future changes in a high-CO_2 world. Oceanography 22(4):37-47.

Feely, R. A., C. L. Sabine, K. Lee, W. Berelson, J. Kleypas, V. J. Fabry, and F. J. Millero. 2004. Impact of anthropogenic CO2 on the CaCO3 system in the oceans. Science 305(5682):362-366.

Ferguson, M. C., C. Curtice, and J. Harrison. 2015. 6. Biologically Important Areas for Cetaceans Within U.S. Waters – Gulf of Alaska Region. Aquatic Mammals 41(1):65-78.

Finneran, J. J., R. Dear, D. A. Carder, and S. H. Ridgway. 2003. Auditory and behavioral responses of California sea lions (*Zalophus californianus*) to single underwater impulses from an arc-gap transducer. Journal of the Acoustical Society of America 114(3):1667-1677.

Finneran, J. J., and C. E. Schlundt. 2013. Effects of fatiguing tone frequency on temporary threshold shift in bottlenose dolphins (*Tursiops truncatus*). The Journal of the Acoustical Society of America 133(3):1819-1826.

Fischer, J. B. 1829. Synopsis Mammalium, 1829. Bos maschatus fossilis:494.

Florko, K. R., T. C. Tai, W. W. Cheung, S. H. Ferguson, U. R. Sumaila, D. J. Yurkowski, and M. Auger-Méthé. 2021. Predicting how climate change threatens the prey base of Arctic marine predators. Ecology Letters 24(12):2563-2575.

Foote, A. D., R. W. Osborne, and A. R. Hoelzel. 2004. Whale-call response to masking boat noise. Nature 428:910.

Ford, J. K. B., and R. R. Reeves. 2008. Fight or flight: antipredator strategies of baleen whales. Mammal Review 38(1):50-86.

Freed, J. C., N. C. Young, B. J. Delean, V. T. Helker, M. M. Muto, K. M. Savage, S. S. Teerlink, L. A. Jemison, K. M. Wilkinson, and J. E. Jannot. 2022. Human-caused mortality and injury of NMFS-managed Alaska marine mammal stocks, 2016-2020. U. S. Dept. of

Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center, Seattle, WA. NOAA Tech. Memo. NMFS-AFSC-442, 116 p.

Frid, A., J. Burns, G. G. Baker, and R. E. Thorne. 2009. Predicting synergistic effects of resources and predators on foraging decisions by juvenile Steller sea lions. Oecologia 158:12.

Frid, A., and L. M. Dill. 2002. Human-caused disturbance stimuli as a form of predation risk. Conservation Ecology 6(1):11.

Friday, N. A., J. M. Waite, A. N. Zerbini, and S. E. Moore. 2012. Cetacean distribution and abundance in relation to oceanographic domains on the eastern Bering Sea shelf: 1999-2004. Deep Sea Research Part II: Topical Studies in Oceanography 65-70:260-272.

Friday, N. A., A. N. Zerbini, J. M. Waite, S. E. Moore, and P. J. Clapham. 2013. Cetacean distribution and abundance in relation to oceanographic domains on the eastern Bering Sea shelf, June and July of 2002, 2008, and 2010. Deep Sea Research Part II: Topical Studies in Oceanography 94:244-256.

Fritz, L., K. Sweeney, R. Towell, and T. Gelatt. 2016. Aerial and ship-based surveys of Steller sea lions (*Eumetopias jubatus*) conducted in Alaska in June-July 2013 through 2015, and an update on the status and trend of the Western Distinct Population segment in Alaska. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administraiton, National Marine Fisheries Service, Alaska Fisheries Science Center, Seattle, WA, May 2016. NOAA Technical Memorandum NMFS-AFSC-321, 72 p.

Fritz, L. W., R. Towell, T. S. Gelatt, D. S. Johnson, and T. R. Loughlin. 2014. Recent increases in survival of western Steller sea lions in Alaska and implications for recovery. Endangered Species Research 26(1):13-24.

Frölicher, T. L., E. M. Fischer, and N. Gruber. 2018. Marine heatwaves under global warming. Nature 560(7718):360-364.

Gabriele, C. M., C. L. Amundson, J. L. Neilson, J. M. Straley, C. S. Baker, and S. L. Danielson. 2022. Sharp decline in humpback whale (*Megaptera novaeangliae*) survival and reproductive success in southeastern Alaska during and after the 2014–2016 Northeast Pacific marine heatwave. Mammalian Biology 102(4):1113-1131.

Gambell, R. 1985. Fin whale *Balaenoptera physalus* (Linnaeus, 1758). Pages 171-192 *in* S. Ridgway, and R. Harrison, editors. Handbook of marine mammals, volume 3. Academic Press, London, UK.

Gauthier, J. M., C. D. Metcalfe, and R. Sears. 1997. Chlorinated organic contaminants in blubber biopsies from northwestern Atlantic balaenopterid whales summering in the Gulf of St Lawrence. Marine Environmental Research 44:201-223.

Geraci, J. R., and D. J. St. Aubin. 1990. Sea Mammals and Oil: Confronting the Risks. Academic Press, Inc., San Deigo, CA.

Gisiner, R. C. 1985. Male territorial and reproductive behavior in the Steller sea lion, *Eumetopias jubatus*. Ph.D. dissertation. University of California, Santa Cruz, CA, 145 p.

Goldbogen, J. A., J. Calambokidis, D. A. Croll, J. T. Harvey, K. M. Newton, E. M. Oleson, G. Schorr, and R. E. Shadwick. 2008. Foraging behavior of humpback whales: kinematic and respiratory patterns suggest a high cost for a lunge. Journal of Experimental Biology 211(23):3712-3719.

Goldbogen, J. A., J. Calambokidis, R. E. Shadwick, E. M. Oleson, M. A. McDonald, and J. A. Hildebrand. 2006. Kinematics of foraging dives and lunge-feeding in fin whales. Journal of Experimental Biology 209(7):1231-1244.

Goold, J. C., and S. E. Jones. 1995. Time and frequency domain characteristics of sperm whale clicks. Journal of the Acoustical Society of America 98(3):1279-91.

Gravem, S. A., W. N. Heady, V. R. Saccomanno, K. F. Alvstad, A. L. M. Gehman, T. N. Frierson, and S. L. Hamilton. 2021. *Pycnopodia helianthoides*. IUCN Red List of Threatened Species 2021:43 p.

Gray, L. M., and D. S. Greeley. 1980. Source level model for propeller blade rate radiation for the world's merchant fleet. The Journal of the Acoustical Society of America 67(2):516-522.

Greene, C. R. J., S. B. Blackwell, and M. W. McLennan. 2008. Sounds and vibrations in the frozen Beaufort Sea during gravel island construction. Journal of Acoustical Society of America 123(2):687-695.

Gulland, F. 2005. Eastern North Pacific gray whale (Eschrichtius robustus) unusual mortality event, 1999-2000.

Gulland, F. M. D., J. D. Baker, M. Howe, E. LaBrecque, L. Leach, S. E. Moore, R. R. Reeves, and P. O. Thomas. 2022. A review of climate change effects on marine mammals in United States waters: Past predictions, observed impacts, current research and conservation imperatives. Climate Change Ecology 3:100054.

Hain, J. H. W., M. J. Ratnaswamy, R. D. Kenney, and H. E. Winn. 1992. The fin whale, *Balaenoptera physalus*, in waters of the northeastern United States continental shelf. Reports of the International Whaling Commission 42:653-669.

Halliday, W. D., N. LeBaron, J. J. Citta, J. Dawson, T. Doniol-Valcroze, M. Ferguson, S. H. Ferguson, S. Fortune, L. A. Harwood, M. P. Heide-Jørgensen, E. V. Lea, L. Quakenbush, B. G. Young, D. Yurkowski, and S. J. Insley. 2022. Overlap between bowhead whales (*Balaena mysticetus*) and vessel traffic in the North American Arctic and implications for conservation and management. Biological Conservation 276:109820.

Halvorsen, M. B., B. M. Casper, C. M. Woodley, T. J. Carlson, and A. N. Popper. 2012. Threshold for onset of injury in Chinook salmon from exposure to impulsive pile driving sounds. PLoS One 7(6):e38968.

Hanselman, D. H., B. J. Pyper, and M. J. Peterson. 2018. Sperm whale depredation on longline surveys and implications for the assessment of Alaska sablefish. Fisheries Research 200:75-83.

Hansen, D. J. 1985. The Potential Effects of Oil Spills and Other Chemical Pollutants on Marine Mammals Occurring in Alaskan Waters. USDOI, MMS, Alaska OCS Region, Anchorage, AK, 22.

Hastings, K. K., T. S. Gelatt, J. M. Maniscalco, L. A. Jemison, R. Towell, G. W. Pendleton, and D. S. Johnson. 2023. Reduced survival of Steller sea lions in the Gulf of Alaska following marine heatwave. Frontiers in Marine Science 10:1127013.

Hastings, M. C., and A. N. Popper. 2005. Effects of sound on fish. Report prepared by Jones and Stokes under contract with California Department of Transportation, No. 43A0139, Sacramento, CA, January 28, 2005.

Helker, V. T., M. M. Muto, K. Savage, S. Teerlink, L. A. Jemison, K. Wilkinson, and J. Jannot. 2019. Human-caused mortality and injury of NMFS-managed Alaska marine mammal stocks, 2012-2016. U. S. Dept. of Commerce, NOAA, NMFS, Alaska Fisheries Science Center, Seattle, WA, May 2019. NOAA Tech. Memo. NMFS-AFSC-392, 71 p.

Hildebrand, J. A. 2009. Anthropogenic and natural sources of ambient noise in the ocean. Marine Ecology Progress Series 395(5):5-20.

Hinzman, L. D., N. D. Bettez, W. R. Bolton, F. S. Chapin, M. B. Dyurgerov, C. L. Fastie, B. Griffith, R. D. Hollister, A. Hope, H. P. Huntington, A. M. Jensen, G. J. Jia, T. Jorgenson, D. L. Kane, D. R. Klein, G. Kofinas, A. H. Lynch, A. H. Lloyd, A. D. McGuire, F. E. Nelson, W. C. Oechel, T. E. Osterkamp, C. H. Racine, V. E. Romanovsky, R. S. Stone, D. A. Stow, M. Sturm, C. E. Tweedie, G. L. Vourlitis, M. D. Walker, D. A. Walker, P. J. Webber, J. M. Welker, K. S. Winker, and K. Yoshikawa. 2005. Evidence and implications of recent climate change in northern Alaska and other Arctic regions. Climatic Change 72(3):251-298.

Holt, M. M., D. P. Noren, V. Veirs, C. K. Emmons, and S. Veirs. 2009. Speaking up: Killer whales (*Orcinus orca*) increase their call amplitude in response to vessel noise. Journal of the Acoustical Society of America 125(1):EL27-EL32.

Horning, M., and J. A. E. Mellish. 2014. In cold blood: evidence of Pacific sleeper shark (Somniosus pacificus) predation on Steller sea lions (*Eumetopias jubatus*) in the Gulf of Alaska. Fishery Bulletin 112(4):297-310.

Houghton, J. 2001. The science of global warming. Interdisciplinary Science Reviews 26(4):247-257.

Huntington, H. P., S. L. Danielson, F. K. Wiese, M. Baker, P. Boveng, J. J. Citta, A. De Robertis, D. M. Dickson, E. Farley, and J. C. George. 2020. Evidence suggests potential transformation of the Pacific Arctic ecosystem is underway. Nature Climate Change 10(4):342-348.

Huntington, H. P., L. T. Quakenbush, and M. Nelson. 2016. Effects of changing sea ice on marine mammals and subsistence hunters in northern Alaska from traditional knowledge interviews. Biology Letters 12(8):20160198.

Huntington, H. P., L. T. Quakenbush, and M. Nelson. 2017. Evaluating the effects of climate change on indigenous marine mammal hunting in northern and western Alaska using traditional knowledge. Frontiers in Marine Science 4:319.

IPCC. 2013. Summary for policymakers. Pages 3-39 *in* D. Q. T. F. Stocker, G. K. Plattner, M. Tignor, S. K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex, and P. M. Midgley, editor. Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York.

IPCC. 2014. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II, and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC, Geneva, Switzerland, 151 p.

IPCC. 2019. Summary for Policymakers. Pages 1-36 *in* H.-O. Pörtner, and coeditors, editors. IPCC Special Report on the Ocean and Cryosphere in a Changing Climate. Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK and New York, NY.

Isaac, J. L. 2009. Effects of climate change on life history: implications for extinction risk in mammals. Endangered Species Research 7(2):115-123.

Ivashchenko, Y. V., R. L. Brownell Jr., and P. J. Clapham. 2014. Distribution of Soviet catches of sperm whales *Physeter macrocephalus* in the North Pacific. Endangered Species Research 25(3):249-263.

Jacobsen, J. K., L. Massey, and F. Gulland. 2010. Fatal ingestion of floating net debris by two sperm whales (*Physeter macrocephalus*). Marine Pollution Bulletin 60(5):765-767.

Jemison, L. A., G. W. Pendleton, L. W. Fritz, K. K. Hastings, J. M. Maniscalco, A. W. Trites, and T. S. Gelatt. 2013. Inter-population movements of Steller sea lions in Alaska with implications for population separation. PLoS One 8(8):e70167.

Jemison, L. A., G. W. Pendleton, K. K. Hastings, J. M. Maniscalco, and L. W. Fritz. 2018. Spatial distribution, movements, and geographic range of Steller sea lions (Eumetopias jubatus) in Alaska. PLoS One 13(12):e0208093.

Jessop, T. S., A. D. Tucker, C. J. Limpus, and J. M. Whittier. 2003. Interactions between ecology, demography, capture stress, and profiles of corticosterone and glucose in a free-living population of Australian freshwater crocodiles. Gen Comp Endocrinol 132(1):161-170.

Jiang, L., R. A. Feely, B. R. Carter, D. J. Greeley, D. K. Gledhill, and K. M. Arzayus. 2015. Climatological distribution of aragonite saturation state in the global oceans. Global Biogeochemical Cycles 29:1656-1673.

Johnson, J. H., and A. A. Wolman. 1984. The Humpback Whale, *Megaptera novaeangliae*. Marine Fisheries Review 46(4):300-337.

Jurasz, C. M., and V. P. Jurasz. 1979. Feeding modes of the humpback whale, *Megaptera novaeangliae*, in Southeast Alaska. Scientific Reports of the Whales Research Institute 31:69-83.

Kastelein, R. A., L. Hoek, R. Gransier, M. Rambags, and N. Claeys. 2014. Effect of level, duration, and inter-pulse interval of 1-2 kHz sonar signal exposures on harbor porpoise hearing. Journal of the Acoustical Society of America 136(1):412-22.

Kastelein, R. A., R. Van Schie, W. C. Verboom, and D. de Haan. 2005. Underwater hearing sensitivity of a male and a female Steller sea lion (*Eumetopias jubatus*). Journal of the Acoustical Society of America 118(3):1820-1829.

Kasuya, T., and T. Miyashita. 1988. Distribution of sperm whale stocks in the North Pacific. Scientific Reports of the Whales Research Institute, Tokyo 39:31-75.

Kato, H., and T. Miyashita. 1998. Current status of North Pacific sperm whales and its preliminary abundance estimates. International Whaling Commission, Unpublished report submitted to the Scientific Committee SC/50/CAWS/52, 6 p.

Kawamura, A. 1980. A review of food of balaenopterid whales. Scientific Reports of the Whales Research Institute 32:155-197.

Kennedy, S. N., M. Keogh, M. Levin, J. M. Castellini, M. Lian, B. S. Fadely, L. D. Rea, and T. M. O'Hara. 2021. Regional variations and relationships among cytokine profiles, white blood cell counts, and blood mercury concentrations in Steller sea lion (*Eumetopias jubatus*) pups. Science of the Total Environment 775:144894.

Keogh, M. J., B. D. Taras, C. Eischens, J. M. Kennish, B. S. Fadely, and L. D. Rea. 2019. Variation in milk, serum, and blubber fatty acids in young, free-ranging Steller sea lions. Marine Mammal Science 35(3):909-933.

Keple, A. R. 2002. Seasonal abundance and distribution of marine mammals in the southern Strait of Georgia, British Columbia. University of British Columbia.

Kight, C. R., and J. P. Swaddle. 2011. How and why environmental noise impacts animals: an integrative, mechanistic review. Ecology Letters 14(10):1052-61.

Kruse, S. 1991. The interactions between killer whales and boats in Johnstone Strait, B.C. K. Pryor, and K. Norris, editors. Dolphin Societies - Discoveries and Puzzles. University of California Press, Berkeley, California.

Kryter, K. D. 1970. The effects of noise on man. Academic Press, Inc., New York.

Kryter, K. D. 1985. The handbook of hearing and the effects of noise, 2nd edition. Academic Press, Orlando, FL.

Kucey, L. 2005. Human disturbance and the hauling out behavior of steller sea lions (*Eumetopias jubatus*). University of British Columbia, British Columbia.

Lafortuna, C. L., M. Jahoda, A. Azzellino, F. Saibene, and A. Colombini. 2003. Locomotor behaviours and respiratory pattern of the Mediterranean fin whale (*Balaenoptera physalus*). European Journal of Applied Physiology 90(3-4):387-395.

Laidre, K. L., I. Stirling, L. F. Lowry, Ø. Wiig, M. P. Heide-Jørgensen, and S. H. Ferguson. 2008. Quantifying the sensitivity of Arctic marine mammals to climate-induced habitat change. Ecological Applications 18(sp2):S97-S125.

Laist, D. W., A. R. Knowlton, J. G. Mead, A. S. Collet, and M. Podesta. 2001. Collisions between ships and whales. Marine Mammal Science 17(1):35-75.

Lambertsen, R. H. 1983. Internal mechanism of rorqual feeding. Journal of Mammalogy 64(1):76-88.

Lambertsen, R. H. 1992. Crassicaudosis: a parasitic disease threatening the health and population recovery of large baleen whales. Rev. Sci. Technol., Off. Int. Epizoot. 11(4):1131-1141.

Lander, M. E., B. S. Fadely, T. S. Gelatt, J. T. Sterling, D. S. Johnson, and N. A. Pelland. 2020. Mixing it up in Alaska: Habitat use of adult female Steller sea lions reveals a variety of foraging strategies. Ecosphere 11(2):e03021.

Lankford, S., T. Adams, R. Miller, and J. Cech Jr. 2005. The cost of chronic stress: impacts of a nonhabituating stress response on metabolic variables and swimming performance in sturgeon. Physiological and Biochemical Zoology 78(4):599-609.

Le Boeuf, B., H. Perez-Cortes, J. Urbán, B. Mate, and F. Ollervides. 2000. High gray whale mortality and low recruitment in 1999: Potential causes and implications. Journal of Cetacean Research and Management 2(2):85-99.

Learmonth, J. A., C. D. Macleod, M. B. Santos, G. J. Pierce, H. Q. P. Crick, and R. A. Robinson. 2006. Potential effects of climate change on marine mammals. Oceanography and Marine Biology: An Annual Review 44:431-464.

Lefebvre, K. A., L. Quakenbush, E. Frame, K. B. Huntington, G. Sheffield, R. Stimmelmayr, A. Bryan, P. Kendrick, H. Ziel, T. Goldstein, J. A. Snyder, T. Gelatt, F. Gulland, B. Dickerson, and V. Gill. 2016. Prevalence of algal toxins in Alaskan marine mammals foraging in a changing arctic and subarctic environment. Harmful Algae 55:13-24.

Levin, M., L. Jasperse, J. P. Desforges, T. O'Hara, L. Rea, J. M. Castellini, J. M. Maniscalco, B. Fadely, and M. Keogh. 2020. Methyl mercury (MeHg) in vitro exposure alters mitogen-induced lymphocyte proliferation and cytokine expression in Steller sea lion (*Eumetopias jubatus*) pups. Science of the Total Environment 725:138308.

Lian, M., J. M. Castellini, T. Kuhn, L. Rea, L. Bishop, M. Keogh, S. N. Kennedy, B. Fadely, E. van Wijngaarden, J. M. Maniscalco, and T. O'Hara. 2020. Assessing oxidative stress in Steller sea lions (Eumetopias jubatus): Associations with mercury and selenium concentrations. Comparative Biochemistry and Physiololgy, Part C 235:108786.

Lischka, S., and U. Riebesell. 2012. Synergistic effects of ocean acidification and warming on overwintering pteropods in the Arctic. Global Change Biology 18(12):3517-3528.

Lomac-MacNair, K., C. Thissen, and M. A. Smultea. 2014. NMFS 90-Day Report for Marine Mammal Monitoring and Mitigation during SAExploration's Colville River Delta 3D Seismic Survey, Beaufort Sea, Alaska, August to September 2014. Report prepared for SAExploration, Inc, by Smultea Environmental Sciences, P.O. Box 256, Preston, WA 98050. December 15, 2014., Preston, WA, December 2, 2014.

Loughlin, T. R. 2002. Steller's sea lion *Eumetopias jubatus*. Pages 1181-1185 *in* W. F. Perrin, B. Würsig, and J. G. M. Thewissen, editors. Encyclopedia of marine mammals. Academic Press, San Diego, CA.

Loughlin, T. R., D. J. Rugh, and C. H. Fiscus. 1984. Northern sea lion distribution and abundance: 1956-80. Journal of Wildlife Management 48(3):729-740.

Loughlin, T. R., and A. E. York. 2000. An accounting of the sources of Steller sea lion, *Eumetopias jubatus*, mortality. Marine Fisheries Review 62(4):40-45.

Lowry, D., Wright, S., Neuman, M., Stevenson, D., Hyde, J., Lindeberg, M., Tolimieri, N., Lonhart, S., Traiger, S., Gustafson, R. 2022. Draft Endangered Species Act status review report: sunflower sea star (*Pynopodia helianthoides*). Final Report to the National Marine Fisheries Service, Office of Protected Resources. October 2022. 89 pp. +App.

Lusseau, D. 2003. Effects of tour boats on the behavior of bottlenose dolphins: Using Markov chains to model anthropogenic impacts. Conservation Biology 17(6):1785-1793.

Lusseau, D. 2006. The short-term behavioral reactions of bottlenose dolphins to interactions with boats in Doubtful Sound, New Zealand. Marine Mammal Science 22(4):802-818.

Lüthi, D., M. Le Floch, B. Bereiter, T. Blunier, J.-M. Barnola, U. Siegenthaler, D. Raynaud, J. Jouzel, H. Fischer, K. Kawamura, and T. F. Stocker. 2008. High-resolution carbon dioxide concentration record 650,000–800,000 years before present. Nature 453(7193):379-382.

MacGillivray, A., G. Warner, and C. McPherson. 2015. Alaska DOT Hydroacoustic Pile Driving Noise Study: Kake Monitoring Results. Technical report by JASCO Applied Sciences for Alaska Department of Transportation and Public Facilities, JASCO Document 01093, Version 2.0, November 2015.

Macleod, C. D. 2009. Global climate change, range changes and potential implications for the conservation of marine cetaceans: A review and synthesis. Endangered Species Research 7(2):125-136.

Maniscalco, J., S. Atkinson, and P. Armato. 2002. Early maternal care and pup survival in Steller sea lions: a remote video monitoring project in the northern Gulf of Alaska. Arctic Research of the United States 16:36-36.

Maniscalco, J. M., P. Parker, and S. Atkinson. 2006. Interseasonal and interannual measures of maternal care among individual Steller sea lions (*Eumetopias jubatus*). Journal of Mammalogy 87(2):304-311.

Matsuoka, K., S. A. Mizroch, and H. Komiya. 2013. Cruise report of the 2012 IWC-Pacific Ocean Whale and Ecosystem Research (IWC-POWER). International Whaling Commission, Cambridge, 43 p.

Mazzariol, S., C. Centelleghe, B. Cozzi, M. Povinelli, F. Marcer, N. Ferri, G. Di Francesco, P. Badagliacca, F. Profeta, and V. Olivieri. 2018. Multidisciplinary studies on a sick-leader syndrome-associated mass stranding of sperm whales (Physeter macrocephalus) along the Adriatic coast of Italy. Scientific Reports 8(1):11577.

McCarthy, J. J., O. Canziani, N. A. Leary, D. J. Dokken, and K. S. White. 2001. Climate change 2001: Impacts, adaptation, and vulnerability. Contribution of working group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom.

McCauley, R. D., J. Fewtrell, and A. N. Popper. 2003. High intensity anthropogenic sound damages fish ears. The Journal of the Acoustical Society of America 113(1):638-642.

McDonald, M. A., J. A. Hildebrand, and S. C. Webb. 1995. Blue and fin whales observed on a sea-floor array in the Northeast Pacific. Journal of the Acoustical Society of America 98(2):712-721.

McGuire, T., A. Stephens, and L. Bisson. 2014. Photo-identification of Cook Inlet beluga whales in the waters of the Kenai Peninsula Borough, Alaska. Final report of field activities and belugas identified 2011–2013. Kenai Peninsula Borough, 92 p.

McQueen, A. D., B. C. Suedel, and J. L. Wilkens. 2019. Review of the adverse biological effects of dredging-induced underwater sounds. WEDA Journal of Dredging 17(1):1-22.

Meier, W. N., D. Perovich, S. Farrell, C. Haas, S. Hendricks, A. A. Petty, M. Webster, D. Divine, S. Gerland, and e. al. 2021. Sea Ice *In* Arctic Report Card 2021, T.A. Moon, M.L Druckenmiller, and R.L. Thoman, eds., 32-40.

Mellinger, D. K., K. M. Stafford, and C. G. Fox. 2004. Seasonal occurrence of sperm whale (*Physeter macrocephalus*) sounds in the Gulf of Alaska, 1999–2001. Marine Mammal Science 20(1):48-62.

Merrick, R. L., and T. R. Loughlin. 1997. Foraging behavior of adult female and young-of-the-year Steller sea lions in Alaskan waters. Canadian Journal of Zoology 75(5):776-786.

Mizroch, S., and D. Rice. 2013. Ocean nomads: Distribution and movements of sperm whales in the North Pacific shown by whaling data and Discovery marks. Marine Mammal Science 29:E136-E165.

Mizroch, S. A., and D. W. Rice. 2006. Have North Pacific killer whales switched prey species in response to depletion of the great whale populations? Marine Ecology Progress Series 310:235-246.

Mizroch, S. A., D. W. Rice, D. Zwiefelhofer, J. Waite, and W. L. Perryman. 2009. Distribution and movements of fin whales in the North Pacific Ocean. Mammal Review 39(3):193-227.

Moberg, G. P. 2000. Biological response to stress: Implications for animal welfare. Pages 1-21 *in* G. P. Moberg, and J. A. Mench, editors. The biology of animal stress: basic principles and implications for animal welfare. CABI Publishing, Oxon, United Kingdom.

Møhl, B., M. Wahlberg, P. T. Madsen, A. Heerfordt, and A. Lund. 2003. The monopulsed nature of sperm whale clicks. The Journal of the Acoustical Society of America 114(2):1143-1154.

Moore, S. E., J. T. Clarke, S. R. Okkonen, J. M. Grebmeier, C. L. Berchok, and K. M. Stafford. 2022. Changes in gray whale phenology and distribution related to prey variability and ocean biophysics in the northern Bering and eastern Chukchi seas. PLoS One 17(4):e0265934.

Moore, S. E., and K. L. Laidre. 2006. Trends in sea ice cover within habitats used by bowhead whales in the western Arctic. Ecological Applications 16(3):932-944.

Moore, S. E., K. M. Stafford, M. E. Dahlheim, C. G. Fox, H. W. Braham, J. J. Polovina, and D. E. Bain. 1998. Seasonal variation in reception of fin whale calls at five geographic areas in the North Pacific. Marine Mammal Science 14(3):617-627.

Moore, S. E., K. M. Stafford, H. Melling, C. Berchok, O. Wiig, K. M. Kovacs, C. Lydersen, and J. Richter-Menge. 2012. Comparing marine mammal acoustic habitats in Atlantic and Pacific sectors of the High Arctic: year-long records from Fram Strait and the Chukchi Plateau. Polar Biology 35(3):475-480.

Moore, S. E., J. M. Waite, N. A. Friday, and T. Honkalehto. 2002. Cetacean distribution and relative abundance on the central-eastern and the southeastern Bering Sea shelf with reference to oceanographic domains. Progress in Oceanography 55(1-2):249-261.

Morete, M. E., T. L. Bisi, and S. Rosso. 2007. Mother and calf humpback whale responses to vessels around the Abrolhos Archipelago, Bahia, Brazil. Journal of Cetacean Research and Management 9(3):241-248.

Morton, A., and H. K. Symonds. 2002. Displacement of *Orcinus orca* (L.) by high amplitude sound in British Columbia, Canada. ICES Journal of Marine Science 59(1):71-80.

Mueter, F. J., C. Broms, K. F. Drinkwater, K. D. Friedland, J. A. Hare, G. L. Hunt Jr, W. Melle, and M. Taylor. 2009. Ecosystem responses to recent oceanographic variability in high-latitude Northern Hemisphere ecosystems. 81:18.

Mulsow, J., and C. Reichmuth. 2010. Psychophysical and electrophysiological aerial audiograms of a Steller sea lion (Eumetopias jubatus). The Journal of the Acoustical Society of America 127(4):2692-2701.

Muto, M. M., V. T. Helker, B. J. Delean, N. C. Young, J. C. Freed, R. P. Angliss, N. A. Friday, P. L. Boveng, J. M. Breiwick, B. M. Brost, M. F. Cameron, P. J. Clapham, J. L. Crance, S. P. Dahle, M. E. Dahlheim, B. S. Fadely, M. C. Ferguson, L. W. Fritz, K. T. Goetz, R. C. Hobbs, Y. V. Ivashchenko, A. S. Kennedy, J. M. London, S. A. Mizroch, R. R. Ream, E. L. Richmond, K. E. W. Shelden, K. L. Sweeney, R. G. Towell, P. R. Wade, J. M. Waite, and A. N. Zerbini. 2021. Alaska marine mammal stock assessments, 2020. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center, Seattle, WA, July 2021. NOAA Technical Memorandum NMFS-AFSC-421, 398 p.

Muto, M. M., V. T. Helker, B. J. Delean, N. C. Young, J. C. Freed, R. P. Angliss, N. A. Friday, P. L. Boveng, J. M. Breiwick, B. M. Brost, M. F. Cameron, P. J. Clapham, J. L. Crance, S. P. Dahle, M. E. Dahlheim, B. S. Fadely, M. C. Ferguson, L. W. Fritz, K. T. Goetz, R. C. Hobbs, Y. V. Ivashchenko, A. S. Kennedy, J. M. London, S. A. Mizroch, R. R. Ream, E. L. Richmond, K. E. W. Shelden, K. L. Sweeney, R. G. Towell, P. R. Wade, J. M. Waite, and A. N. Zerbini. 2022. Alaska marine mammal stock assessments, 2021. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center, Seattle, WA, August 2022. NOAA Technical Memorandum NMFS-AFSC-441, 398 p.

Neff, J. M. 1990. Composition and Fate of Petroleum and Spill-Treating Agents in the Marine Environment. Pages 1-33 *in* J. R. Geraci, and D. J. St. Aubin, editors. Sea Mammals and Oil: Confronting the Risks. Academic Press, New York, NY.

Neilson, J., C. Gabriele, J. Straley, S. Hills, and J. Robbins. 2005. Humpback whale entanglement rates in southeast Alaska. Pages 203-204 *in* Sixteenth Biennial Conference on the Biology of Marine Mammals, San Diego, California.

Neilson, J. L., and C. Gabriele. 2020. Glacier Bay and Icy Strait humpback whale population monitoring: 2019 update. U.S. Dept. of Interior, National Park Service, Glacier Bay National Park and Preserve, Gustavus, AK, May 2020. National Park Service Resource Brief, 6 p.

Neilson, J. L., C. M. Gabriele, A. S. Jensen, K. Jackson, and J. M. Straley. 2012. Summary of reported whale-vessel collisions in Alaskan waters. Journal of Marine Biology 2012:106282.

Nemoto, T. 1970. Feeding pattern of baleen whales in the ocean. Pages 241-252 *in* J. H. Steele, editor. Marine Food Chains. University of California Press, Berkeley, CA.

NMFS. 2008. Recovery plan for the Steller sea lion (*Eumetopias jubatus*). Eastern and Western Distinct Population Segments (*Eumetopias jubatus*). Revision. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Silver Spring, MD, March 2008, 325 p.

NMFS. 2010a. Final recovery plan for the fin whale (*Balaenoptera physalus*). U.S. Dept. of Commerce, NOAA, National Marine Fisheries Service, Office of Protected Resources, Silver Spring, MD, July 2010, 121 p.

NMFS. 2010b. Final recovery plan for the sperm whale (*Physeter macrocephalus*). U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources, Silver Spring, MD, December 2010, 165 p.

NMFS. 2016. Recovery plan for the Cook Inlet beluga whale (*Delphinapterus leucas*). U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Region, Protected Resources Division, Juneau, AK, December 2016.

NMFS. 2018a. Assessment of the Pacific cod stock in the Gulf of Alaska. Alaska Fisheries Science Center, Seattle, WA.

NMFS. 2018b. Revision to technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing (Version 2.0): underwater acoustic thresholds for onset of permanent and temporary threshold shifts. U.S. Dept. of Commerce, National Oceanic and Atmospherica Administraiton, National Marine Fisheries Service, Office of Protected Resources, Silver Spring, MD. NOAA Tech. Memo. NMFS-OPR-55, 178 p.

NMFS. 2020. 5-year review: summary and evaluation of western Distinct Population Segment Steller sea lion *Eumetopias jubatus*. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Region, Protected Resources Division, Juneau, AK, February 2020, 61 p.

NMFS. 2021. Occurrence of Endangered Species Act (ESA) listed humpback whales off Alaska. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Region Protected Resources Division, Juneau, AK, Revised August 6, 2021. Internal guidance document.

Nøttestad, L., A. Fernö, S. Mackinson, T. Pitcher, and O. A. Misund. 2002. How whales influence herring school dynamics in a cold-front area of the Norwegian Sea. ICES Journal of Marine Science 59(2):393-400.

Notz, D., and J. Stroeve. 2016. Observed Arctic sea-ice loss directly follows anthropogenic CO_2 emission. Science 354(6313):747-750.

Nowacek, D. P., L. H. Thorne, D. W. Johnston, and P. L. Tyack. 2007. Responses of cetaceans to anthropogenic noise. Mammal Review 37(2):81-115.

NRC. 2003. Ocean Noise and Marine Mammals. National Research Council, Ocean Study Board, National Academy Press, Washington, D.C.

Nymo, I. H., R. Rodven, K. Beckmen, A. K. Larsen, M. Tryland, L. Quakenbush, and J. Godfroid. 2018. Brucella Antibodies in Alaskan True Seals and Eared Seals-Two Different Stories. Front Vet Sci 5:8.

Omura, H. 1955. Whales in the northern part of the North Pacific. Norsk Hvalfangst-Tidende 7:395-405.

Oreskes, N. 2004. The scientifc consensus on climate change. Science 306:1686.

Orr, J. C., V. J. Fabry, O. Aumont, L. Bopp, S. C. Doney, R. A. Feely, A. Gnanadesikan, N. Gruber, A. Ishida, F. Joos, R. M. Key, K. Lindsay, E. Maier-Reimer, R. Matear, P. Monfray, A. Mouchet, R. G. Najjar, G.-K. Plattner, K. B. Rodgers, C. L. Sabine, J. L. Sarmiento, R. Schlitzer, R. D. Slater, I. J. Totterdell, M.-F. Weirig, Y. Yamanaka, and A. Yool. 2005. Anthropogenic ocean acidification over the twenty-first century and its impact on calcifying organisms. Nature 437:681-686.

Overholtz, W., and J. Nicolas. 1979. Apparent feeding by the fin whale, *Balaenoptera physalus*, and the humpback whale, *Megaptera novaengliae*, on the American sand lange, *Ammodytes americanus*, in the Northwest Atlantic. Fisheries Bulletin 71(1):285-287.

Overland, J., E. Dunlea, J. E. Box, R. Corell, M. Forsius, V. Kattsov, M. S. Olsen, J. Pawlak, L.-O. Reiersen, and M. Wang. 2019. The urgency of Arctic change. Polar Science 21:6-13.

Overland, J. E. 2020. Less climatic resilience in the Arctic. Weather and Climate Extremes 30:100275.

Owl Ridge. 2014. Cosmopolitan State 2013 Drilling Program Marine Mammal Monitoring and Mitigation 90-day Report. Prepared by Owl Ridge Natural Resource Consultants for BlueCrest Alaska Operating LLC, Anchorage, AK, Sept. 26, 2014.

Panigada, S., M. Zanardelli, S. Canese, and M. Jahoda. 1999. Deep diving performances of Mediterranean fin whales. Pages 144 *in*.

Panigada, S., M. Zanardelli, M. MacKenzie, C. Donovan, F. Mélin, and P. S. Hammond. 2008. Modelling habitat preferences for fin whales and striped dolphins in the Pelagos Sanctuary (Western Mediterranean Sea) with physiographic and remote sensing variables. Remote Sensing of Environment 112(8):3400-3412.

Patterson, B., and G. Hamilton. 1964. Repetitive 20 cycle per second biological hydroacoustic signals at Bermuda. Proceedings of a Symposium held at the Lerner Marine Laboratory Bimini, Bahamas. Pages 125-145 *in* W. N. Tavolga, editor. Marine Bioacoustics, Pergamon Press Oxford.

Payne, R. S. 1970. Songs of the humpback whale. Capitol Records, Hollywood, CA.

Pearson, W. H., J. R. Skalski, and C. I. Malme. 1992. Effects of sounds from a geophysical survey device on behavior of captive rockfish (Sebastes spp.). Canadian Journal of Fisheries and Aquatic Sciences 49(7):1343-1356.

Perkins, J. S., and P. C. Beamish. 1979. Net entanglements of baleen whales in the inshore fishery of Newfoundland. Journal of the Fisheries Research Board of Canada 36(5):521-528.

Perovich, D., W. Meier, M. Tschudi, S. Farrell, S. Hendricks, S. Gerland, L. Kaleschke, R. Ricker, X. Tian-Kunze, M. Webster, and K. Wood. 2019. Arctic Report Card: Update for 2019 Sea Ice.

Perry, S. L., D. P. DeMaster, and G. K. Silber. 1999a. The great whales: History and status of six species listed as endangered under the U.S. Endangered Species Act of 1973. Marine Fisheries Review 61(1):1-74.

Perry, S. L., D. P. DeMaster, and G. K. Silber. 1999b. The Great Whales: History and Status of Six Species Listed as Endangered Under the U.S. Endangered Species Act of 1973: a special issue of the Marine Fisheries Review. Marine Fisheries Review 61(1):1-74.

Petersen, S., A. Krätschell, N. Augustin, J. Jamieson, J. R. Hein, and M. D. Hannington. 2016. News from the seabed – Geological characteristics and resource potential of deep-sea mineral resources. Marine Policy 70:175-187.

Peterson, W., N. Bond, and M. Robert. 2016. The blob (part three): Going, going, gone? PICES Press 24(1):46.

Pirrone, N., S. Cinnirella, X. Feng, R. B. Finkelman, H. R. Friedli, J. Leaner, R. Mason, A. B. Mukherjee, G. B. Stracher, and D. Streets. 2010. Global mercury emissions to the atmosphere from anthropogenic and natural sources. Atmospheric Chemistry and Physics 10(13):5951-5964.

Pitcher, K. W., and D. G. Calkins. 1981. Reproductive biology of Steller sea lions in the Gulf of Alaska. Journal of Mammalogy 62(3):599-605.

Popper, A., T. Carlson, B. Casper, and M. Halvorsen. 2014a. Does man-made sound harm fishes. Journal of Ocean Technology 9(1):11-20.

Popper, A. N., and A. D. Hawkins. 2019. An overview of fish bioacoustics and the impacts of anthropogenic sounds on fishes. Journal of Fish Biology 94(5):692-713.

Popper, A. N., A. D. Hawkins, R. R. Fay, D. A. Mann, S. Bartol, T. J. Carlson, S. Coombs, W. T. Ellison, R. L. Gentry, and M. B. Halvorsen. 2014b. ASA S3/SC1. 4 TR-2014 Sound exposure guidelines for fishes and sea turtles: a technical report prepared by ANSI-Accredited standards committee S3/SC1 and registered with ANSI. Springer.

Qi, D., L. Chen, B. Chen, Z. Gao, W. Zhong, Richard A. Feely, Leif G. Anderson, H. Sun, J. Chen, M. Chen, L. Zhan, Y. Zhang, and W.-J. Cai. 2017. Increase in acidifying water in the western Arctic Ocean. Nature Climate Change 7(3):195-199.

Randhawa, N., F. Gulland, G. M. Ylitalo, R. DeLong, and J. A. Mazet. 2015. Sentinel California sea lions provide insight into legacy organochlorine exposure trends and their association with cancer and infectious disease. One Health 1:37-43.

Rea, L. D., J. M. Castellini, J. P. Avery, B. S. Fadely, V. N. Burkanov, M. J. Rehberg, and T. M. O'Hara. 2022. Corrigendum to "Regional variations and drivers of mercury and selenium concentrations in Steller sea lions" [Sci. Total Environ. 744 (2020) 140787]. Science of the Total Environment 831:154887.

Rea, L. D., J. M. Castellini, L. Correa, B. S. Fadely, and T. M. O'Hara. 2013. Maternal Steller sea lion diets elevate fetal mercury concentrations in an area of population decline. Science of the Total Environment 454-455:277-282.

Reijnders, P. J. H. 1986. Reproductive failure in common seals feeding on fish from polluted coastal waters. Nature 324(6096):456-457.

Reine, K., D. Clarke, and C. Dickerson. 2014. Characterization of underwater sounds produced by hydraulic and mechanical dredging operations. The Journal of the Acoustical Society of America 135:3280.

Reine, K. J., and C. Dickerson. 2014. Characterization of underwater sounds produced by a hydraulic cutterhead dredge during maintenance dredging in the Stockton Deepwater Shipping Channel, California, ERDC TN-DOER-E38, March 2014, 23 p.

Reisdorph, S. C., and J. T. Mathis. 2014. The dynamic controls on carbonate mineral saturation states and ocean acidification in a glacially dominated estuary. Estuarine, Coastal and Shelf Science 144:8-18.

Reyff, J. 2020. Review of down-the-hole rock socket drilling acoustic data measured for White Pass and Yukon Route (WP&YR) mooring dolphins. Report prepared by Illingworth and Rodkin, Inc., Cotati, CA, May 28, 2020.

Reyff, J., and C. Heyvaert. 2019. White Pass and Yukon Railroad mooring dolphin installation: pile driving and drilling sound source verification, Skagway, AK, Prepared by Illingworth and Rodkin, Inc. for PND Engineers, Inc., Job No 18-221.

Rice, A. C., A. Širović, J. S. Trickey, A. J. Debich, R. S. Gottlieb, S. M. Wiggins, J. A. Hildebrand, and S. Baumann-Pickering. 2021. Cetacean occurrence in the Gulf of Alaska from long-term passive acoustic monitoring. Marine Biology 168:72.

Rice, D. W. 1989. Sperm whale *Physeter macrocephalus* Linnaeus, 1758. Pages 177-233 *in* S. Ridgway, and R. Harrison, editors. Handbook of marine mammals, volume 4. Academic Press, New York, New York.

Richardson, W. J., C. R. Greene Jr, C. I. Malme, and D. H. Thomson. 1995. Marine mammals and noise. Academic Press, Inc., San Diego, CA.

Richardson, W. J., and C. I. Malme. 1993. Man-made noise and behavioral responses. Pages 631-700 *in* J. J. Burns, J. J. Montague, and C. J. Cowles, editors. The Bowhead Whale, volume Society for Marine Mammology Special Publication Number 2. Allen Press, Inc., Lawrence, KS.

Ridgway, S. H., D. A. Carder, R. R. Smith, T. Kamolnick, C. E. Schlunt, and W. R. Elsberry. 1997. Behavioural responses and temporary shift in masked hearing threshold of bottlenose dolphins, *Tursiops truncatus*, to 1-second tones of 141 to 201 dB re 1 mPa. Naval Command, Control and Surveillance Center, RDT&E Division, San Diego, California, July 1997.

Robinson, S. P., P. D. Theobald, P. A. Lepper, G. Hayman, V. F. Humphrey, L.-S. Wang, and S. Mumford. 2011. Meaasurement of underwater noise arising from marine aggregate operations. Pages 465-468 *in* A. N. Popper, and A. Hawkins, editors. The Effects of Noise on Aquatic Life. Springer, New York.

Rockwood, R. C., J. Calambokidis, and J. Jahncke. 2017. High mortality of blue, humpback and fin whales from modeling of vessel collisions on the U.S. West Coast suggests population impacts and insufficient protection. PLoS One 12(8):e0183052.

Rolland, R. M., S. E. Parks, K. E. Hunt, M. Castellote, P. J. Corkeron, D. P. Nowacek, S. K. Wasser, and S. D. Kraus. 2012. Evidence that ship noise increases stress in right whales. Proceedings of the Royal Society B: Biological Sciences 279(1737):2363-2368.

Romano, T. A., D. L. Felten, S. Y. Stevens, J. A. Olschowka, V. Quaranta, and S. H. Ridgway. 2002. Immune response, stress, and environment: Implications for cetaceans. Pages 253-279 *in* C. J. Pfeiffer, editor. Molecular and Cell Biology of Marine Mammals. Krieger Publishing Co., Malabar, FL.

Rone, B. K., A. N. Zerbini, A. B. Douglas, D. W. Weller, and P. J. Clapham. 2017a. Abundance and distribution of cetaceans in the Gulf of Alaska. Marine Biology 164:23.

Rone, B. K., A. N. Zerbini, A. B. Douglas, D. W. Weller, and P. J. Clapham. 2017b. Abundance and distribution of cetaceans in the Gulf of Alaska. Marine Biology 164(23).

Rugh, D. J., K. E. Shelden, and B. A. Mahoney. 2000. Distribution of belugas, *Delphinapterus leucas*, in Cook Inlet, Alaska, during June/July 1993–2000. Marine Fisheries Review 62(3):6-21.

Rugh, D. J., K. E. Shelden, C. L. Sims, B. A. Mahoney, B. K. Smith, L. K. Litzky, and R. C. Hobbs. 2005. Aerial surveys of beluga in Cook Inlet, Alaska, June 2001, 2002, 2003, and 2004. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center, Seattle, WA. NOAA Technical Memorandum NMFS-AFSC-149, 71 p.

Sandegren, F. E. 1970. Breeding and maternal behavior of the Steller sea lion (*Eumetopias jubata*) in Alaska. University of Alaska, Fairbanks, AK, 138.

Savage, K. 2017. Alaska and British Columbia large whale unusual mortality event summary report. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Region Protected Resources Division, Juneau, AK, August 17, 2017.

Savery, L. C., D. C. Evers, S. S. Wise, C. Falank, J. Wise, C. Gianios Jr, I. Kerr, R. Payne, W. D. Thompson, and C. Perkins. 2013. Global mercury and selenium concentrations in skin from free-ranging sperm whales (Physeter macrocephalus). Science of the Total Environment 450:59-71.

Schoeman, R. P., C. Patterson-Abrolat, and S. Plon. 2020. A global review of vessel collisions with marine animals. Frontiers in Marine Science 7:292.

Selin, N. E. 2009. Global biogeochemical cycling of mercury: a review. Annual review of environment and resources 34:43-63.

Service, N. M. F. 2022. Fisheries of the United States, 2020.

Sharpe, F. A., and L. M. Dill. 1997. The behavior of Pacific herring schools in response to artificial humpback whale bubbles. Canadian Journal of Zoology-Revue Canadienne De Zoologie 75(5):725-730.

Shelden, K. E. W., K. T. Goetz, D. J. Rugh, D. G. Calkins, B. A. Mahoney, and R. C. Hobbs. 2015. Spatio-temporal changes in beluga whale, *Delphinapterus leucas*, distribution: results from aerial surveys (1977-2014), opportunistic sightings (1975-2014), and satellite tagging (1999-2003) in Cook Inlet, Alaska. Marine Fisheries Review 77(2):1-32.

Shelden, K. E. W., R. C. Hobbs, C. L. Sims, L. Vate Brattstrom, J. A. Mocklin, C. Boyd, and B. A. Mahoney. 2017. Aerial surveys, abundance, and distribution of beluga whales (*Delphinapterus leucas*) in Cook Inlet, Alaska, June 2016. U. S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center, Seattle, WA, June 2017. AFSC Processed Report 2017-09, 62 p.

Shelden, K. E. W., D. J. Rugh, K. T. Goetz, C. L. Sims, L. Vate Brattstrom, J. A. Mocklin, B. A. Mahoney, B. K. Smith, and R. C. Hobbs. 2013. Aerial surveys of beluga whales, *Delphinapterus leucas*, in Cook Inlet, Alaska, June 2005 to 2012. U. S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center, Seattle, WA, December 2013. NOAA Technical Memoorandum NMFS-AFSC-263, 131 p.

Silber, G. K. 1986. The relationship of social vocalizations to surface behavior and aggression in the Hawaiian humpback whale (*Megaptera novaeangliae*). Canadian Journal of Zoology 64(10):2075-2080.

Silber, G. K., and J. D. Adams. 2019. Vessel operations in the Arctic, 2015–2017. Frontiers in Marine Science 6:1-18.

Silber, G. K., D. W. Weller, R. R. Reeves, J. D. Adams, and T. J. Moore. 2021. Co-occurrence of gray whales and vessel traffic in the North Pacific Ocean. Endangered Species Research 44:177-201.

Simon, M., M. Johnson, and P. T. Madsen. 2012. Keeping momentum with a mouthful of water: behavior and kinematics of humpback whale lunge feeding. Journal of Experimental Biology 215(21):3786-3798.

Sinclair, E., D. S. Johnson, T. K. Zeppelin, and T. S. Gelatt. 2013. Decadal variation in the diet of Western Stock Steller sea lions (*Eumetopias jubatus*). NMFS-AFSC-248.

Sinclair, E. H., and T. K. Zeppelin. 2002. Seasonal and spatial differences in diet in the western stock of Steller sea lions (*Eumetopias jubatus*). Journal of Mammalogy 83(4):973-990.

Skalski, J. R., W. H. Pearson, and C. I. Malme. 1992. Effects of sounds from a geophysical survey device on catch-per-unit-effort in a hook-and-line fishery for rockfish (Sebastes spp.). Canadian Journal of Fisheries and Aquatic Sciences 49(7):1357-1365.

Soule, D. C., and W. S. Wilcock. 2013. Fin whale tracks recorded by a seismic network on the Juan de Fuca Ridge, Northeast Pacific Ocean. The Journal of the Acoustical Society of America 133(3):1751-1761.

Southall, B. L., A. E. Bowles, W. T. Ellison, J. J. Finneran, R. L. Gentry, C. R. Greene Jr., D. Kastak, D. R. Ketten, J. H. Miller, P. E. Nachtigall, W. J. Richardson, J. A. Thomas, and P. L. Tyack. 2007. Marine mammal noise exposure criteria: Initial scientific recommendations. Aquatic Mammals 33(4):411-521.

Squadrone, S., E. Chiaravalle, S. Gavinelli, G. Monaco, M. Rizzi, and M. Abete. 2015. Analysis of mercury and methylmercury concentrations, and selenium: mercury molar ratios for a toxicological assessment of sperm whales (Physeter macrocephalus) in the most recent stranding event along the Adriatic coast (Southern Italy, Mediterranean Sea). Chemosphere 138:633-641.

Stafford, K. M., J. C. George, Q. Harcharek, and S. E. Moore. 2023. Humpback whale sightings in northern Arctic Alaska. Marine Mammal Science 40:246-253.

Stafford, K. M., D. K. Mellinger, S. E. Moore, and C. G. Fox. 2007. Seasonal variability and detection range modeling of baleen whale calls in the Gulf of Alaska, 1999-2002. Journal of the Acoustical Society of America 122(6):3378-3390.

Stafford, K. M., S. E. Moore, P. J. Stabeno, D. V. Holliday, J. M. Napp, and D. K. Mellinger. 2010. Biophysical ocean observation in the southeastern Bering Sea. Geophysical Research Letters 37(2):L02606.

Steiger, G. H., J. Calambokidis, J. M. Straley, L. M. Herman, S. Cerchio, D. R. Salden, J. Urban-R., J. K. Jacobsen, O. von Ziegesar, K. C. Balcomb, C. M. Gabriele, M. E. Dahlheim, S. Uchida, J. K. B. Ford, P. Ladron de Guevara-P., M. Yamaguchi, and J. Barlow. 2008. Geographic variation in killer whale attacks on humpback whales in the North Pacific: Implications for predation pressure. Endangered Species Research 4:247-256.

Stewart, J. D., T. W. Joyce, J. W. Durban, J. Calambokidis, D. Fauquier, H. Fearnbach, J. M. Grebmeier, M. Lynn, M. Manizza, W. L. Perryman, M. T. Tinker, and D. W. Weller. 2023. Boom-bust cycles in gray whales associated with dynamic and changing Arctic conditions. Science 382(6667):207-211.

Stone, G. S., S. K. Katona, A. Mainwaring, J. M. Allen, and H. D. Corbett. 1992. Respiration and surfacing rates of fin whales (*Balaenoptera physalus*) observed from a lighthouse tower. Report of the International Whaling Commission 42:739-745.

Straley, J. M., J. R. Moran, K. M. Boswell, J. J. Vollenweider, R. A. Heintz, T. J. Quinn Ii, B. H. Witteveen, and S. D. Rice. 2018. Seasonal presence and potential influence of humpback whales on wintering Pacific herring populations in the Gulf of Alaska. Deep Sea Research Part II: Topical Studies in Oceanography 147:173-186.

Straley, J. M., G. Schorr, A. Thode, J. Calambokidis, C. Lunsford, E. M. Chenoweth, V. O. Connell, and R. Andrews. 2014. Depredating sperm whales in the Gulf of Alaska: local habitat use and long distance movements across putative population boundaries. Endangered Species Research 24(2):125-135.

Stroeve, J., M. M. Holland, W. Meier, T. Scambos, and M. Serreze. 2007. Arctic sea ice decline: Faster than forecast. Geophysical Research Letters 34(9).

Stroeve, J., and D. Notz. 2018. Changing state of Arctic sea ice across all seasons. Environmental Research Letters 13(10):103001.

Stroeve, J. C., V. Kattsov, A. Barrett, M. Serreze, T. Pavlova, M. Holland, and W. N. Meier. 2012. Trends in Arctic sea ice extent from CMIP5, CMIP3 and observations. Geophysical Research Letters 39(16).

Suedel, B. C., A. D. McQueen, J. L. Wilkens, and M. P. Fields. 2019. Evaluating effects of dredging-induced underwater sound to aquatic species: a literature review. U.S. Army Corps of Engineers, Engineer Research and Development Center (ERDC), Dredging Operations and Environmental Research (DOER), Vicksburg, MS, September 2019. Final Report ERDC/EL TR-19-18.

Sullender, B. K., K. Kapsar, A. Poe, and M. Robards. 2021. Spatial management measures alter vessel behavior in the Aleutian archipelago. Frontiers in Marine Science 7:1186.

Suryan, R. M., M. L. Arimitsu, H. A. Coletti, R. R. Hopcroft, M. R. Lindeberg, S. J. Barbeaux, S. D. Batten, W. J. Burt, M. A. Bishop, J. L. Bodkin, R. Brenner, R. W. Campbell, D. A. Cushing, S. L. Danielson, M. W. Dorn, B. Drummond, D. Esler, T. Gelatt, D. H. Hanselman, S. A. Hatch, S. Haught, K. Holderied, K. Iken, D. B. Irons, A. B. Kettle, D. G. Kimmel, B. Konar, K. J. Kuletz, B. J. Laurel, J. M. Maniscalco, C. Matkin, C. A. E. McKinstry, D. H. Monson, J. R. Moran, D. Olsen, W. A. Palsson, W. S. Pegau, J. F. Piatt, L. A. Rogers, N. A. Rojek, A. Schaefer, I. B. Spies, J. M. Straley, S. L. Strom, K. L. Sweeney, M. Szymkowiak, B. P. Weitzman, E. M. Yasumiishi, and S. G. Zador. 2021. Ecosystem response persists after a prolonged marine heatwave. Scientific Reports 11(1):6235.

Sweeney, K., B. Birkemeier, K. Luxa, and T. Gelatt. 2019. Results of Steller sea lion surveys in Alaska, June-July 2019. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center, Marine Mammal Laboratory, Seattle, WA, December 2019. NOAA AFSC Processed Report 2019-12, 21 p.

Sweeney, K., L. Fritz, R. Towell, and T. Gelatt. 2017. Results of Steller sea lion surveys in Alaska, June-July 2017. Memorandum to the Record, December 5, 2017.

Sweeney, K., R. Towell, and T. Gelatt. 2018. Results of Steller sea lion surveys in Alaska, June-July 2018: Memorandum to The Record. U.S. Dept. of Commerce, NOAA, NMFS, Alaska Fisheries Science Center, Marine Mammal Laboratory, Seattle, WA, December 2018.

Thoman, R., and J. Walsh. 2019. Alaska's Changing Environment: documenting Alaska's physical and biological changes through observations. International Arctic Research Center, University of Alaska Fairbanks.

Thompson, P. O., W. C. Cummings, and S. J. Ha. 1986. Sounds, source levels, and associated behavior of humpback whales, Southeast Alaska. Journal of the Acoustical Society of America 80(3):735-740.

Thompson, P. O., L. T. Findley, and O. Vidal. 1992. 20-Hz pulses and other vocalizations of fin whales, *Balaenoptera physalus*, in the Gulf of California, Mexico. The Journal of the Acoustical Society of America 92(6):3051-3057.

Thompson, T. J., H. E. Winn, and P. J. Perkins. 1979. Mysticete sounds. Pages 403-431 *in* H. E. Winn, and B. L. Olla, editors. Behavior of Marine Animals: Current Perspectives in Research Vol. 3: Cetaceans. Plenum Press, New York, NY.

Thorson, P., and J. Reyff. 2006. San Francisco-Oakland Bay bridge east span seismic safety project marine mammals and acoustic monitoring for the marine foundations at piers E2 and T1, January-September 2006. Prepared by SRS Technologies and Illingworth & Rodkin, Inc. for the California Department of Transportation: 51 p.

Todd, V. L. G., I. B. Todd, J. C. Gardiner, E. C. N. Morrin, N. A. MacPherson, N. A. DiMarzio, and F. Thomsen. 2015. A review of impacts of marine dredging activities on marine mammals. ICES (International Council for the Exploration of the Seas) Journal of Marine Science 72(2):328-340.

Tomilin, A. 1967. Mammals of the USSR and adjacent countries. Cetacea 9:666-696.

Tyack, P., and H. Whitehead. 1983. Male competition in large groups of wintering humpback whales. Behaviour 83(1/2):132-154.

Tyack, P. L. 1981. Interactions between singing Hawaiian humpback whales and conspecifics nearby. Behavioral Ecology and Sociobiology 8:105-116.

Vanderlaan, A. S. M., and C. T. Taggart. 2007. Vessel collisions with whales: the probability of lethal injury based on vessel speed. Marine Mammal Science 23(1):144-156.

VanWormer, E., J. A. K. Mazet, A. Hall, V. A. Gill, P. L. Boveng, J. M. London, T. Gelatt, B. S. Fadely, M. E. Lander, J. Sterling, V. N. Burkanov, R. R. Ream, P. M. Brock, L. D. Rea, B. R. Smith, A. Jeffers, M. Henstock, M. J. Rehberg, K. A. Burek-Huntington, S. L. Cosby, J. A. Hammond, and T. Goldstein. 2019. Viral emergence in marine mammals in the North Pacific may be linked to Arctic sea ice reduction. Scientific Reports 9(1):15569.

Vidal, O., and G. Pechter. 1989. Behavioral observations on fin whale, *Balaenoptera physalus,* in the presence of killer whale, *Orcinus orca*. Fishery Bulletin 87(2):370-373.

Wade, P. R. 2021. Estimates of abundance and migratory destination for North Pacific humpback whales in both summer feeding areas and winter mating and calving areas. National Marine Fisheries Service, Alaska Fisheries Science Center, Seattle, WA. Paper submitted to the International Whaling Commission SC/68C/IA/03.

Waring, G. T. e., E. e. Josephson, C. P. e. Fairfield, K. e. Maze-Foley, D. Belden, T. V. N. Cole, L. P. Garrison, K. Mullin, C. D. Orphanides, R. M. Pace III, D. Palka, M. C. Rossman, and F. W. Wenzel. 2007. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments 2006. NMFS-NE-201, 388.

Wartzok, D., A. N. Popper, J. Gordon, and J. Merrill. 2003. Factors Affecting the Responses of Marine Mammals to Acoustic Disturbance. Marine Technology Society Journal 37(4):6-15.

Watkins, W., K. Moore, and P. Tyack. 1985. Sperm whales acoustic behaviour in the Southeast Caribbean. Cetology 49:1-15.

Watkins, W. A. 1981. Activities and underwater sounds of fin whales. Scientific Reports of the Whales Research Institute 33:83-117.

Watkins, W. A., P. Tyack, K. E. Moore, and J. E. Bird. 1987. The 20-Hz signals of finback whales (*Balaenoptera physalus*). The Journal of the Acoustical Society of America 82(6):1901-1912.

Watson, R. T., and D. L. Albritton. 2001. Climate change 2001: Synthesis report: Third assessment report of the Intergovernmental Panel on Climate Change. Cambridge University Press.

Weilgart, L., and H. Whitehead. 1993. Coda communication by sperm whales (*Physeter macrocephalus*) off the Galapagos Islands. Canadian Journal of Zoology 71(4):744-752.

Weilgart, L. S. 2007. A brief review of known effects of noise on marine mammals. International Journal of Comparative Psychology 20(2):159-168.

Weir, C. R., and J. C. Goold. 2007. The burst-pulse nature of 'squeal' sounds emitted by sperm whales (*Physeter macrocephalus*). Marine Biological Association of the United Kingdom. Journal of the Marine Biological Association of the United Kingdom 87(1):39.

Weller, D. W., R. Anderson, B. Easley-Appleyard, G. Ferrara, A. R. Lang, J. Moore, P. E. Rosel, B. Taylor, and N. C. Young. 2023. Distinct population segment analysis of western North Pacific gray whales (*Eschrichtius robustus*) under the Endangered Species Act. U. S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center, La Jolla, CA, March 2023. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-679, 26 p.

Weller, D. W., A. Klimek, A. L. Bradford, J. Calambokidis, A. R. Lang, B. Gisborne, A. M. Burdin, W. Szaniszlo, J. Urban, A. G.-G. Unzueta, S. Swartz, and R. L. Brownell Jr. 2012. Movements of gray whales between the western and eastern North Pacific. Endangered Species Research 18(2):193-199.

West, K. L., G. Levine, J. Jacob, B. Jensen, S. Sanchez, K. Colegrove, and D. Rotstein. 2015. Coinfection and vertical transmission of Brucella and Morbillivirus in a neonatal sperm whale (*Physeter macrocephalus*) in Hawaii, USA. Journal of Wildlife Diseases 51(1):227-232.

Whitehead, H., and T. Arnbom. 1987. Social organization of sperm whales off the Galapagos Islands, February–April 1985. Canadian Journal of Zoology 65(4):913-919.

Wiese, K. 1996. Sensory capacities of euphausiids in the context of schooling. Marine and Freshwater Behaviour and Physiology 28(3):183-194.

Wieting, D. S. 2016. Interim Guidance on the Endangered Species Act Term "Harass". U.S. Dept. of Commerce, NOAA, NMFS, Office of Protected Resources, Silver Spring, MD, October 21, 2016. Memorandum from the Director of the NMFS Office of Protected Resources to NMFS Regional Administrators.

Wilcox, C., G. Heathcote, J. Goldberg, R. Gunn, D. Peel, and B. D. Hardesty. 2015. Understanding the sources and effects of abandoned, lost, and discarded fishing gear on marine turtles in northern Australia. Conservation Biology 29(1):198-206.

Wild, L., A. Thode, J. Straley, S. Rhoads, D. Falvey, and J. Liddle. 2017. Field trials of an acoustic decoy to attract sperm whales away from commercial longline fishing vessels in western Gulf of Alaska. Fisheries Research 196:141-150.

Wild, L. A., H. E. Riley, H. C. Pearson, C. M. Gabriele, J. L. Neilson, A. Szabo, J. Moran, J. M. Straley, and S. DeLand. 2023. Biologically Important Areas II for cetaceans within U.S. and adjacent waters–Gulf of Alaska region. Frontiers in Marine Science 10:763.

Williams, R., D. E. Bain, J. K. B. Ford, and A. W. Trites. 2002. Behavioural responses of male killer whales to a 'leapfrogging' vessel. Journal of Cetacean Research and Management 4(3):305-310.

Winn, H. E., P. J. Perkins, and T. C. Poulter. 1970. Sounds of the humpback whale. Pages 39-52 *in* 7th Annual Conference on Biological Sonar and Diving Mammals, Stanford Research Institute, Menlo Park.

Yamamoto, A., M. Kawamiya, A. Ishida, Y. Yamanaka, and S. Watanabe. 2012. Impact of rapid sea-ice reduction in the Arctic Ocean on the rate of ocean acidification. Biogeosciences 9(6):2365-2375.

Young, N. C., M. M. Muto, V. T. Helker, B. J. Delean, J. C. Freed, R. P. Angliss, N. A. Friday, P. L. Boveng, J. M. Breiwick, B. M. Brost, M. F. Cameron, P. J. Clapham, J. L. Crance, S. P. Dahle, M. E. Dahlheim, B. S. Fadely, M. C. Ferguson, L. W. Fritz, K. T. Goetz, R. C. Hobbs, Y. V. Ivashchenko, A. S. Kennedy, J. M. London, S. A. Mizroch, R. R. Ream, E. L. Richmond, K. E. W. Shelden, K. L. Sweeney, R. G. Towell, P. R. Wade, J. M. Waite, and A. N. Zerbini. 2022. Draft Alaska marine mammal stock assessments, 2022. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center, Seattle, WA. NOAA Technical Memorandum NMFS-AFSC-X.

Young, N. C., M. M. Muto, V. T. Helker, B. J. Delean, J. C. Freed, R. P. Angliss, N. A. Friday, P. L. Boveng, J. M. Breiwick, B. M. Brost, M. F. Cameron, P. J. Clapham, J. L. Crance, S. P. Dahle, M. E. Dahlheim, B. S. Fadely, M. C. Ferguson, L. W. Fritz, K. T. Goetz, R. C. Hobbs, Y. V. Ivashchenko, A. S. Kennedy, J. M. London, S. A. Mizroch, R. R. Ream, E. L. Richmond, K. E. W. Shelden, K. L. Sweeney, R. G. Towell, P. R. Wade, J. M. Waite, and A. N. Zerbini. 2023. Alaska marine mammal stock assessments, 2022. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center, Seattle, WA, July 2023. NOAA Technical Memorandum NMFS-AFSC-474, 316 p.

Zerbini, A. N., J. M. Waite, J. L. Laake, and P. R. Wade. 2006. Abundance, trends and distribution of baleen whales off Western Alaska and the central Aleutian Islands. Deep Sea Research Part I-Oceanographic Research Papers 53(11):1772-1790.