United States Department of the Interior

U.S. FISH AND WILDLIFE SERVICE
Anchorage Fish and Wildlife Field Office
4700 BLM Road, Anchorage, Alaska 99507

In Reply Refer To:
FWS/AFES/AFWFO

FEB 27 2015

Mark L. Everett
U.S. Coast Guard District 17
P.O. Box 25517
Juneau, Alaska 99802

Marcia Combes
U.S. Environmental Protection Agency
222 West 7th Avenue, #19
Anchorage, Alaska 99513

Re: Alaska Federal/State Preparedness Plan for Response to Oil & Hazardous Substance Discharges (Consultation #2011-0036)

Dear Mr. Everett and Ms. Combes:

The U.S. Fish and Wildlife Service (Service) wishes to acknowledge the U.S. Coast Guard's (USCG) and Environmental Protection Agency's (EPA) commitment to a meaningful consultation pursuant to section 7(a)2 of the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq., as amended, ESA) regarding Alaska's Federal and State Preparedness Plan for Response to Oil and Hazardous Substance Discharges and Releases (Unified Plan). The enclosed document transmits the Service's Biological Opinion (BO), which is based upon the best scientific and commercial data available to inform the analyses of potential effects of the implementation of the Unified Plan on listed or candidate species and designated critical habitat.

The Service's BO assesses listed species under our management authority including: the southwest Distinct Population Segment (DPS) of northern sea otter (*Enhydra lutris kenyoni*, listed as threatened in 2005); short-tailed albatross (*Phoebastria albatrus*, listed as endangered in 2000); the spectacled eider (*Somateria fischeri,* listed as threatened in 1993); Alaska breeding population of Steller's eider (*Polysticta stelleri*, listed as threatened in 1997); Pacific walrus (*Odobenus rosmarus divergens*, a candidate as of 2011); and the polar bear (*Ursus maritimus*, listed as threatened in 2008). We also assess adverse effects to critical habitat federally designated for Steller's and spectacled eiders, and sea otters.

Section 7 Consultation History

03/03/2011 – Service received a letter from EPA and USCG expressing intent to consult on the Unified Plan
05/16/2011 – Service received a request from EPA and USCG for a species list
06/16/2011 – Service issued species list to EPA and USCG
02/14/2012 – EPA and USCG requested formal consultation on the Unified Plan
09/04/2013 – Service receive Draft BA
09/05/2013 – Service received Draft Dispersant Use Plan
09/20/2013 – Service provided comments to EPA and USCG on the Draft Dispersant Use Plan
02/10/2014 – Service received a Final BA and request for initiation of formal consultation
04/08/2014 – Service received final draft of dispersant policy
04/11/2014 – Service requested additional information
07/02/2014 – Service received additional information, but some information needs were still outstanding
10/06/2014 – Service received final installment of requested information
10/07/2014 – Service issued notice to EPA and USCG that information was adequate and formal consultation was initiated
02/10/2015 – Service requested and received approval for a 10 day extension for completion of the BO

Using EPA's risk assessment framework, the Service evaluated potential exposure to stressors, assessed the ecological impacts to the exposure, and finally characterized risk. Under this approach, the Service found that proposed activities implemented under the Unified Plan would not jeopardize listed species under the jurisdiction of the Service or result in adverse modification of critical habitat. Take of individuals, however, is likely to occur during a spill response event, but will be enumerated during emergency consultation. This BO fully documents our rational for reaching these conclusions.

Thank you for your cooperation in meeting our joint responsibilities under section 7 of the ESA. If you have questions, please contact Ecological Services Branch Chief, Ellen Lance, Ellen_Lance@fws.gov (907-271-1467), or me at Socheata_Lor@fws.gov (907-271-2787).

Sincerely,

Socheata Lor, Ph.D.
Anchorage Field Supervisor

Enclosure: Biological Opinion

cc: Sadie Wright, NOAA; Capt. Dan Travers, USCG

BIOLOGICAL OPINION

For the

Alaska Federal/State Preparedness Plan for Response to Oil & Hazardous Substance Discharges/Releases

Consultation with
U.S. Coast Guard and
Environmental Protection Agency

Prepared by:
Anchorage Fish and Wildlife Field Office
U. S. Fish and Wildlife Service
4700 BLM Rd
Anchorage, AK 99507
February 27, 2015

Cover Photo. Spectacled eiders (*Somateria fischeri*)

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Acronyms & Abbreviations

A-C:	Alaska-Chukotka
ACP:	Arctic Coastal Plain
ADEC:	Alaska Department of Environmental Conservation
ARRT:	Alaska Regional Response Team
BA:	Biological Assessment. The Biological Assessment of the Alaska Federal/State Preparedness Plan for Response to Oil & Hazardous Substance Discharges/Releases (Unified Plan)
BCFO:	Bunker C fuel oil
BIOS:	Baffin Island Oil Spill
BLM:	The Bureau of Land Management
BMPs:	Best Management Practices
BO:	Biological Opinion
BOEM:	Bureau of Ocean Energy Management
BSEE:	Bureau of Safety and Environmental Enforcement
CDC:	Centers for Disease Control and Prevention
CFR:	Code of Federal Regulations
CHU:	Critical Habitat Unit
CI:	Confidence Interval
CITES:	Convention on International Trade in Endangered Species of Wildlife Fauna and Flora
DHS:	Deepwater Horizon Spill
DMA:	Division of Management Authority
DOC:	Department of Commerce
DOI:	Department of the Interior
DPS:	Distinct Population Segment
DWG:	Dispersant Working Group
EEZ:	Exclusive Economic Zone
EPA:	U.S. Environmental Protection Agency
ESA:	Endangered Species Act of 1973, as amended
EU:	Environmental Unit
EVOS:	Exxon Valdez oil spill
FOSC:	Federal On-Scene Coordinator
GHG:	Greenhouse gas
GRS:	Geographic Response Strategy
IAP:	Incident Action Plan
ICS:	Incident Command System
I-I:	Inuvialuit-Inupiat
IPCC:	Intergovernmental Panel on Climate Change
IUCN:	International Union for Conservation of Nature
KSCHU:	Kuskokwim Shoals Critical Habitat Unit
LBCHU:	Ledyard Bay Critical Habitat Unit
MMPA:	Marine Mammal Protection Act
MMS:	Minerals Management Service

MOA: Memorandum of Agreement
NCP: National Contingency Plan
NMFS: National Marine Fisheries Service
NMML: National Marine Mammal Laboratory
NOAA: National Oceanic and Atmospheric Administration
NOBE: Newfoundland Offshore Burn Experiment
NSE: North Slope Eider
OCs: Organochlorine compounds
OSAs Oil-suspended particulate matter aggregates
PAHs: Polycyclic aromatic hydrocarbons
PBSG: Polar Bear Specialist Group
PCEs Primary Constituent Elements of Critical Habitat
POPs: Persistent organic pollutants
PVA Population viability analysis
PWS: Prince William Sound
RP: Responsible Party
SBS: Southern Beaufort Sea
SCP: Subarea Contingency Plan
SMART: Special Monitoring of Applied Response Technologies
SRC: Spill Response Coordinator
UME: Unusual Mortality Event
US, U.S.: United States
USCG: U.S. Coast Guard
USEPA: U.S. Environmental Protection Agency
USFWS: United States Fish U.S. Fish and Wildlife Service (Service)
USGS: U.S. Geological Survey
UV: Light Ultra-violet
WAF Water Accommodated Fraction
Y-K: Yukon-Kuskokwim

Units of Measure
µl: microliter
bbl: oil barrel, 42 US gal (159 liters)
cm: centimeter
dwt: deadweight tonnage
ft: feet
g: gram
gal: gallon
h: hour
km: kilometer
km^2: square kilometer
L: liter
lb: pound
m: meter
M: million
mi: mile
ml: milliliter
mos: months
ppm: parts per million
yr(s): year(s)

1.0 INTRODUCTION

This document transmits the U.S. Fish and Wildlife Service's (Service) Biological Opinion (BO) in accordance with section 7(a)2 of the Endangered Species Act of 1973, as amended (ESA), on effects of *Alaska Federal/State Preparedness Plan for Response to Oil and Hazardous Substance* Discharges (ARRT 2010; hereafter referred to as the Unified Plan, or "the Action"; see http://www.akrrt.org/UnifiedPlan/) on: the southwest Distinct Population Segment (DPS) of northern sea otter (*Enhydra lutris kenyoni*, listed as threatened in 2005); short-tailed albatross (*Phoebastria albatrus*, listed as endangered in 2000); the spectacled eider (*Somateria fischeri*, listed as threatened in 1993); Alaska breeding population of Steller's eider (*Polysticta stelleri*, listed as threatened in 1997); Pacific walrus (*Odobenus rosmarus divergens*, a candidate as of 2011); the polar bear (*Ursus maritimus*, listed as threatened in 2008); and designated critical habitat for these species. The U.S. Coast Guard (USCG) and the U.S. Environmental Protection Agency (EPA) are the lead Federal agencies, or "Action Agencies" implementing the Unified Plan, and have made the following determinations of effects (Table 1).

Table 1. Effects determinations from USEPA and USCG for listed species under jurisdiction of the Service.

Species	Status[a]	CH[b]	Deter-mination[c]	Rationale
Northern sea otter – southwest Alaska DPS	T	Yes	LAA, LAA (CH)	Dispersed oil can foul fur, resulting in hypothermia. Ingestion of dispersed oil while grooming could result in sublethal effects. Impacts to eyes, mucus membranes, or lungs may occur from exposure to dispersants or dispersed oil. Removal of kelp in CH that provides protection from marine predators may occur.
Short-tailed albatross	E	No	LAA	This species does not breed or nest in Alaska. Species congregates in open ocean and at the edge of the continental shelf.
Spectacled eider	T	Yes	LAA, LAA (CH)	Response activities during the breeding season could cause nest abandonment or destruction. Response activities may displace eiders from feeding and sheltering habitat. Exposure to dispersants or dispersed oil may result in hypothermia. Exposure to particulates generated by *in situ* burning could result in adverse effects. Removal of soil and vegetation in critical habitat and nesting areas could reduce the available nesting and feeding area. Flushing of marine shorelines could damage benthic organisms, reducing prey base. Exposure of prey (e.g., larval bivalves) to dispersed oil may affect eiders.
Steller's eider-Alaska Breeding Population	T	Yes	LAA, LAA (CH)	Response activities during the breeding season could cause nest abandonment or destruction. Response activities may displace eiders from feeding and sheltering habitat. Exposure to dispersants or dispersed oil may result in hypothermia. Exposure to particulates generated by *in situ* burning could result in adverse effects. Removal of soil and vegetation in critical habitat and nesting areas could reduce the available nesting and feeding area. Flushing of marine shorelines could damage benthic organisms, reducing prey base. Exposure of prey (e.g., larval bivalves) to dispersed oil may affect eiders.
Pacific walrus	C	No	LAA	Response activities may cause a stampede, resulting in injury, mortality, or abandonment of calves. Effects may occur from inhaling *in situ* burn particulates or exposure to dispersants or dispersed oil. Prey (e.g., bivalves) may be affected by dispersants.
Polar bear	T	No[d]	LAA	Injury or mortality may result from encounters with security personnel (i.e., bear guards). Ingestion of contaminants may occur during grooming or consumption of contaminated prey (e.g., seals exposed to dispersed oil). Disturbances near den sites could cause a female to abandon the den, resulting in cub mortality from hypothermia or predation.
Eskimo curlew	E	No	NLAA	Current population status is unknown and this species is considered potentially extinct.
Aleutian shield fern	E	No	NE	Aleutian shield fern is found only in an location where oil spill response would not occur.

[a] T=Threatened, E= Endangered, C=Candidate
[b] CH=Critical Habitat
[c] LAA=Likely to Adversely Affect, NLAA=Not Likely to Adversely Affect, LAA; NE=No Effect
[d] Critical habitat for polar bears was designating on December 7, 2010 (75 FR 76086). On January 11, 2013, the final rule was vacated and remanded to the Service by the U.S. District Court for the District of Alaska in Alaska Oil and Gas Association et al. v. Salazar et al (D. Alaska)(3:11-cv-00025-RRB). Service decisions regarding the District Court's order are currently pending, and the scope and description of a final critical habitat designation for polar bears are unresolved at this time.
[d] Yellow-billed loons were as a candidate from 2009 - 2014, but found not warranted for listing on October 1, 2014 (79 FR 59195).

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This programmatic consultation assesses potential impacts of the program as a whole, considering activities conducted under the Unified Plan both individually and cumulatively to ensure they are not likely to jeopardize the continued existence of listed entities or result in the destruction or adverse modification of designated critical habitat. Regulations adopted pursuant to section 7(a)(2) further clarify that "jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR 402.02).

This BO is based on information from a variety of sources including the Biological Assessment (BA) produced for this consultation (Windward 2014), published literature, agency and consultant biological surveys and reports, and personal communications with species experts. The assessment approach is explained in detail in Chapter 4 of the BO. The BO does not include an incidental take exemption because information on the location, timing, design, and other aspects of these actions are not available at this time. We will review the effects of those actions, and through emergency section 7(a)(2) consultation, issue incidental take statements in the future, if appropriate, when formal consultation is requested on specific discretionary actions.

The USCG and EPA requested evaluation of the Pacific walrus by submitting a determination of effects for this species. Although the ESA provides no legal protection for candidate species, they are evaluated at the request of the lead Federal agencies, thus Pacific walrus is included in this analysis. Under the ESA, listed entities include threatened and endangered species or populations, but for brevity in this BO, the term "listed species" refers to threatened, endangered, and candidate species and populations.

1.1 Species Not Further Considered in this Opinion

Several species including the Aleutian shield fern (*Polystichum aleuticum*, listed as endangered in 1988), Eskimo curlew (*Numenius borealis*, listed as endangered in 1967), yellow-billed loon (*Gavia adamsii*, a candidate from 2009 to 2014); and Kittlitz's murrelet (*Brachyramphus brevirostris*; a candidate from 2004 - 2013) are not further considered in the BO because either: 1) we concurred with the Action Agency's determinations of No Effect or Not Likely to Adversely Affect (e.g., Aleutian shield fern and Eskimo curlew), or 2) they were candidates found not warranted for listing under the ESA (e.g., yellow-billed loon and Kittlitz's murrelet). Explanations and justifications follow.

The Aleutian shield fern is known to occur only atop Mt. Reed on Adak Island. Mt. Reed receives few human visitors and has no paved roads or other transportation routes by which vessels or automobiles carry hazardous substances. No development is planned for Mt. Reed. There is little if any potential for the Aleutian shield fern to be exposed to spill response actions implemented as part of the Unified Plan. EPA and USCG determined that there would be no effect to the Aleutian shield fern.

The Eskimo curlew is likely extinct. The last record confirmed by physical evidence is a specimen collected in Barbados in 1963. Since that time, 39 potential sightings have occurred in 22 different years, most recently in Nova Scotia in 2006 (Hoffman 2007). The reliability of these sightings is variable and none have been confirmed by physical evidence. Surveys of the Eskimo curlew's historic and potential breeding areas over recent decades have not detected the species (USFWS 2011). Due to the very low probability of encountering this species during a spill response action, we concur with the determination of the EPA and USCG that implementation of the Unified Plan is not likely to adversely affect Eskimo curlews.

Yellow-billed loon and Kittlitz's murrelet were candidates at the time the BA was prepared by USCG/EPA. However, in both instances, the species were found not warranted for listing under the ESA (79 FR 59195 and 78 FR 61764, respectively). Therefore, the effects of the Unified Plan on yellow-billed loon and Kittlitz's murrelet will not be analyzed further in this BO.

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2.0 PROPOSED ACTION

The proposed action considered in this BO includes the oil and hazardous substance discharge responses authorized and conducted under the Unified Plan (ARRT 2010) and the proposed *Dispersant Use Plan for Alaska,* as provided in Final Draft form (ARRT 2014). The Unified Plan establishes the decision-making processes that direct oil spill response in Alaska. Major components of the activities that may be authorized or conducted to respond to oil spills in Alaska are shown on Table 2.

Table 2. Spill Response Action described in the Unified Plan

Potential Response Action		Description of Response Action
Mechanical counter-measures	Deflection/ containment phase:	Booming Constructing barriers, dams, pits, and trenches Culvert blocking
	Recovery phase:	Skimming/Vacuuming Sorption
	Removal/ cleanup phase:	Flushing and flooding Steam cleaning and sandblasting Removing contaminated soil, sediment, vegetation, or natural debris
Non-mechanical countermeasures and monitoring		Application of approved chemical dispersants by vessel or aircraft *In situ* burning Required real-time efficacy monitoring with specialized equipment
Tracking and surveillance		The use of aircraft, vessels, all-terrain vehicles, or heavy machinery Installation of buoys Sample collection
Waste management		Waste handling and storage Waste transport Waste treatment and/or disposal Decontamination
Wildlife protection		Recovery of contaminated carcasses to prevent contamination of other wildlife Wildlife deterrence (i.e., hazing) Pre-emptive capture and relocation of uncontaminated wildlife Capture, treatment, and release of contaminated wildlife Strategic avoidance
Natural attenuation		No action; allow affected habitat to recover naturally and monitor results

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2.1 Mechanical Countermeasures

Mechanical countermeasures are primary response actions that are intended to deflect, exclude, or contain oil or other spilled material before it can further impact ecological resources.

Deflection and Containment

Deflection or containment actions may involve deploying booms or constructing structures, such as earthen berms, on land to contain and collect a spilled material. In upland environments, the placement and configuration of controls is often based on detailed drainage patterns and topography. In coastal environments, the mapping or modeling of winds, currents, and tidal patterns, in conjunction with real-time observations, supports the placement and configuration of booms and sorbents.

Booming

A boom is typically a flexible floating barrier used to divert (either into or away from an area) or contain buoyant spilled materials in aquatic environments (i.e., open water, nearshore, rivers, and lakes). Fire booms are used to concentrate spilled oil during an *in situ* burn. Oil spill containment booms generally have five operating components—flotation chamber, freeboard, skirt, tension member, and ballast. The overall height of the boom is divided between the freeboard (the portion above the surface of the water) and the skirt (the portion below the water surface). Boom heights range from approximately six inches to over 90 inches depending on environmental conditions. Flotation attached to the freeboard, and ballast (e.g., chain, weights) attached to the skirt, enable the boom to float upright in the water. Boom is typically made up of 50-foot sections and can be connected to form longer booms. Configurations vary according to the site-specific conditions and purpose (e.g., containment versus deflection). Deployment typically involves the use of one or more large vessels and/or small work boats with associated crew(s). Shoreside workers and heavy machinery on barges or piers may also be used if boom ends are anchored onshore. In open water, booms are typically deployed between two vessels in order to concentrate the spilled substance or oil slick for recovery actions (e.g., skimming).

The use of defensive or containment booms is one of the first response actions called for in Geographic Response Strategies (GRS) under the Unified Plan. Boom designs are specific to the environment in which they will be used, however, they are less effective in rough water, high winds, fast currents, or broken ice (Stevens and Aurand 2008; NOAA 2010). Booms require frequent tending and adjustment to stay in position over the course of their use and thus require the periodic or continuous presence of a work vessel (or other equipment) and crew to be effective.

Constructing Barriers, Dams, Pits, and Trenches

Filter fences, berms, dams, pits, and trenches are used to divert or contain spilled materials in upland, riparian, or sea-ice environments. These physical barriers are typically used in conjunction with skimming or other recovery techniques (e.g., sorbents, vacuuming).
The construction of these physical structures typically require the use of heavy machinery to install man-made materials (e.g., filter fences, sand bags, air- or water-filled seal booms) or place natural substrates (e.g., soil, snow, ice rubble), although hand construction may be possible. If water flow from a bermed area is necessary, an underflow culvert or overflow weir may be

included in the construction of a berm or dam. Activity is associated with construction as equipment and personnel are mobilized to and from the site (air, boat, or land transportation to the site).

Culvert Blocking

Open culverts present a potential route for spilled material to enter otherwise unaffected areas. In order to eliminate this threat, culverts may be blocked with a temporary or permanent fixture (e.g., plywood, plug, plastic sheeting, and sand bags). Culvert blocking may also be achieved through the use of deflection booming near the culvert.

Recovery

The recovery of spilled oil is often an important component of an oil spill response action and is typically carried out in conjunction with containment, diversion, deflection, and/or removal actions. In the case of uncontaminated petroleum products, recovered material is reprocessed and refined for commercial use. Several technologies or processes, including skimmers, vacuums, sorbent materials, and manual or mechanical removal, may be used in recovery, depending on the environment in which the spill occurred, the nature and amount of the material spilled, and the behavior of the material following release. Highly refined petroleum products such as gasoline, diesel, and kerosene tend to evaporate from the water very quickly, even during winter months. Crude oil becomes difficult to recover, burn, or chemically disperse after the first 24 - 48 hours because evaporation accelerates as the oil spreads and thins, viscosity and density may increase, emulsification tends to occur, and slick thickness rapidly decreases (NOAA 2010). In sub-freezing temperatures, when ice pack is present, spilled oil will evaporate more slowly than oil spilled in open water (Payne et al. 1991). Overall, recovery efforts in open water tend to have limited effectiveness; recovery rates can range from 1 - 30% (MMS 2010).

Skimming/Vacuuming

Skimmers are mechanical devices that collect oil or other floating contaminants at the water's surface through suction or sorption. They are designed to minimize the intake of water and maximize the uptake of spilled material but often generate wastewater that requires additional space (on land or shipboard) for storage and treatment. The efficiency of skimmers is limited if the water is rough; if aquatic vegetation, floating debris, or ice is present; or if the floating material is too viscous.

The objective of this response activity is to recover floating oil from the water surface. There are numerous types or categories of skimming devices, including weir, centrifugal, submersion plane, and oleophilic. Weir skimmers use gravity to drain oil from the water surface into a submerged holding tank. Once in the holding tank, oil may be pumped away to larger storage facilities. Centrifugal (also vortex) skimmers create a water/oil whirlpool in which the heavier water forces oil to the center of the vortex. Once in the center, oil may be pumped away from the chamber within the skimmer. Submersion plane skimmers use a belt or inclined plane to push the oil beneath the water surface and toward a collection well in the hull of the vessel. Oil is scraped from the surface or removed by gravity into a collection well where it is subsequently removed with a pump. Oleophilic (i.e., having an affinity for oil) skimmers may take on several forms (e.g., disc, drum, belt, rope, brush), but the general principle of oil collection remains the same; oil on the surface of the water adheres to a rotating oleophilic surface. Once oil adheres to the surface it may be scraped off into containers or pumped directly into large storage tanks.

Skimmers are placed at the oil/water interface to recover, or skim, oil from the water surface. Skimmers may be operated independently from shore, be mounted on vessels, or be completely self-propelled. To minimize the amount of water collected incidental to skimming oil, booming may be used in conjunction with skimming to concentrate the floating oil in a wedge at the back of the boom, which directs a thick layer of oil to the skimmer head.

In shallow water, hoses attached to vacuum pumps may be used instead of other skimming devices. Oil may be removed from the water surface using circular hose heads (four to six inches in diameter); however, this is likely to result in the intake of a large water-to-oil ratio and inefficient oil removal. Instead, flat head nozzles, sometimes known as "duckbills" are often attached to the suction end of the hose in order to maximize the contact between the oil and vacuum, minimizing the amount of water that is removed from the environment. Duckbills (very much like an attachment to a vacuum cleaner) are typically 18 inches or less in width and less than two inches in height. In other words, duckbills are relatively small and designed for maximizing the amount of oil removed from the water surface relative to the volume of water removed. Vacuum hoses may also be attached to small, portable skimmer heads to recover oil they have collected. Adequate storage for recovered oil/water mixtures, as well as suitable transfer capability, must be available. Recovery systems that use skimmers are often placed where oil naturally accumulates: in pockets, pools, or eddies. Vacuums may be small, portable units or truck/vessel-mounted units used to remove pooled or stranded material (typically oil), regardless of the viscosity. Large amounts of water may be entrained during the vacuuming of floating material and require storage, treatment, and disposal.

Sorption

Sorbents collect spilled materials, particularly petroleum or similar products, through either adsorption (adherence to the sorbent surface) or absorption (penetration of the pores of the sorbent). Natural and mineral sorbents include peat moss, straw, snow, and clay. Synthetic sorbents are inert and insoluble materials generally manufactured in particulate form and designed to be spread over an oil slick or deployed as sheets, rolls, pillows, or booms. They are typically deployed by hand or machine to the spilled material (either floating or on land) and removed and replaced once coated or saturated. In the case of oil spills, the sorbent material is recovered from the coated/saturated sorbents to the degree practicable. Used sorbents require collection, handling, and offsite hazardous waste disposal.

The objective of this response is to remove floating oil by allowing it to adhere to pads or rolls made of oleophilic material. The dimensions of sorbent pads are typically 2 x 2 ft. Sorbent rolls are approximately the same width as pad and may be 100 feet long. The use of sorbents to remove floating oil is different from the use of skimmers in two ways: (1) the use of sorbents is a passive oil collection technique that requires no mechanized equipment, whereas skimmers may be attached to active vessels for oil collection; and (2) sorbents are left temporarily in the affected environment to adsorb oil in a specific locale, whereas skimmers may transit in order to collect oil in a broader area.

Sorbents are most likely to be used to remove floating oil in nearshore environments that contain shallow water. They are often used as a secondary method of oil removal following gross oil removal, such as skimming. Sorbents may be used for all types of oil; lighter oils absorb into the material and heavier oils adsorb onto the surface of sorbent material, requiring sorbents with greater surface area. Retrieval of sorbent material is mandatory, as is at least daily monitoring to check that sorbents are not harming wildlife or breaking apart after lengthy deployments. However, sorbent materials generally do not remain in the environment for longer than one day.

Passive collection with sorbents can also be used in conjunction with other techniques (e.g., flushing, booming) to collect floating oil for recovery. This variation of the removal of surface oil allows for oil adsorption onto oleophilic material placed in the intertidal zone or along the riverbank. Sorbent material is placed on the surface of the shoreline substrate, allowing it to adsorb oil as it is released by tidal or wave action. The sorbents most typically used for medium to heavy oils are snares made of oleophilic material; snares are attached at 18-inch intervals along a rope that can be tied, anchored, or staked along the intertidal shoreline. As the snares are moved about by tidal or wave action, they also help remobilize oil by rubbing across rock surfaces. Snare lines are monitored on a regular basis for their effectiveness at picking up oil, and to collect and replace oiled sorbents with new material. This method is often used as a secondary treatment method after gross oil removal, and along sensitive shorelines where access is restricted.

Removal/Cleanup

A response action may include the manual or mechanical removal of spilled material, contaminated soil, sediment, vegetation, or debris in upland (including shorelines) and nearshore environments. Shorelines or streams that are in the path of a spill may be subject to the pre-emptive removal of debris (e.g., large logs or root balls) to minimize the retention of a spilled material and its subsequent release over time. Removal may also be augmented by flushing or otherwise washing surfaces (including large vegetation) to which spilled materials have adhered. Flushing or related responses are used in conjunction with containment and recovery actions. Chemicals may also be used to assist in the removal or release of spilled materials (particularly oil) from surfaces; however, no chemicals are currently approved by the ARRT for use in this manner.

Flushing and Flooding

Flushing and flooding are response actions that rely on hydraulic action to remove spilled material from a solid or semi-solid surface (e.g., rocks, bulkhead, and cobble beaches) where it can be contained and collected. Water can be heated to enhance the removal process. These actions are typically applied in shoreline habitats. Flushing involves forcing large quantities of ambient or supplied water at pressure (ranging from < 50 - 1,000 pounds per square inch) through sediment or across surfaces to move hydrophobic contaminants into a containment area. Flooding involves the use of very large quantities of water to flush a spilled product from the sediment to the surface and into a containment area.

The objective of ambient water flushing is to remobilize oil stranded on surface substrate, and in crevices and rock interstices to water's edge for collection. Water is pumped from hoses onto an oiled beach, beginning above the highest level where the oil is stranded, and slowly working down to the water level. The flow of water remobilizes oil stranded on the surface sediments and flushes it down to water's edge. The remobilized oil is contained by boom and recovered for disposal. Increased water pressure may be needed to assist in the remobilization as the oil weathers and begins to harden on the substrate. Because of the potential for higher pressures to cause siltation and physical disruption of the softer substrates, flushing with higher pressures is restricted to rock or hard man-made substrates. Intake and outflow hoses may range from 2 – 4 inches in diameter and, depending on the pump used, pump between 200 -400 gallons of water per minute. Intake hoses are fitted with screens to minimize the extraction of debris, flora and fauna. Screen holes generally range from 0.25 - 1.0 inch in diameter, depending on the environment from which the water is being pumped. Intake hoses are propped off bottom using rebar in about three feet of water to further minimize the amount of sediment, debris, and organisms taken into the hose and pump.

Flooding is used to mobilize stranded oil from rock crevices and interstices. Ambient water is pumped through a header pipe at low pressure above and inshore from the fouled area of shoreline. A pipe creates a sheet of water simulating tidal washing over the affected area. Removing stranded oil may be particularly important when a more sensitive habitat is nearby and in danger of becoming fouled with oil remobilized in tidal cycles. The effects of flooding may also be desired when a spring tide has deposited oil above the normal high water mark or when the wave energy of the adjacent water is not great enough to sufficiently wash the affected area over the following tidal cycle. After oil has been loosened from the substrate it is collected and removed using a variety of mechanical, manual and passive methods.

Low pressure washing with ambient water is used to mobilize liquid oil that has adhered to the substrate or man-made structures, pooled on the surface, or become trapped in vegetation to the water's edge for collection. Low-pressure washing (<50 pounds per square inch) with ambient seawater sprayed through hoses is used to flush oil to the water's edge for pickup. Oil is trapped by booms and picked up with skimmers or sorbents. This variation may also be used in concert with ambient water flooding, which helps move the oil without the potential effects associated with higher water pressures.

High pressure washing with ambient water is used to mobilize oil that has adhered to hard substrates or man-made structures to the water's edge for collection. It is similar to low-pressure washing except the water pressure may reach 100+ pounds per square inch, and it can be used to flush floating oil or loose oil out of tide pools and between crevices on riprap. Compared to the lower pressure spray, high-pressure spray will more effectively remove oil that has adhered to rocks. Because water volumes are typically low, this response method may require the placement of sorbents directly below the treatment area or the use of a deluge to carry oil to the water's edge for collection.

Warm water, moderate-pressure washing is used to mobilize thick and weathered oil that has adhered to rock surfaces, prior to flushing it to the water's edge for collection. Seawater is heated (typically between the ambient temperature and 90ºF) and applied at moderate pressure to mobilize weathered oil that has adhered to rocks. If the warm water is not sufficient to flush the oil down the beach, flooding or additional low- or high-pressure washing may be used to float the oil to the water’s edge for pickup. Oil is then trapped by boom and may be picked up with skimmers or sorbents.

Hot water, moderate-pressure washing is used to dislodge and mobilize trapped and weathered oil from inaccessible locations and surfaces not amenable to mechanical removal, prior to flushing oil to water’s edge for collection. Water heaters are mounted on offshore barges or on small land-based units. The water is heated to temperatures from 90ºF-170ºF, which is usually sprayed in small volumes, by hand, using moderate-pressure wands. Used without water flooding, this procedure requires immediate use of vacuums (vacuum trucks or super suckers) to remove the oil/water runoff. With a flood system, the oil is flushed to the water’s edge for collection with skimmers or sorbents. This response is generally used when the oil has weathered to the point that even warm water at high pressure is ineffective for the removal of adhered oil, which must be removed due to the threat of continued release of oil or for aesthetic reasons.

Steam Cleaning and Sandblasting
When constructed or low-value shoreline habitat is contaminated by a floating product, steam cleaning or sandblasting may be used to remove the product from rocky substrates. This process is very limited in scope but nonetheless effective for oil recovery. Biota living in areas treated in this manner will likely be destroyed by the high heat, pressure, and/or abrasion.

Removing Contaminated Soil, Sediment, Vegetation, or Natural Debris
Manual removal is conducted using hand tools (e.g., rakes, shovels, scrapers). Material is collected in containers typically transported by vehicle to a storage area for later disposal. Mechanical removal relies on heavy equipment (e.g., bulldozers, backhoes) and is usually implemented when the spill area/debris size exceeds the capacity of manual removal.
Oiled sediment is removed by either use of hand tools or by use of various kinds of motorized equipment. Oiled sediment removal is restricted to the supratidal and upper intertidal areas to minimize disturbance of biological communities in the lower intertidal and subtidal. After removal, oiled sediments are transported and disposed of offsite.

Aquatic, shoreline, or riparian vegetation heavily contaminated by a spilled product may be a continuing threat to organisms that forage on the vegetation or otherwise use the habitat. Vegetation can be removed either manually or mechanically. The heavier the machinery used, the greater the soil or sediment compaction and noise produced, although foot traffic by workers will also cause some compaction. Debris (e.g., seaweed, trash, and logs) is removed from the shoreline when it becomes heavily contaminated and when it is a potential source of chronic oil release, an aesthetic problem, or a source of contamination for organisms on the shoreline.

2.2 Non-mechanical Countermeasures and Monitoring

Non-mechanical countermeasures alter the physical or chemical properties of spilled material (i.e., petroleum or oil-like materials), such that the options for recovery are improved or the overall impacts of spilled material that cannot be recovered are reduced.

Application of Approved Chemical Dispersants by Vessels or Aircraft

Two dispersant formulations from EPA's product schedule are currently available for use in Alaska: Corexit® EC9500A and Corexit® EC9527A (hereafter referred to as Corexit® 9500 and Corexit® 9527). See Table 3 for Corexit® 9500 and Corexit® 9527 dispersant formulations. In certain instances, use of these dispersants requires authorization from ARRT. Use of Corexit® 9527 is restricted to existing stocks and will be phased out as these stocks are depleted. Other chemical formulas currently available for use during an oil spill (i.e., those listed on the National Contingency Plan [NCP] product schedule; EPA 1994; 59 FR 47384) would require ARRT approval for use in Alaska.

Chemical dispersants are mixtures of surfactants, hydrocarbon-based solvents, and other compounds altering the spatial distribution, chemical fate, and physical transport of spilled oil in aquatic environments. Dispersants are specifically designed to enhance dispersion of oil into the water column by generating smaller droplets of oil that are subject to natural processes, such as dissolution, volatilization from the water surface, biodegradation, and sedimentation from interactions with suspended particulate material. The application of chemical dispersants in marine environments is restricted to a response to spilled petroleum or other oil-carried or oil-like contaminants. Dispersants do not reduce the total amount of oil in the environment, but instead, change the characteristics of the oil, thereby changing the transport, fate, and potential effects of the oil.

Table 3. Corexit® 9500 and Corexit® 9527 dispersant formulations

Chemical Constituent	Chemical Type	CAS[b] No.
Propylene glycol	solvent	57-55-6
2-Butoxy ethanol[a]	solvent	111-76-2
Sodium dioctyl-sulfosuccinate	surfactant	577-11-7
Sorbitan monooleate	surfactant	1338-43-8
Polysorbate 80	detergent/surfactant	9005-65-6
Polysorbate 85	surfactant	9005-70-3
1-(2-Butoxy-1-methylethoxy)-2-propanol	solvent	29911-28-2
Petroleum distillates, hydro-treated, light	solvent	64742-47-8

[a] This chemical is not included in the formulation of Corexit® 9500

[b] CAS: Chemical Abstracts service [Top]

The use of chemical dispersant as a response option is reserved for occasions when resources are at risk and other response actions are either not feasible or not adequate to contain or control the spill because of field conditions (e.g., remote location, lack of access). Dispersed oil is less likely to wash ashore in sensitive coastal areas or to form a slick capable of oiling wildlife at the sea surface (NRC 2005). However, the tradeoff of using dispersants is pelagic species may be more exposed to oil after chemical dispersion (Windward 2014).

Dispersant use generally requires ARRT approval on a case-by-case basis, except in the case of immediate risk of the ignition or inhalation of volatile and poisonous constituents of oil[1]. The exception to this general approach is the Preauthorization Zone, shown in Figure 1. Within this zone, use of dispersants would not require prior approval by the ARRT.

Dispersants are applied to the oil's surface via either vessel-mounted equipment or aerial spraying (at concentrations of 2 - 5% by volume of the oil). Subsurface application, was performed for the 2010 Deepwater Horizon Spill (DHS) in the Gulf of Mexico, but based on the description of the action provided by USCG/EPA (EPA and USCG 2015), is not included as an action in this consultation. The effectiveness of dispersants is dependent upon the amount of time that has elapsed since the spill (oil weathering), surface oil thickness, oil viscosity, water depth, salinity, temperature, and sea conditions (NRC 2005). Dispersants require physical mixing for optimum effect. The mixing can be intentionally induced (e.g., use of propeller wash in broken ice conditions).

Efficacy of applied dispersant can be assessed in a variety of ways. An interagency monitoring program has been designed for monitoring use of *in situ* burning and dispersants. This program, termed the Special Monitoring of Applied Response Technologies (SMART) program, involves personnel from USCG, National Oceanic and Atmospheric Administration (NOAA), USEPA, Centers for Disease Control and Prevention, and Bureau of Safety and Environmental Enforcement (BSEE; part of the agency formerly known as the Minerals Management Service, MMS). SMART protocols identify three levels of monitoring:

- **Tier I—**A trained observer, flying over the oil slick and using photographic job aids or advanced remote sensing instruments, assesses dispersant efficacy and reports results to the incident command post. This is the minimum level of monitoring required for dispersant use nationally.
- **Tier II—**Real-time empirical data is gathered from the treated slick. A sampling team on a boat uses a monitoring instrument to continuously monitor for dispersed oil one m under the dispersant-treated slick and reports the results to the incident command post. Water samples are taken for later analysis at the laboratory.
- **Tier III—**Expanded real-time empirical data is gathered from the treated slick to determine where the dispersed oil goes and what happens to it. Similar to Tier II, a sampling team(s) uses at least two monitoring instruments to monitor the water at several depths, often from the center of the slick. A portable water laboratory provides data for water temperature, pH, conductivity, dissolved oxygen, and turbidity. Results are reported to the incident command post.

[1] Spilled oil products may contain poisonous and flammable volatile organic compounds, and oil dispersal is a possible option to reduce the immediate risk of ignition or inhalation. The FOSC may use dispersants without obtaining outside consent or consultation under circumstances presenting a hazard to human life (40 CFR 300.910(d)).

Conditions/stipulations of the Dispersant Use Plan include:

- All dispersant application field tests will be conducted on a representative portion of the oil slick.
- The Federal On-Scene Coordinator (FOSC) immediately notifies the Department of the Interior (DOI) ARRT representative of the decision to authorize dispersant use.
- If the FOSC determines that dispersant use may affect listed species under the Service's jurisdiction, the FOSC initiates a spill-specific emergency ESA section 7 consultation during which the Service Spill Response Coordinator (SRC) and/or section 7 biologist will provide mitigation measures to lessen potential impacts to ESA-listed species.
- The Service's SRC and Environmental Unit (EU) (which the SRC and/or a section 7 biologist is a part of), provides the FOSC any necessary supporting information, including weather and other environmental characteristics, and a description and prioritization of Resources at Risk.
- Following review of the dispersant field test, the EU provides the FOSC with a recommendation on whether full-scale dispersant application should commence.
- Dispersant application effectiveness and potential trade-offs associated with its use will be evaluated on a daily basis, informing the FOSC's decision to continue, postpone, modify, or cease dispersant application based on that day's monitoring information.
- Dispersant applications will only be carried out in daylight conditions.
- Use of dispersants will not exceed 96 hours following the dispersant application field test (unless an extension is approved as a "atypical dispersant use" using the Process for Case-by-Case Dispersant Use Authorization, which includes consultation with DOI) and will be guided by the "Environmental Monitoring for Atypical Dispersant Operations."
- Dispersants will only be applied in areas where the water depth is 10 fathoms (60 feet) or greater, and at sufficient distances from shore to ensure that sensitive nearshore and benthic habitats are not affected by dispersants and/or dispersed oil.
- Dispersant applications will maintain a minimum 500 meters (1,640 feet) horizontal separation from swarming fish, rafting flocks of birds, marine mammals in the water, and/or marine mammal haulouts.
- Any monitoring required by the Service and/or National Marine Fisheries Service (NMFS) for ESA section 7 compliance will be conducted.
- DOI and/or Department of Commerce (DOC) will provide a specialist in aerial surveying of marine mammals and pelagic birds to accompany a SMART Tier 1 monitoring team to help ensure compliance with the above requirements. If DOI and/or DOC cannot provide the appropriate specialist(s), a third party acceptable to the DOI and/or DOC will be identified to accompany the monitoring team.
- Information on the location of all dispersant application(s) will be provided to the public, including posting on the ARRT website.
- A checklist verifying that all conditions/stipulations have been met will be completed prior to approval of dispersant use.
- Other incident-specific conditions/stipulations may be developed on a case-by-case basis.

The *Dispersant Use Plan for Alaska* as described in Final Draft form (April 2014; ARRT 2014) in Appendix A of the BA (Windward Environmental LLC and ERM 2014) is incorporated into the Unified Plan, with the exception of subsea application. The Preauthorization Area identified in the Dispersant Use Plan extends from the Western Aleutians to the east side of Prince William Sound, starting 24 nautical miles from the coast and extending south out to the 200 mile Exclusive Economic Zone (EEZ), and north 100 nautical miles offshore (Figure 1).

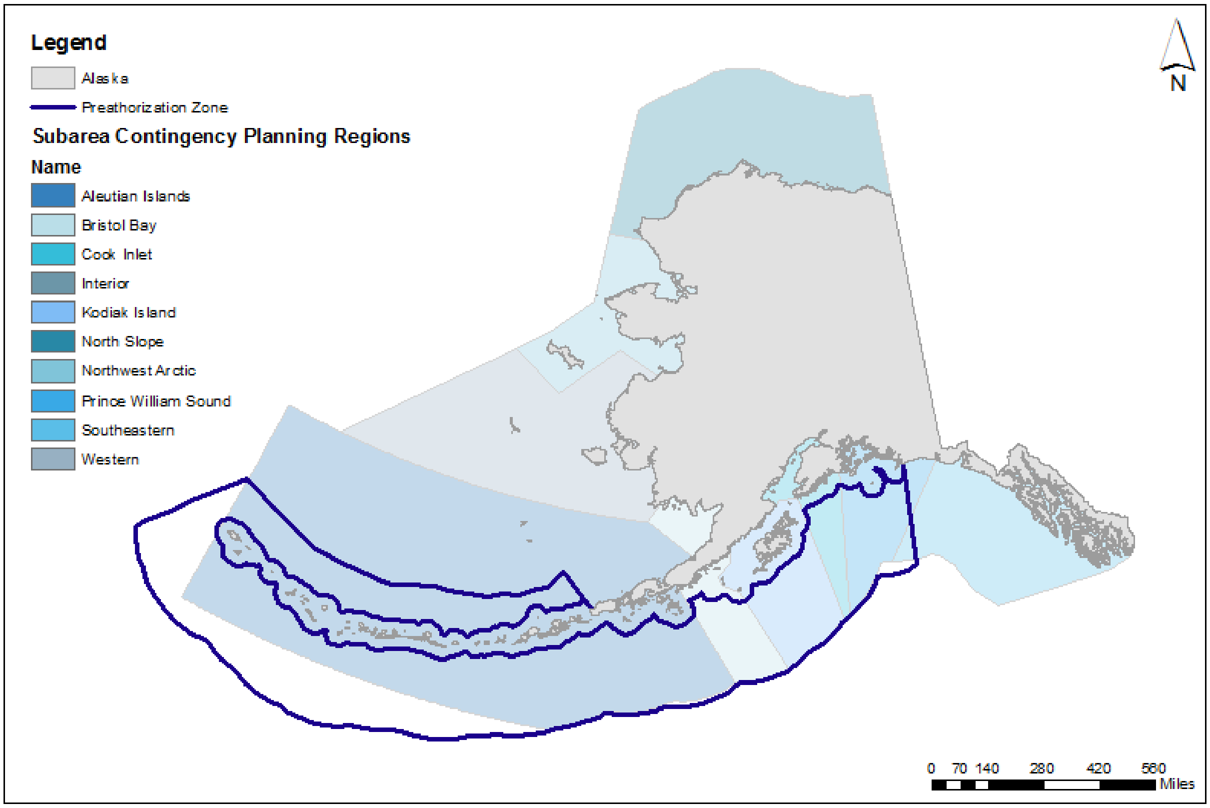

Figure 1. The boundaries of the Preauthorization Area of the Dispersant Use Plan under the Unified Plan. The boundaries of the Subarea Contingency Plans (SCPs) are shown where they overlap with the Preauthorization Area.

[Top]

The Preauthorization Area enables the USCG to require certain vessel and facility response plan holders in Alaska to maintain a minimum dispersant use capability in accordance with the USCG August 31, 2009 rulemaking (33 CFR Parts 154 and 155; "Vessel and facility response plans for oil: 2003 removal equipment requirements and alternative technology revisions; Final Rule").

The NCP Subpart J Section 300.910(d) affords the FOSC the authority to authorize the use of dispersant without obtaining concurrence from the ARRT when the FOSC has judged that the use of dispersant is necessary to prevent or substantially reduce a hazard to human life. Once the threat to human life has subsided, the continued use of dispersant must follow the approval process in the NCP Section 300.910(b), which includes review and approval by DOI.

Conditions/stipulations that apply within the Preauthorization Area include:

- The preauthorization of dispersant use only applies to incidents involving tank vessels carrying crude oil to/from a U.S. port.
- The Preauthorization Area excludes any avoidance areas to be identified in certain Subarea Contingency Plans (SCPs). State and federal natural resource trustees, including the Service, will assist in the identification of these avoidance areas.
- Avoidance areas for protection of the short-tailed albatross have been approved by the ARRT Dispersant Working Group (DWG) in accordance with Section 1.4 of the Dispersant Use Plan (See Appendix D for correspondence regarding avoidance areas). These avoidance areas will be incorporated into the Unified Plan via inclusion in SCPs. Use of dispersants within these areas will be considered in the same manner as for areas outside of the Preauthorization Area.

In Situ Burning

In situ burning is a response action used to address spilled oil in either aquatic or terrestrial habitats. According to the "*In Situ* Burning Guidelines for Alaska, Revision 1" (ADEC et al. 2008; included in the Unified Plan as Appendix II to Annex F), burning can be conducted if, "mechanical containment and recovery by themselves are incapable of controlling the oil spill, burning is feasible, and the burn will lie a safe distance from populated areas." The FOSC has the authority to authorize *in situ* burning on a case-by-case basis after obtaining concurrence from the EPA and Alaska Department of Environmental Conservation (ADEC) representatives to the ARRT[2]. A review checklist is included in the *in situ* burning guidelines to facilitate the decision process. The checklist includes the following steps:

1. Review the completed Application to Burn Plan (Appendix A to the *In Situ* Burn Guidelines for Alaska, Revision 1; ADEC et al. 2008)
2. Determine the feasibility of burning
3. Determine whether burn may be conducted at a safe distance from population areas
4. Determine whether environmental and other considerations will be adequately addressed
5. Review consultations and requests for authorization
6. Make a decision on whether to authorize burn

The objective of *in situ* burning is to remove oil from the water surface or habitat by burning it in place, or *in situ*. Oil floating on the water surface is collected into slicks a minimum of two to three mm thick and ignited. The oil is typically collected in fire-resistant boom that is towed through the spill zone by watercraft, or collected by natural barriers such as the shore. Although *in situ* burning may be used in any open water environment, the environment dictates the specific procedure employed in a given burn. For example, in offshore and nearshore marine environments, bays and estuaries, large lakes and large rivers a boom may be towed at one knot or less during the burning process in order to maintain the proper oil concentration or thickness. Wind or mechanically generated currents (known as herding) may be used to collect and concentrate oil along the shoreline or in a stationary boom attached to the shoreline.

[2] Concurrence from DOI and DOC natural resource trustees will be obtained when practicable.

Once an oil slick is sufficiently thick, an external igniter is used to heat the oil, generating enough vapors above the surface of the oil to sustain a burn. It is these vapors, rather than the liquid oil on the water surface, that actually burn. When the oil burns enough so the remaining layer is less that one to two mm thick, the fire goes out. The fire is extinguished at this thickness because the oil slick is no longer sufficiently thick to provide insulation from the cool water. This insulation is necessary to sustain the heat that produces the vapors, which are subsequently burned. The small quantity of burn residue remaining in the boom is then manually recovered for disposal.

The use of *in situ* burning as a response action is a valuable tool to quickly remove oil from open water or upland areas and prevent it from reaching sensitive habitats or populations. For spills in uplands or wetlands where there is a layer of water underneath the oil slick, the oil is often naturally contained by being trapped in the vegetation or concentrated in open water areas. For spills on land that do not have any natural containment, temporary dikes can be constructed to contain and isolate the oil for burning. For spills on snow, two burning approaches can be used. Oiled snow can be plowed into piles and burned right on the ground or on the ice. Alternately, oiled snow can be removed with front-end loaders, loaded into dump trucks, and hauled to a burn pit (ACS 1999).

The burning of weathered or emulsified oil is typically infeasible because it is not likely to continue burning once ignited. This is due to the emulsion of oil with water, as well as the evaporation of flammable, volatile oil components. Sea and wind conditions also affect the feasibility of *in situ* burning. Concentrated oil is better able to remain ignited, and oil trapped between sea-ice floes is often sufficiently concentrated so that further containment measures may not be necessary prior to an *in situ* burn.

For *in situ* burning operations, SMART protocols include deploying one or more air quality monitoring teams with specialized portable equipment downwind of the burn at sensitive locations, such as population centers. Teams begin sampling before the burn to collect background baseline air quality data. After the burn starts, the teams continue sampling for particulate concentration trends, recording them both manually at fixed intervals and automatically, and report results to the incident command post.

Other Non-mechanical Countermeasures and Monitoring

Examples of other non-mechanical countermeasures include application of other chemical agents (e.g., solidifiers and fire foam), and application of biodegrading organisms or nutrient stimulants used to enhance biodegradation of oil. Such countermeasures, including subsea dispersant application, while not previously approved by the ARRT, are available to FOSCs provided they are approved by the ARRT – which includes review by DOI – prior to application in accordance with National Contingency Plan (NCP) Section 300.910(b). Other non-mechanical countermeasures and oil spill response monitoring methods have not been previously approved by the ARRT, therefore, are not part of the proposed action, and are not considered in this consultation.

2.3 Tracking and Surveillance

Tracking and surveillance (e.g., aerial reconnaissance) is performed for almost all spill events for which a response is planned. These activities are conducted to visually and electronically assess the field conditions and extent of a spill and to project, through computational modeling, the future movements of the spill. Information is also gathered on the location and movement of sensitive wildlife.

Nuka Research (2006) identifies two tracking tactics: plume delineation on land and discharge tracking on the water. Each is used to determine the size, shape, and trajectory of a spill, as well as the resources required to appropriately control the spilled material, and reduce ecological and economic impacts. On land, it is easier to map a plume of spilled material and predict its trajectory than in water. Actions may involve land transport or aerial surveillance. The location of a plume can be validated through the use of monitoring equipment (e.g., photo ionization detection). To monitor deep soil, excavation equipment may be required.

For spills on the water, aerial surveillance is typically used to visually inspect a spill. In addition, infrared remote sensing and other non-invasive imaging technologies can be used during aerial surveillance to facilitate location, trajectory, and density mapping, including under ice. In some instances, buoy-based systems moving through a spill on the water and electronically tracking the position and direction of the material's movement may be deployed. Additional in-water tracking may be conducted by means of vessels, and vessel operators may sample materials that can be analyzed for current spill conditions (i.e., extent of oil weathering). The trajectory of a plume and wildlife movement is tracked over time. Information gathered during tracking and surveillance helps support the development of an Incident Action Plan (IAP), wildlife protection measures, and other BMPs.

Use of Aircraft, Vessels, All-terrain Vehicles, or Heavy Machinery

Fixed and rotary wing (i.e., helicopters) aircraft, small craft, ships, all-terrain vehicles, and/or heavy machinery may be routinely employed during tracking and surveillance activities and do not require special approval by the ARRT for deployment. Based on capabilities (e.g., operating limits, range, onboard equipment, personnel), such purpose-built or general purpose assets may be staged in forward staging areas adjacent to but outside the operating area to minimize mobilization/demobilization intervals and maximize asset time available to perform response activities. Personnel using these assets may perform aerial, water surface, subsurface, ground, or subterranean reconnaissance visually or electronically, transport tracking and surveillance personnel to remote areas, move/deploy/recover equipment or supplies used in tracking and surveillance, sample collection, and/or communication. Most of these assets are pre-identified in industry or government response plans, and in most cases, are continuously maintained and ready for use.

Installation of Buoys

In certain cases, buoys may be deployed from aircraft, small craft, ships, or shore for tracking and surveillance of spilled product, or for marking the boundaries of environmentally sensitive areas or specially designated on-water zones potentially in the path of spilled product. The buoys used in these applications are of two main types: drift buoys and static buoys. Drift (i.e., unanchored) buoys may be deployed into spilled product or near the spill's leading edge. Drift buoys have highly visible colors to help track product movement in the water visually, and/or radar-reflective material/features for aerial/surface radar tracking, and/or more sophisticated technology for longer-range monitoring (e.g., radio telemetry) from satellite, aerial, surface, or shore-based tracking. Static (i.e., anchored) buoys of similar configuration may be set-up to mark outer boundaries of protected or environmentally sensitive areas (e.g., rookeries, hatcheries, haulouts) or specially designated on-water special use zones (e.g., safety/security zones, channels).

Sample Collection

Water, tissue, soil, and product samples are often collected as part of tracking and surveillance activities. Collection of water and soil samples, both from baseline (i.e., unaffected) and affected areas is vital to assess and document size, volume, toxicity, and other impacts on the environment before and during the event. Collection of product samples from spill sources and in the spill environment are essential for determining characteristics of the product and the nature and course of the interaction between the pollutant and the environment. This critical information informs response strategies developed and tactics used to combat the spill.

2.4 Waste Management

Waste handling and associated activities are common to all response actions apart from natural attenuation. Response actions produce large volumes of waste (e.g., contaminated soils, used sorbents, personal protection equipment) that must be handled, stored, decontaminated, transported, and/or disposed of properly. Protocols that comply with state and federal regulations are in place to minimize the reintroduction of wastes into the environment and protect habitats, endangered species, and response workers.

Waste Handling and Storage

Waste handling and storage are required throughout a spill response. Materials (e.g., soil, sediment, and snow) used to construct diversion and exclusion or containment structures may be contaminated by the spilled material due to leaching or other processes, generating additional wastes to be handled and disposed of properly. Some spilled materials may be pumped or suctioned directly into storage tanks or drums for the purpose of either recovery or treatment and disposal. Pumping and suctioning usually entrain large volumes of water that must also be stored and treated. In the case of viscous oils, reheating might be required prior to pumping.

Waste Transport

The handling, transport, and disposal of wastes require the use of heavy machinery and vessel or overland transport. It is possible that the volume of waste produced by the response operations will exceed the capacity of local waste receivers. In this event, disposal at multiple sites will be required. There are also some wastes (e.g., oil emulsions, oily water, and hazardous wastes) that cannot be treated in Alaska and must be transported to the contiguous U.S. In these cases, longer transport distances could increase the possibility of subsequent or secondary spills or accidents.

Waste Treatment and/or Disposal

Under ideal conditions, spilled products can be recovered and reused, reducing the wastes generated by a response action. For example, recovered oil can be refined into low-grade fuel or other petroleum products. Some chemical agents can separate oil from water or other materials, allowing the volume of wastewater that requires treatment or disposal to be reduced. Although no chemical agents are currently pre-approved for such use in Alaska, they may be proposed on a case-by-case basis. Oil collected from aquatic habitats will be mixed with water and require separation and decanting prior to disposal; such decanting may take place on board a work vessel or be conducted at an upland location or facility. Decanted water may contain small amounts of dissolved oil constituents or consist of an oil-water emulsion but must meet water quality standards prior to discharge. Waste disposal involves either direct disposal (i.e., without treatment) or treatment and then disposal. Wastes can be incinerated (onsite or offsite), but any incineration of waste in Alaska is subject to ADEC regulations.

Decontamination

During an oil spill response action, all personnel, hand tools, equipment, vehicles, and vessels must be decontaminated in a manner that does not reintroduce oily wastes into the natural environment. The decontamination process involves a multi-stage flushing procedure that removes and collects such wastes. The wastes are then stored and treated in accordance with state and federal regulations. Of primary concern is the reintroduction of oily waste and contaminated materials into the natural environment during the decontamination procedure. The use of engineered controls (e.g., berms, booms, plastic sheeting, and tarps) reduces the risk of the accidental release of contaminated materials.

2.5 Wildlife Protection/Mitigation Measures

Wildlife protection responses are actions that could be implemented should listed species be threatened by exposure to a spilled material. Wildlife protection for listed species is conducted by trained personnel under a USFWS permit.

The Unified Plan describes that wildlife might be deterred from entering an area impacted by a spill in order to prevent them from becoming contaminated, or captured and treated after they have been exposed or injured. Animals might also be captured and temporarily held or relocated (i.e., preemptively captured) to prevent them from being exposed to spilled material. Although returning captured animals to the wild is the ultimate goal, not all captured animals may be able to be released following holding or treatment due to injuries received from exposure to spilled products. Guidelines that address procedures and decision criteria have been developed by the ARRT Wildlife Protection Working Group in accordance with the NCP and approved by the ARRT (see Annex G of the Unified Plan).

Recovery of Contaminated Carcasses to Prevent Contamination of Other Wildlife

Recovery of contaminated carcasses from affected areas is an important primary response strategy to prevent further contamination of other wildlife in water and on land. Contaminated carcasses can cause further direct or indirect environmental harm through mechanisms such as secondary pollution (i.e., pollution reentering the environment from a contaminated source) or by ingestion by other creatures using the carcass as a food source. The Unified Plan contains detailed guidelines (Appendix 11 of Annex G) on carcass collection including procedures for searching, documentation of collection *in situ*, chain of custody, inventory, storage, use as evidence, and disposal. Natural resource trustees, including Service personnel, use these basic guidelines to develop incident-specific guidelines tailored to each event. Oil spills are assigned a Responsible Party (RP) through the Natural Resource Damage Assessment (NRDA) process. Carcass recovery is a useful tool for assessing the amount of lethal take during NRDA.

Deterrence

Deterrence (i.e., hazing) of wildlife is the act of causing animals to move away from the spill area to prevent them from being exposed to the spilled material. However, deterrence of wildlife under the Service's authority requires prior approval in order to be conducted lawfully. Take may occur during hazing of wildlife for the protection of the species, but the amount or degree of take may increase due to spill exposure if hazing is not conducted. The decision whether to haze animals away from a spill will be evaluated on case-by case basis during incident-specific consultation. Spill responders are required to monitor, tabulate, and report take (including disturbance) of any listed species encountered during response activities to ensure that this information is available for NRDA and law enforcement actions.

Pre-emptive Capture and Relocation of Uncontaminated Wildlife & Capture, Treatment, and Release of Contaminated Wildlife

Similar to deterrence (above), this activity requires prior authorization to be conducted legally. Capture and handling of wildlife under the Service's authority requires training and incident-specific approval and coordination. As with deterrence, if these actions are conducted for the protection of the species, take may occur, but level of take may be lower than if no pre-emptive capture or treatment efforts are conducted. The decision to capture animals will be made on a case-by-case basis.

Strategic Avoidance

Strategic avoidance as a means of wildlife protection occurs during response strategy formulation and as part of tactical practice in the field. At the strategic level, environmentally sensitive areas are identified within the EU of the Incident Command System (ICS). Areas threatened by the spill are prioritized for protection as a primary response strategy. Such areas are also disqualified for use as forward operating locations (e.g., bases, heliports, staging areas, decontamination sites) in the response. At the field tactical level, environmentally sensitive areas are avoided in the development of plans and procedures (e.g., shoreline cleaning, berming) which may result in wildlife exposures to cleaning agents and mechanisms. Methods which may cause irritation, injury, or death receive consultation with natural resource trustees, including the Service, during deployment planning.

2.6 Decision-Making Processes

As described in the Effects of the Action section below, oil spill response activities have the potential to negatively impact listed species under the Service's authority if not properly managed and mitigated. Therefore, it is important to understand when and how various response activities are taken during an incident. Although it is not possible to predict where, when, and how big a spill may occur, it is possible to understand the direction the response would take based on the existing planning documents, the revision process for those planning documents, and the decision-making process that occurs during each incident.

Response Planning

Spill response planning in Alaska is accomplished through the development of a series of inter-related plans, for which the NCP provides the overarching framework and establishes procedures designed to minimize the imminent threat to human health or the environment from an uncontrolled release of oil or other hazardous substances. The Unified Plan applies the NCP framework in a regional context containing both administrative and technical statewide guidance for all members of the response community to follow during emergency response to a spill in Alaska. This guidance is organized as a series of annexes (A through Z), each with supporting appendices. Administrative guidance in the Unified Plan establishes how the spill response will be organized, managed, and funded; technical guidance addresses countermeasures that have been approved for use as part of the response.

Mechanical countermeasures are the main focus of emergency spill response under the Unified Plan; however, most of the details regarding the selection and implementation of a response are provided in supplemental documents (e.g., Nuka Research 2006; NOAA 2010) prepared in response to or in support of the Unified Plan[3]. Because of their greater potential for adverse effects, the Unified Plan incorporates guidance on the use of non-mechanical countermeasures (i.e., the application of dispersants or other chemical agents and *in situ* burning) and other response measures (i.e., wildlife protection). The Unified Plan further describes the decision process leading to the selection of a non-mechanical countermeasure in order to support the evaluation of tradeoffs associated with implementation (i.e., magnitude of environmental harm versus benefit). No other non-mechanical countermeasures have been approved for use in Alaska; any proposal would require approval by ARRT, of which DOI is a member.

The Unified Plan is supplemented by ten SCPs, which provide greater detail for local response planning in large inland and coastal areas of Alaska (Figure 1, Figure 2). The SCPs set resource protection priorities and incorporate key provisions of local government emergency response plans and applicable information from RP spill response plans. These SCPs are updated regularly, and the updates are reviewed and approved by ARRT to maintain consistency with the Unified Plan.

In 2001, the USCG, EPA, DOI Office of Environmental Policy and Compliance, the Service, NMFS, and National Ocean Service signed *Inter-agency Memorandum of Agreement (MOA) Regarding Oil Spill Planning and Response Activities Under the Federal Water Pollution Control Act's National Oil and Hazardous Substances Contingency Plan and the Endangered Species Act* , an agreement which provides a general framework for cooperation and participation in the exercise of their oil spill planning and response responsibilities. The MOA outlines procedures to streamline ESA compliance before, after, and during an incident (USCG et al. 2001).

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[3] A more complete list of documents describing mechanical countermeasures and their uses can be found in Annex N of the Unified Plan

Pre-spill Activities

Spill drills, exercises, training events, equipment and facility testing, and field deployments may affect listed species. These activities do not constitute emergencies, and are not eligible for emergency consultation. Separate consultation is required for pre-spill activities that may affect listed species or critical habitat. This may include approval of GRSs by the EPA or USCG.

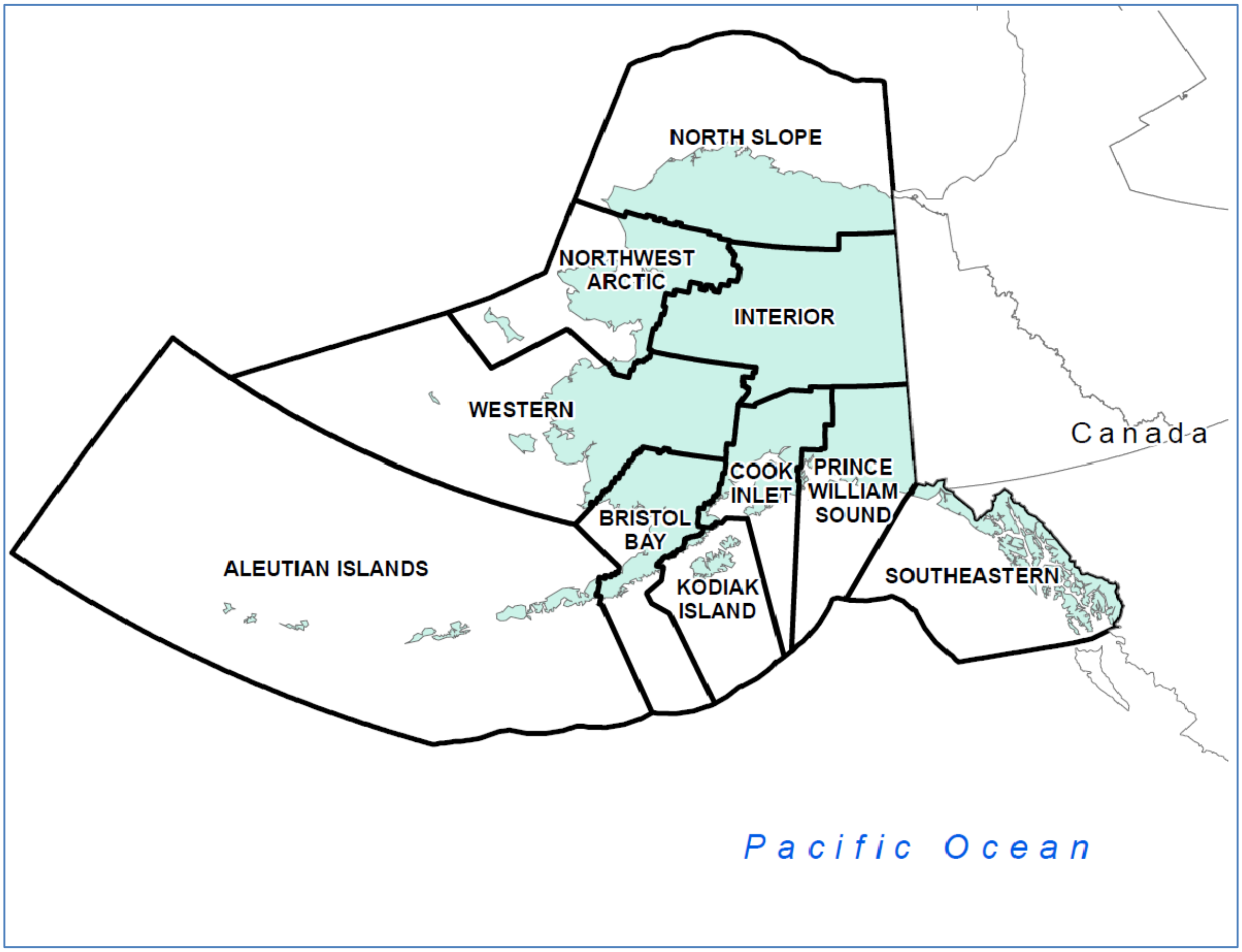

Figure 2. Map of Alaska showing the delineations for the 10 subareas designated under the Unified Plan. Each subarea has a separate Subarea Contingency Plan for oil spill response (from Windward 2014). [Top]

During an Incident

The selection and implementation of incident-specific response strategies are ultimately at the discretion of the Unified Command (i.e., the team of on-scene coordinators representing the RP and federal, state, and local agencies), following the guidance in the Unified Plan and in consultation with other members of the response community. The Service's section 7 biologists are involved in selection of site-specific strategies either through involvement in the EU or through coordination with the Service's SRC and the DOI representatives on the ARRT.

The Unified Command is responsible for selecting, prioritizing, and implementing the actions meeting these goals. The selection of the response action (or actions) for a given spill is dependent on a number of factors, including the nature and magnitude of the spill, weather, timing, location, accessibility, resources at risk, and likely fate and effects of the material released. Every response strategy has uncertainties, along with potential environmental tradeoffs that are evaluated as part of the action selection process. Response decisions are made using the best information available, with the knowledge that the initial understanding of the event may be incomplete. During a spill, responses are modified as environmental conditions change or additional information becomes available. The spill response community relies on training and exercises to make the uncertainties manageable. This emergency spill response training, a requirement of the Unified Plan, is expected to assist decision-making in the face of uncertainty and to ensure that at-risk environmental resources, such as listed species and their habitats are properly protected.

During each incident, the FOSC (USCG or EPA) will determine if the response may affect listed species. If the response overlaps in time and space with listed species under the Service's authority, the FOSC will initiate emergency consultation pursuant to section 7 of the ESA (Figure 3). The Service provides recommendations to the FOSC to minimize impacts on listed species and documents any incidental take resulting from spill response actions.

The use of dispersants and *in situ* burning as countermeasures for oil spills requires an additional decision-making process under the Unified Plan (Annex F). Decisions regarding the use of dispersants must take into account the resources at risk, the size of the spill, the physico-chemical properties of the type of oil spilled, the feasibility of the response actions, and site-specific conditions (e.g., weather, sea state, the presence of ice). The overarching criterion for decision-making is that dispersed oil will be less harmful to listed species and critical habitat than non-dispersed oil.

In marine waters outside of the pre-authorization zone, the USCG FOSC must formally request the use of dispersants anywhere in Alaska's waters (Figure 4). The FOSC works with the RP, the Service's SRC, the EU of the ICS, and other resource agencies to complete a comprehensive, detailed checklist and application, and submit them to the incident-specific ARRT for expedited approval. This request documents the conditions under which the dispersant would be applied and the environmental tradeoffs associated with the decision. The ARRT considers each request on a case-by-case basis. The EPA representative to the ARRT must concur, modify, or reject the request. If Alaskan waters or interests are involved or threatened by the spill, the state's representative to the ARRT must also concur, modify, or reject the request. EPA and State of Alaska representatives must be in agreement as to the disposition of the FOSC's dispersant use request.

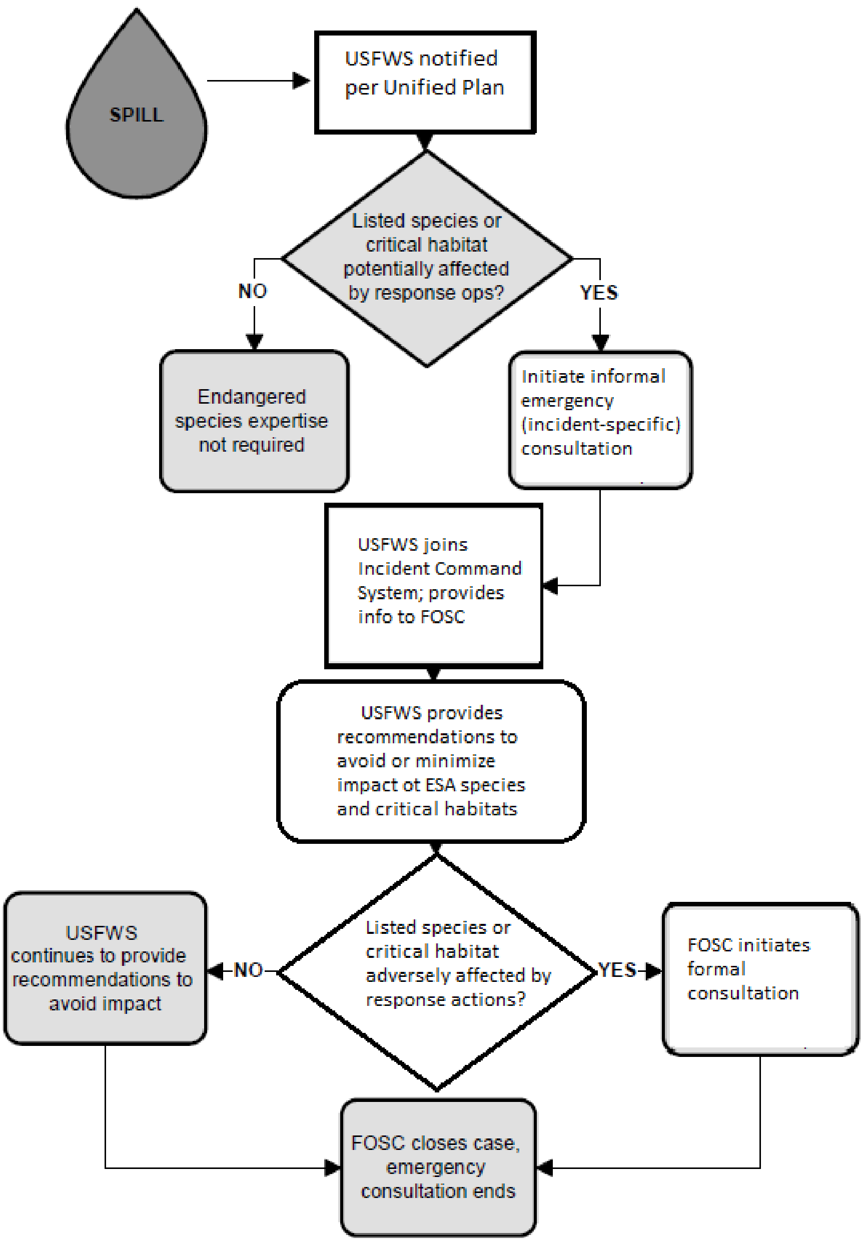

Figure 3. Diagram showing the notification of the Service and initiation of an emergency consultation pursuant to section 7 of the ESA as per the 2001 MOA. [Top]

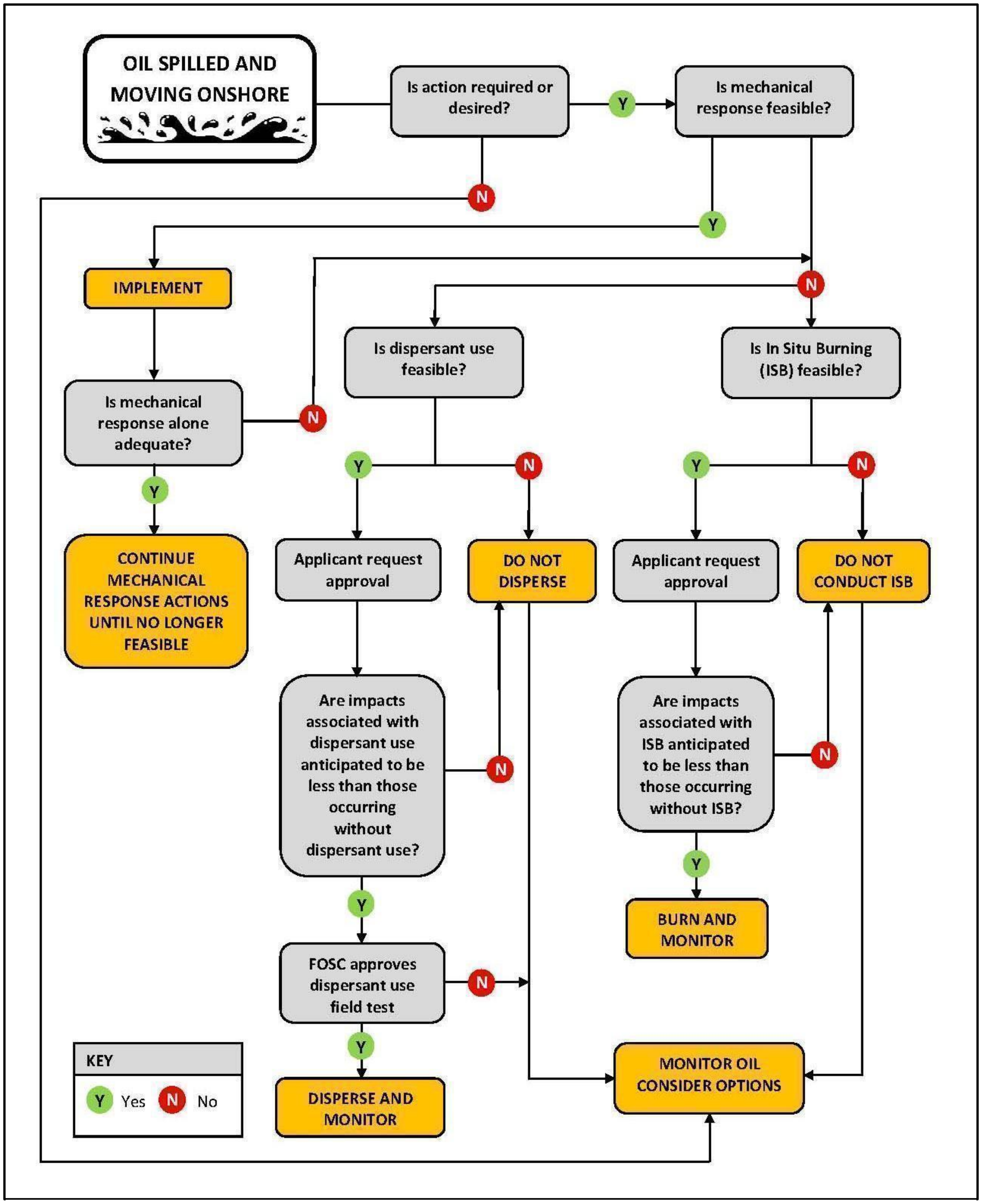

Figure 4. Diagram showing the incident-specific decision-making process for the use of dispersants and in situ burning as oil spill response tools.

[Top]

Decision-making regarding *in situ* burning should take into account the same information as considered for dispersant use (described above and also described in Revision 1 to the *In Situ* Burning Guidelines for Alaska, included in Annex F to the Unified Plan; ADEC et al. 2008).

Burning may be considered if mechanical countermeasures are ineffective, burning is feasible, and can be conducted at a safe distance from populated areas or sensitive resources. *In situ* burning is included as part of the emergency consultation process with the Service, who provides recommendations regarding how to avoid or minimize impacts to listed species or critical habitats from burning oil or burning activities.

2.7 Interrelated and Interdependent Actions

For purposes of the ESA, "effects of the action" means the direct and indirect effects of an action on the listed species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action (50 CFR 402.02). To concur that an action may affect, but is not likely to adversely affect, listed species, the Service must find that all of the effects of the proposed action or interrelated or interdependent actions are expected to be insignificant, discountable, or entirely beneficial. Insignificant effects relate to the size of the impact and should never reach the scale where a take will occur. Discountable effects are those that are extremely unlikely to occur. Based on best judgment, one would not 1) be able to meaningfully measure, detect, or evaluate insignificant effects; or 2) expect discountable effects to occur. Wholly beneficial effects are contemporaneous positive effects with no adverse effects to listed species.

Interrelated and interdependent actions are those which have no independent utility apart from the proposed action. They depend on the larger action for their justification (50 CFR §402.02). Interrelated and interdependent actions related to oil spill response activities include actions not directed by the Unified Plan, but resulting from decisions made under the Unified Plan. This includes the influx of people and supplies into the response area during an event. Depending on the size of a spill, this associated movement of people and supplies can be the equivalent of a small community. The establishment of a small community for the purposes of spill response would include increased flights or marine vessel traffic to the area to transport people and supplies, increased water and energy consumption, increased waste management, and increased human activity in the vicinity of the community (which could have a marine coastal component). Increased recreational human activity from oil spill responders during their time off may increase baseline stressors on the environment (e.g., potentially increased coastal disturbance, noise, additional oil spills) in marine or coastal areas.

2.8 Assumptions

We conducted this consultation using a number of assumptions:

1. We assumed that the Unified Plan will be followed during a response as it is written (including its associated documents described above), and that the recommendations provided by the Service during an incident in order to minimize effects to ESA-listed species will be followed.
2. We also assumed that per the *2001 Inter-agency MOA (USCG 2001)* the FOSC and Area Committees will solicit and involve the Service's SRC and section 7 personnel as described here and in the Unified Plan.
3. When a response planning document (supplemental to the Unified Plan) provides contradictory information (e.g., related to a decision-making process or action

description) to the Unified Plan, we assumed responders will defer to and operate under the Unified Plan, except regarding the use of dispersants.

4. We assumed responders would operate under the most recent draft of the Dispersant Use Plan (ARRT 2014). Regarding subsea (i.e., below the water surface) use of dispersants, we assumed responders would follow guidance provided by the USEPA and USCG documented in *Discussion Paper Clarifying Inclusion Of Atypical Dispersant Use In Formal Consultation On The Alaska Unified Plan* (EPA and USCG 2015). This document specifies that subsea dispersant uses are not part of this consultation and are therefore not considered in this BO (See EPA and USCG 2015; Appendix E).
5. In areas identified as avoidance areas for the short-tailed albatross, we assumed that dispersant use would be considered in the same manner as for areas not within an approved Preauthorization Area. See Appendix D for correspondence regarding avoidance areas.
6. For the purpose of assessing potential exposure risk in our effects analyses, we assumed that an incident has occurred to trigger the use of the Unified Plan. The Unified Plan is designed for use during a spill, or potential spill, therefore we assumed that the actions under consideration may occur during future spill events.
7. The conclusions regarding the maximum possible exposure of listed species to spill response assume the hypothetical worst-case scenarios developed for analysis do not underestimate the level of take that could actually occur.
8. We assume Best Management Practices (BMPs) and impact avoidance and minimization measures specified within the Unified Plan will be fully implemented

2.9 Action Area and Life of the Project

The "Action Area" is defined in the implementing regulations for section 7 at 50 CFR 402.02 as "all areas to be affected directly or indirectly by the Federal action". It includes the spatial distribution of all negative stressors and positive subsidies on the environment likely to be directly or indirectly caused by an action. Under this approach, those stressors and subsidies on the environment are analyzed outward from their source until they can no longer be meaningfully detected. Individuals of a listed species affected by a proposed action might leave an action area after being exposed and their responses might occur outside of an action area. In these instances, the action area does not expand to include the area where the responses occur.

For this BO, the action area includes the State of Alaska and its coasts and its contiguous waters bounded by the U.S. exclusive economic zone (EEZ). Generally, the USCG has jurisdiction over the "coastal zone" and the EPA has jurisdiction inland of the coastal zone, as defined in the NCP (40 CFR 300.5). Our assessment of baseline conditions in the Action Area focuses on those areas occupied by species designated as threatened or endangered under the ESA or designated as a candidate for listing that are under the jurisdiction of the Service.

The Unified Plan is intended to be reviewed and revised by the ARRT every five years. Updates to the Unified Plan are provided to the Service for review per the 2001 Inter-agency MOA. The Service evaluates the changes to determine if additional consultation under ESA section 7 is necessary. Consultation is considered to be necessary if the addition of new (i.e., technologies or species) have the potential to affect listed species. The most recent comprehensive update, "Change 3" of the Unified Plan was finalized in 2010; this review incorporates all changes to date, as described under Section 2.8 Assumptions. Therefore, the anticipated life of the Unified Plan is from 2015 - 2020. Because the end of the five-year update schedule does not invalidate the Unified Plan, we did not limit our evaluation of effect to listed species to this time period.

[Top]

3.0 STATUS OF THE SPECIES

See APPENDIX A.

4.0 ENVIRONMENTAL BASELINE

The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the Action Area, the anticipated impacts of all proposed Federal projects in the Action Area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process (50 CFR 402.02). The environmental baseline for the Unified Plan provides information specific to the status of listed species within the U.S. EEZ.

4.1 Sea otter

Status in the Action Area

The range of the listed population of sea otters is entirely within the action area; see the Status of the Species Section for the current condition of and factors affecting this species. Our most recent estimate of the size of the southwest Alaska DPS of the northern sea otter, based on surveys in 2000 - 2011, is 54,771 animals (USFWS 2014c; Table 4). Populations are stable or increasing in the Kodiak, Katmai, Kamishak and Cook Inlet Areas and stable or decreasing in the Aleutians and the Alaska Peninsula. The population size in southwest Alaska has declined by more than 50% since the mid-1980s. While the overall population trend for the Southwest Alaska stock is believed to have stabilized, current numbers are well below historical levels, and there is no evidence of recovery.

Sea otters are carnivores that forage in nearshore marine and intertidal habitat. They eat a wide variety of benthic (living in or on the sea floor) invertebrates, including sea urchins, clams, mussels, crabs, and octopus. Clams were the most frequently identified sea otter prey item (57 - 67% of the diet) in the northern Kodiak Archipelago. Mussels, crabs, and green sea urchins contributed ≤25% to the total prey (Doroff and DeGange 1994). Sea otters mainly forage in depths less than 20 m (Bodkin et al. 2004). In some parts of Alaska, sea otters also eat epibenthic (living upon the sea floor) fishes (Estes et al. 1982; Estes 1990). They have a high metabolic rate compared to land mammals of similar size (Costa 1978; Costa and Kooyman 1984). To maintain the level of heat production required to sustain them, sea otters eat large amounts of food; estimated at 23– 33% of their body weight per day (Riedman and Estes 1990).

The sea otter is considered a keystone species that strongly influences the species composition and diversity of the nearshore marine environment it inhabits (Estes et al. 1978). For example, studies of subtidal communities in Alaska have demonstrated that when sea otters are abundant, epibenthic herbivores such as sea urchins will be present at low densities whereas kelp, which is consumed by sea urchins, will flourish. Conversely, when sea otters are absent, grazing by abundant sea urchin populations creates areas of low kelp abundance, known as urchin barrens (Estes and Harrold 1988).

Table 4. Population estimates for the Southwest Alaska stock of northern sea otters (USFWS 2014).

Survey Area	Year	Unadjusted Estimate	Adjusted Estimate	CV	N_{min}	Reference
Aleutian Islands	2000	2,442	8,742	0.22	7,309	Doroff *et al*. (2003)
North Alaska Peninsula	2000	4,728	11,253	0.34	8,535	Burn and Doroff (2005)
South Alaska Peninsula - Offshore	2001	1,005	2,392	0.82	1,311	Burn and Doroff (2005)
South Alaska Peninsula - Shoreline	2001	2,651	6,309	0.09	5,865	Burn and Doroff (2005)
South Alaska Peninsula - Islands	2001	402	957	0.09	889	Burn and Doroff (2005)
Unimak Island	2001	42	100	0.09	93	USFWS unpublished data
Kodiak Archipelago	2004		11,005	0.19	9,361	USFWS unpublished data
Katmai	2008		7,095	0.13	6,362	Coletti *et al*. (2009)
Kamishak Bay	2002		6,918	0.32	5,340	Bodkin *et al*. (2003)
Current Total			**54,771**		**45,064**	
Previous SAR Total			47,676		38,703	

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Critical Habitat Designation and Use

On October 8, 2009, the Service finalized designation of 15,164 km^2 (5,855 mi^2) of critical habitat for the threatened northern sea otter in southwest Alaska. The Primary Constituent Elements (PCEs) are the physical and biological features essential to conservation of the species and may require special management considerations. The PCEs for the designated critical habitat of the sea otter are: 1) shallow, rocky areas less than two m (6.6 ft) in depth where marine predators are less likely to forage or 2) nearshore waters within 100 m (328.1 ft) from the mean high tide line that may provide protection or escape from marine predators; and 3) kelp forests, which occur in waters less than 20 m (65.6 ft) in depth, that provide protection from marine predators or 4) prey resources within the areas identified by PCEs 1, 2, and 3 that are present in sufficient quantity and quality to support the energetic requirements of the species.

Threats and Possible Stressors in the Action Area

Sea otters are susceptible to the acute and chronic effects of spills in the marine environment, as was demonstrated by the effects of the 1989 Exxon Valdez Oil Spill (EVOS) in Prince William Sound (PWS). An estimated 3,905 (1,904 - 11,257) sea otters died during EVOS (Degange et al. 1994), and the PWS population has only recently shown signs of full recovery (Harwell and Gentile 2014). Risk of spills in the Aleutians is considered relatively high compared to other places in Alaska. This risk was realized in 2004 with the wreck of the M/V *Selendang Ayu* (Unalaska Island, 2004) when >300,000 gal of heavy bulk fuel oil spilled into the sea (ADEC 2014). The acute impacts to sea otters from this spill were minimal, but this spill was considered by many to be a "shot across the bow" warning of the existing risks in the region (Ritchie and Gill 2008).

Spills generally involve waste products, hazardous materials, or petroleum products. Waste products are substances that can be accidently introduced into the environment by industry activities. Examples include ethyl glycol, drilling muds, or treated water. Hazardous materials include any substance that can pose a health or environmental risk, including products such as ammonia and urea. Releases of oil or other petroleum products are generally referred to here as oil spills. Examples include oil, gas, or hydraulic fluid spills from mechanized equipment or spills from pipelines or facilities. Oil spills as considered either small (< 1,000 bbls) or large (≥ 1,000 bbls). A volume of oil of 1,000 bbls equals 42,000 U.S. gallons (gal), or 158,987 liters. Large spills are associated with oil platforms, such as drill rigs or pads and pipelines.

Spill data for events occurring both in marine waters and on land was compiled from 1995 - 2005 (ADEC 2007). These data show that most spills were caused by structural or mechanical failures or inadequacies or human factors. Accidents caused 3% of spills, but resulted in 13% of total volume spilled. Major sources of spills from regulated industries included oil exploration and production (60% of spills and 38% of total volume), non-crude terminals (11% of spills), pipelines (9% of spills and 32% of volume), and rail transport (3% of spills, but 15% of volume). Lesser sources within regulated industry included crude terminals and refineries. Major sources in unregulated industries included mining, vessel transport, and storage.

Spill risks in the range of the listed sea otter are primarily associated with shipping and local industry. The shipping industry transports various types of petroleum products both as fuel and cargo within southwest Alaska. Shipping routes in the area include the North Pacific Great Circle Route, which is the shortest transportation distance for vessels travelling between Northwest North America and East Asia. From August 1, 2008 - July 31, 2009, nearly 16,000 vessel tracks were recorded from over 2,200 vessels in the Aleutians (DNV and ERM 2010a). Nearly 75% of vessels were deep draft vessels transiting the North Pacific Great Circle Route; most of the ships were bulk carriers and container ships (DNV and ERM 2010a). Important shipping passes through the Aleutian Islands, especially Unimak Pass, Akutan Pass, and the approach to Dutch Harbor, coincide with habitats used by sea otters, short-tailed albatross, and wintering Steller's eiders. In 2012, 1,961 ships made 4,615 transits through Unimak Pass, 3% of which were tankers (Nuka 2014). (Nuka 2014).

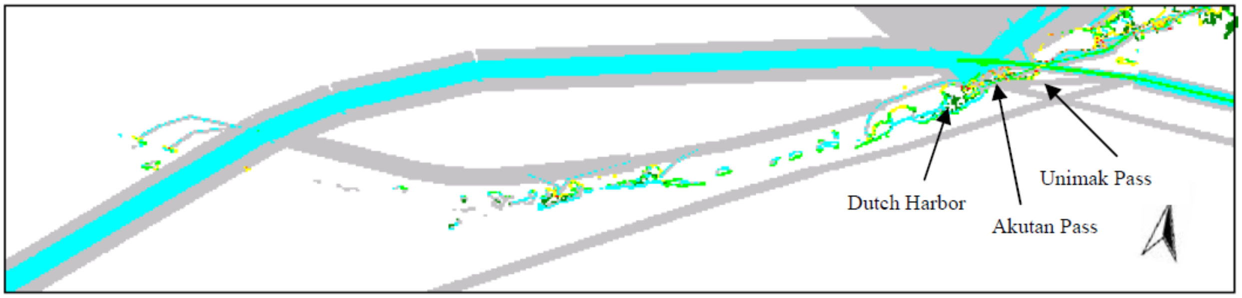
Information on oil spills throughout the range of the listed sea otter from 2006 - 2010 indicates that an average of four spills of crude oil occurred each year in the marine environment (ADEC 2014). Crude oil spills ranged in size from less than four to 760 liters (1 - 200 gal), with a mean size of about 41.8 liters (11 gal). Spills of non-crude oil averaged 62 per year, ranging in size from less than four to 24,320 liters (1 - 6,400 gal). The majority of the non-crude oil spills were small, with a mean size of about 380 liters (100 gallons) and a median size of four liters (1 gal). Dispersants have been used in an extremely limited capacity in Alaska to date, primarily during field trials during EVOS.

Spills occurring near shore in southwest Alaska would generally spread toward the southwest with the Alaska Coastal Currents or through the Aleutian Passes into eddies in the Bering Sea. Spread of spills would depend on location, surface wind, tides, and freshwater discharges (Figure 9; Chen and Firing 2006).

DNV and ERM (2010b) modeled existing accident frequency in the Aleutians for 2008 - 2009. Model parameters included shipping lane data (i.e., hazards), environmental data (wind, currents, etc.), internal operation data (normal vessel speed, onboard equipment that minimizes accident frequency and consequences), and external operations data (presence of vessel traffic managements systems, emergency tugs, etc.). The total predicted frequency of accidents was 8.67 per year, but the authors note that this is likely to be too high due to model sensitivity to environmental data. They found that the greatest accident frequencies are associated with fishing vessels (72%), tugs (10%), and tank barges (4%). The accident rate was very low in terms of vessel miles (8.67/5.36E+06 = 1.62 accidents per million vessel miles; Figure 5). The vast majority of accidents do not result in spills (DNV and ERM 2010b). DNV and ERM also evaluated the potential consequences of spills and found that scenarios associated with large spills (≥400,000 bbl) of persistent oil at high-release rates have significant potential for ecological impacts (DNV and ERM 2011).

There is no oil or gas production within the range of the listed otter, but exploration efforts are planned for lower Cook Inlet. Potential impacts of oil spills on sea otters could range from negligible to high, depending on the location, extent, and type of material spilled. If areas within the range of the listed otter were to be opened for oil and gas exploration and development in the future, potential impacts to sea otters should be given thorough consideration.

Threats and impacts of past and present impacts of Federal, State, or private actions and activities are described in the Status of the Species section. A review of the threats to sea otter recovery was completed in 2013(USFWS 2013). Most threats were assessed to be of low importance to recovery of the sea otter; threats judged to be most important are predation (moderate to high importance) and oil spills (low to moderate importance). The Recovery Plan concludes that due to the large spatial extent of the DPS, even a large spill from a crude oil tanker would be unlikely to affect a substantial proportion of the overall sea otter population (USFWS 2013). Table 5 summarizes that analysis.



Color	Accident Frequency (accidents per year within each calculation location)
	1.0 E-08 - 1.0 E-06
	1.0 E-06 - 1.0 E-05
	1.0 E-05 - 1.0 E-04
	1.0 E-04 - 1.0 E-03
	1.0 E-03 - 1.0 E-02
	> 1.0 E-02

*e.g. 1.0E-08 = 0.00000001 accident per year or once in a hundred million years; 1.0 E-02 = 0.01 accidents per year or once in a hundred years

Figure 5. Geographic distribution of accident frequency in the Aleutian Islands. Increased risk along the Great circle route is shown in blue (from DNV and ERM 2010b). [Top]

Table 5. Summary of importance of threats to recovery of the southwest Alaska DPS of the northern sea otter by management unit (from USFWS 2010).

Management Unit		Western Aleutians	Eastern Aleutian	Bristol Bay	South Alaska Peninsula	Kodiak, Kamishak, Alaska Peninsula
Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range from Oil spills	Potential Impact	High	High	High	High	High
	Geographic Scope	Local to Widespread	Local to Widespread	Local to Widespread	Local to Widespread	Local to Widespread
	Likelihood	Very to Not Likely	Very to Somewhat Likely	Very to Not Likely	Very to Not Likely	Very to Somewhat Likely
	Level of Confidence	High	High	High	High	High
	Importance to Recovery	Low	Moderate	Low	Low	Moderate
	Management potential	High	Moderate	Moderate	Moderate	Moderate

[Top]

Recovery

The sea otter recovery plan (USFWS 2013), establishes the goals of the recovery program: establish a framework within which recovery actions are undertaken to ensure the long-term survival of the southwest Alaska DPS of the northern sea otter and to control or reduce threats to the species to the extent that it no longer requires the protections afforded by the ESA, and therefore warrants delisting. Although subject to change, full recovery of the southwest Alaska DPS is currently envisioned as a cessation of further population declines with viable numbers of sea otters present throughout the current range of the DPS. Threats to the species will be adequately identified, and will have sufficiently abated to ensure the high probability of the survival of the southwest Alaska DPS for at least 100 years. The current status of the population does not meet these criteria.

4.2 Short-Tailed Albatross

Status in the Action Area

These wide-ranging seabirds are found throughout the North Pacific and Bering Sea within the Action Area. The current population estimate is 4,354 individuals. The population growth rate is approximately 7.5% per year (range from 5.2 - 9.4%; USFWS 2014a). A small number of recent sightings have occurred in the Chukchi Sea as well, suggesting that they may be increasing their range into Arctic waters. Waters around the Aleutian Islands are important for feeding, particularly during the summer non-breeding season. The diet of short-tailed albatross includes squid, shrimp, fish, flying fish eggs, and other crustaceans obtained from at or near the sea surface (Hasegawa and DeGange 1982, Tickell 1975, Tickell 2000). Albatross may be found in the Action Area during all times of year because juveniles and up to 25% of adults each year will forego returning to the North Pacific and Japanese nesting habitat.

The Aleutians and Bering Sea may be especially important during molting. Data from albatrosses captured at sea in the Aleutian Islands showed that most birds were undergoing extensive flight feather molt (R. Suryan and K. Courtot, unpublished data). Satellite tracking data indicated individuals were spending an average of 19 consecutive days (maximum of 53 days) within a 62-mile (mi) (100 km) radius of some Aleutian passes (R. Suryan and K. Courtot, unpublishe data). O'Connor (2013) examined locations of sub-adult short-tailed albatross and fishing locations of vessels in 2008 - 2011 and found albatross-vessel association hotspots at several canyons along the Bering Sea shelf.

Threats and Possible Stressors in the Action Area

Commercial Fishing in the U.S

Short-tailed albatross are periodically captured in commercial longline, groundfish, and trawl fisheries. Birds dive after baited hooks as they are being set, get hooked, and drown while being dragged below the water's surface with the sinking line. The Service, NMFS, and the fishing industry have recognized this and enacted various means of reducing mortality. These measures have included: implementing an observer program to ensure accurate reporting of bycatch; requiring use of avoidance and minimization measures such as bird deterrence streamers (tori lines); supplying free streamer line kits to commercial longline vessel owners; and conducting a 50% cost-share program to reimburse owners of certain longline vessels for half of the costs of purchasing tori line-deployment booms. In addition, NMFS has conducted public awareness and education campaigns to improve use of streamers on smaller vessels.

Controlled and large scale field studies have demonstrated that properly deployed paired streamer lines are effective at reducing seabird attacks on the gear by 85 - 100% (Melvin et al. 2001). The effectiveness of streamer lines is borne out by bycatch data, which shows continued reduction in bycatch rate since fishermen began using the lines in 1999 (NOAA 2007). Single streamer lines are slightly less effective than paired lines, reducing seabird bycatch by 96% and 71% for the sablefish and Pacific cod fisheries respectively (Melvin *et al*. 2001). Tools and techniques continue to improve; Melvin et al. (2011) compared a third wire snatch block, warp boom, and paired streamer lines on two trawlers in the eastern Bering Sea. They determined that bird strikes could be diminished by deploying streamer lines at least a meter above the third-wire block and by minimizing the aerial extent of the third wire.

Oil Spills

The number and volume of oil and other hazardous materials spills in the marine waters of the State of Alaska is highly variable. Between 1995 and 2012 the number of marine spills reported annually ranged from 11 - 37, and total annual spill volume ranged from 5,017 - 352,602 gal. Most spills in Alaska marine waters from 1995 - 2012 were non-crude oil spills (primarily diesel and other lighter fuels). Crude oil spills were much less frequent ranging from zero to two per year, with total volumes ranging from 0 - 924 gal. The Aleutian Islands region had the greatest volume of spills in marine waters from 1995 – 2012 (Figure 6; ADEC 2007).

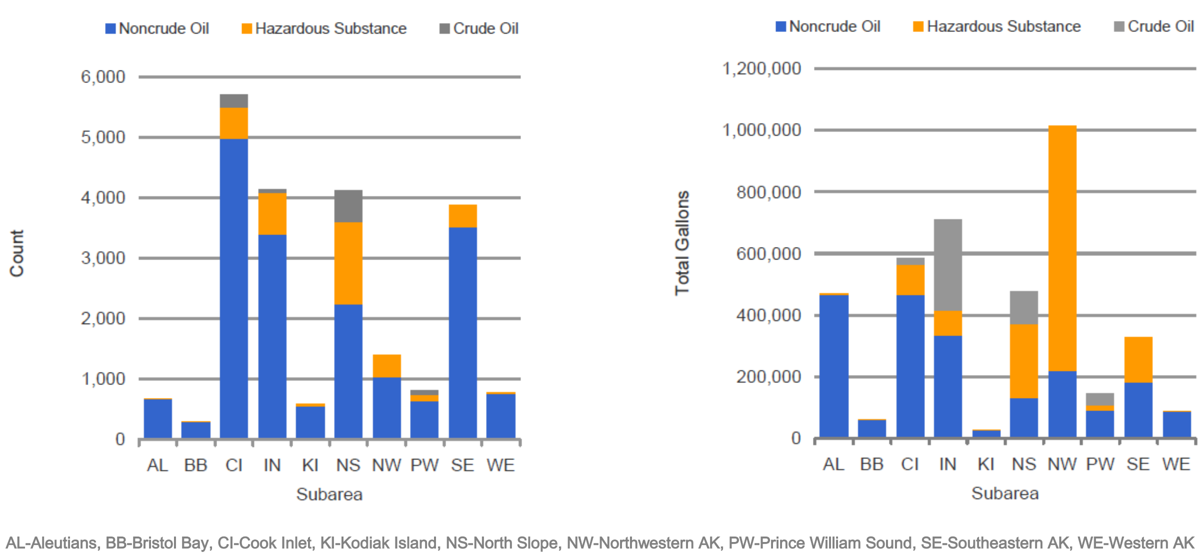


Figure 6. Number of spills by subarea and product (left) and gallons spilled by subarea and product (right) from ADEC (2007). [Top]

Shipping is a major source of spills in the Aleutian Islands and Bering Sea. Shipping between North America and East Asian countries is increasing, especially among deep draft shipping vessels travelling along the Great Circle Route (DNV and ERM 2010a, 2010b, 2014, Nuka 2014). Geographically, the greatest spill risk from vessels is predicted along the Aleutian Island chain, particularly at Unimak Pass and Akutan Pass (DNV and ERM 2010b) where short-tailed albatross concentrations may be high. Albatrosses that are molting in these areas may be less mobile and more sensitive to threats that occur in the vicinity, including oil spills. Due to the high overlap with important foraging areas for short-tailed albatross and high risk of spills in these areas, substantial impacts to adult and juvenile birds could occur. Shipping increases are also likely along the west coast of Canada and the contiguous U.S. Spills in these areas could affect locations where a high proportion of immature short-tailed albatrosses have been tracked (Guy et al. 2013).

The risk of oil spills in the Bering and Chukchi seas is also increasing. As sea-ice recedes due to climate change, the potential for increases in Arctic shipping continues to grow. Although short-tailed albatross have only rarely been observed in the Chukchi Sea, the reduction in sea-ice and the increasing numbers of widely-ranging subadult short-tailed albatrosses may result in a greater number of albatrosses in Arctic waters (Day et al. 2013; Gall et al. 2013) where they could be exposed to petroleum products spilled in Arctic shipping accidents.

Another major source of spills is from oil and gas industries. At the present time, the Aleutians have limited potential for oil and gas development. Approximately 1.75 million offshore acres along the Alaska Peninsula are available for development, but current restrictions require development to be conducted from onshore facilities. Potential in the area is considered low to moderate and no large scale oil exploration or development is being conducted.

Although the risk of spills and potential for impacts to short-tailed albatrosses exists in many places throughout their range, most spills occurring in the Action Area would not affect enough albatross to raise concerns for the well-being of the population. This is because short-tailed albatross have a very broad range, spills generally have localized effects, and large spills with wide-spread impacts are highly unlikely to occur.

Recovery

A final recovery plan was completed in 2008 (USFWS 2008). The short-tailed albatross may be delisted under the following conditions: the total breeding population reaches a minimum of 1000 pairs; (population totaling 4000 or more birds); AND the 3-year running average growth rate of the population as a whole is ≥6% for ≥7 years; AND at least 250 breeding pairs exist on two island groups other than Torishima, each exhibiting ≥6% growth for ≥7 years; AND a minimum of 75 pairs occur on a site or sites other than Torishima and the Senkaku Islands. The listed population does not currently meet these criteria.

4.3 Polar Bear

Status in the Action Area

Two Polar Bear stocks occur within the Action Area: the Alaska-Chukotka (A-C) Stock and the Southern Beaufort Sea (SBS) Stock. The A-C stock is widely distributed on the pack ice of the northern Bering, Chukchi, and eastern Siberian seas (Figure 7; Garner et al. 1990; Garner et al. 1994). The constant movement of pack ice influences the movement of polar bears; this makes obtaining a reliable population size estimate from mark and recapture studies challenging. For example, polar bears of this stock move south with advancing ice during fall and winter and north in advance of receding ice in late spring and early summer (Garner et al. 1990). Experts estimate the stock to number approximately 2,000 polar bears (Aars et al. 2006). Currently, the International Union for Conservation of Nature (IUCN) Polar Bear Specialist Group classifies the A-C stock as declining based on reported high levels of illegal killing in Russia, continued legal harvest in the United States, and observed and projected losses in sea-ice habitat (Table 6, Obbard et al. 2010).

The SBS stock is distributed across the northern coasts of Alaska, and the Yukon and Northwest territories of Canada (Figure 7). Estimates of the stock size of the SBS were 1,778 from 1972 - 1983 (Amstrup et al. 1986), 1,480 in 1992 (Amstrup 1995), and 2,272 in 2001 (USGS, unpublished data). Declining survival, recruitment, and body size (Regehr et al. 2006; Rode et al. 2010), low population growth rates during years of reduced sea-ice (2004 and 2005), and an overall declining population growth rate of 3% per year from 2001 - 2005 (Hunter et al. 2007) suggest that the SBS is now declining. Regehr et al. (2006) estimated the SBS to be 1,526 (95% CI: 1,211 - 1,841). Most recently, mark-recapture work from 2001 - 2010 estimated 2010 abundance to be 907 (95% CI: 548 – 1,270), but possible spatial heterogeneity in the population could bias abundance estimates (IUCN/SSC PBSG 2015). This suggests that the size of the subpopulation declined between the late 1990s and 2010. The status of this stock is listed as 'reduced' by the IUCN (IUCN; Obbard et al. 2010) and 'depleted' under the Marine Mammal Protection Act (MMPA).

Table 6. Status of polar bear stocks in the Action Area.

	IUCN Polar Bear Specialist Group[a]			
Subpopulation/stock	**Population status**	**Population trend**	**Population size**	**MMPA[b] Status**
Alaska-Chukotka	Reduced	Declining	Unknown	Depleted
Southern Beaufort Sea	Reduced	Declining	1,526 (95% CI: 1,211 – 1,841)	Depleted

[a] The Polar Bear Specialist Group is a research scientist group under the auspices of the International Union for the Conservation of Nature (IUCN); Obbard et al. (2010)
[b] Marine mammals listed under the Endangered Species Act are given a "depleted" status under the Marine Mammal Protection Act (MMPA).

[Top]

Typically, most polar bears from the A-C and SBS stocks occur in the active ice zone, far offshore, where they hunt for seals from broken pack ice throughout the year. Bears also spend a limited time on land to feed or move to other areas, although melting sea-ice may result in increased numbers of polar bears moving from the offshore ice onto land. Polar bears may also abandon melting sea-ice and/or use the terrestrial environment to transit to other areas. When fall storms and ocean currents result in bears coming to land, they may remain along the coast or on barrier islands until the ice returns. Polar bears may travel to land by swimming from remnant ice to terrestrial habitats. Polar bears occasionally den along the Chukchi Sea coast.

Polar bears have recently been documented offshore in the Action Area. Aerial surveys flown by the National Marine Mammal Laboratory (NMML [2013]) recorded 65 sightings of 277 individual polar bears in the Chukchi and Beaufort seas in all months of the study period (June-October) except June. Some of these sightings were repeat observations of the same animal (NMML 2013). Polar bears were observed on the beach or tundra along the coast or on barrier islands between Cape Lisburne and Demarcation Point from August to October, and were observed on sea-ice in September (NMML 2013). They were observed swimming at sea in all months from July to October, generally near sea-ice or land. Exceptions to this included five sightings on 15 Aug, 25 Aug, 5 Sep, 15 Oct, and 18 Oct of polar bears swimming offshore in open water, with no sea-ice in the vicinity. These five polar bears were sighted in both seas, from approximately 30 - 110 km offshore (NMML 2013).

The Service designated polar bear critical habitat in 2010 (75 FR 76086). In January 2013, the U.S. District Court for the District of Alaska issued a decision vacating and remanding the final rule to the Service in *Alaska Oil and Gas Association et al. v. Salazar et al.* (D. Alaska; 3:11-cv-00025-RRB). Decisions regarding the District Court's order are currently pending, and no critical habitat designation is currently in place.

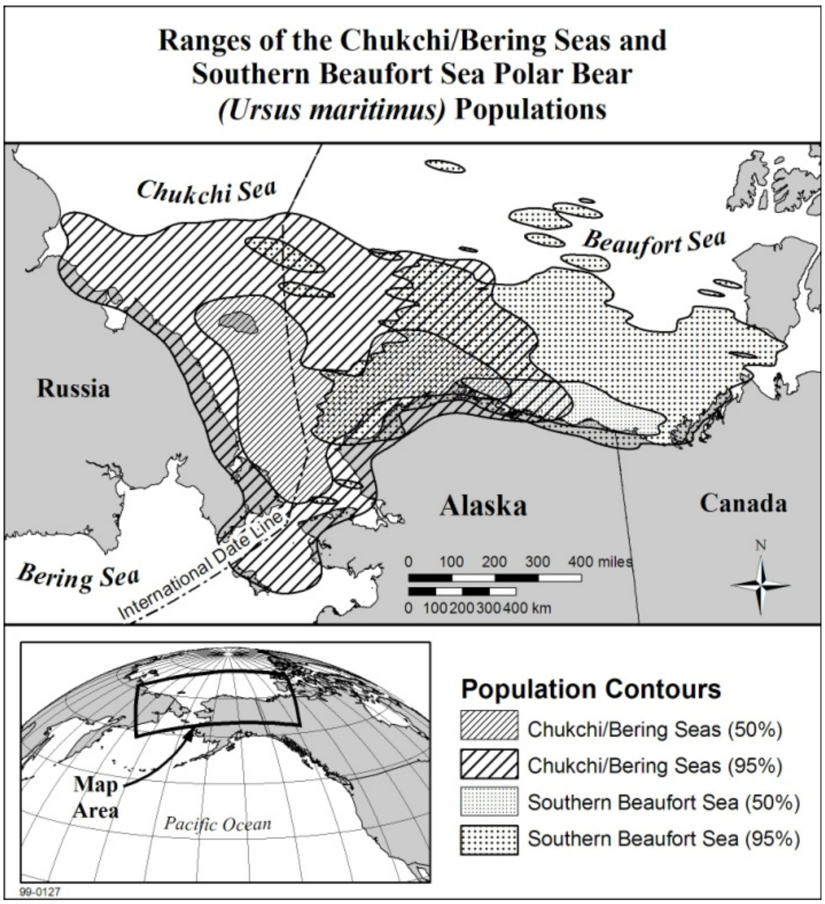


Figure 7. Ranges of Alaska polar bear stocks (73 FR 28212). [Top]

Threats and Possible Stressors in the Action Area

The two main stressors in the Action Area for the polar bear are loss of sea-ice resulting from climate change and subsistence hunting.

Loss of Sea-ice

Declines in sea-ice have occurred in optimal polar bear habitat in the southern Beaufort and Chukchi seas between 1985 - 1995 and 1996 - 2006, and the greatest declines in 21st century optimal polar bear habitat are predicted to occur in these areas (Durner et al. 2009). These stocks are vulnerable to large-scale dramatic seasonal fluctuations in ice movements which result in decreased abundance and access to prey, and increased energetic costs of hunting. The A-C and the SBS are currently experiencing the initial effects of changes in sea-ice conditions (Hunter et al. 2007; Regehr et al. 2009; Rode et al. 2010). Regehr et al. (2010) found that the vital rates of polar bear survival, breeding rates, and cub survival declined with an increasing number of ice-free days/year over the Continental Shelf, and suggested that declining sea-ice affects these vital rates via increased nutritional stress.

Subsistence Harvest

Subsistence hunting of polar bears occurs within the Action Area. Subsistence hunting of polar bears is managed through international and other agreements. Harvest quotas are set by the Inuvialuit-Inupiat (I-I) Council and the U.S./Russia Polar Bear Commission (U.S./Russia Commission) for the SBS and A-C polar bear populations, respectively. Quotas are based on the best available scientific data and traditional ecological knowledge to minimize potential for over-harvest. Total reported polar bear harvest numbers, including all bears harvested from 2007 - 2011 in Alaska communities are as follows: Barrow, 49; Gambell, 9; Kivalina, 3; Kotzebue, 3; Little Diomede, 14; Nome, 1; Point Hope, 51; Point Lay, 2; Savoonga,16; Shishmaref, 6; Wainwright, 4; and Wales, 5 (78 FR 1942).

Southern Beaufort Sea stock

In 1988 the I-I Council established a sustainable harvest quota for the SBS population of 80 polar bears. In 2010, the Council adjusted the quota downward to 70 polar bears based on a revised population estimate of 1,526 (Regehr et al. 2006). The reported annual average combined Alaska/Canada harvest for the SBS population from 2004 - 2009 was 44. The 2008/2009 reported harvest for Alaskan North Slope villages was 25 polar bears (DeBruyn et al. 2010).

Alaska-Chukotka stock

Russia and the U.S. signed the *Agreement between the United States of America and the Russian Federation on the Conservation and Management of the Alaska-Chukotka Polar Bear Population* (Bilateral Agreement) in 2000, which established the U.S./Russia Commission and provided a common legal, scientific, and administrative framework to manage the shared A-C polar bear population. Implementing legislation for the Bilateral Agreement was signed in the U.S. on January 12, 2007. In June 2010, the U.S./Russia Commission adopted an annual take limit of the A-C polar bear population of 19 females and 39 males (DeBruyn et al. 2010). Harvest will be split evenly between Native peoples of Alaska and Chukotka. The Alaskan share of the harvest is 29 total polar bears per year, which is below the average of 37 polar bears harvested each year between 2004 and 2008 (USFWS, unpublished data).

Oil and Gas Activities

Potential effects to polar bears from oil and gas exploration could arise due to disturbance from the presence of vessels and aircraft, noise from seismic surveys, and human bear interactions. Impacts of most of these interactions are expected to be minimal due to the impact avoidance and reduction measures applied by the oil industry and included in authorizations issued by the Service under the MMPA (USFWS 2012, USFWS 2013). Oil spills and spill response activities may affect polar bears if bears or their prey come into contact with spilled or dispersed oil. Oil exploration and development is the greatest source of risk for spills in Northern Alaska. Offshore exploration in the nearshore Southern Beaufort Sea has been ongoing since 1982; exploration wells are planned to be drilled in the Chukchi Sea in the very near future (Figure 8).

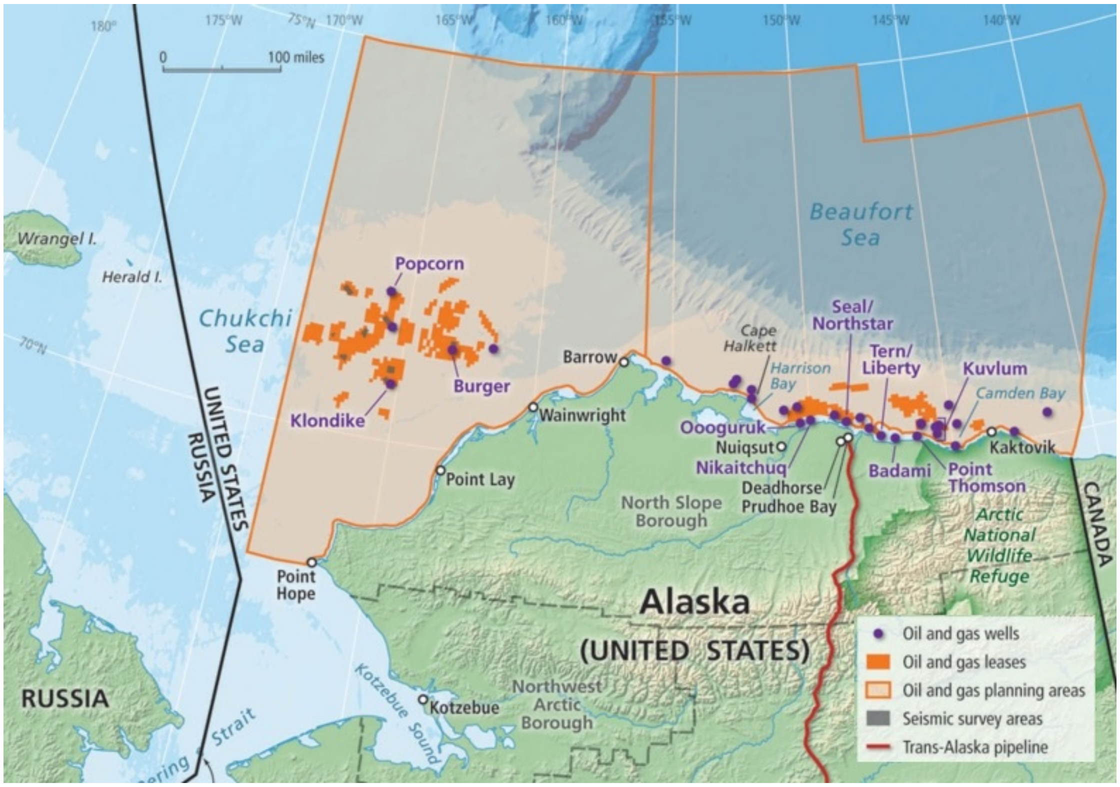


Figure 8. Oil and gas exploration and development areas in Northern Alaska (from Natural Research Council, in Fischman 2014). [Top]

More than 16 billion barrels (bbl) have been produced, and more than 2,000 wells drilled on the Beaufort Sea/North Slope. Seven large oil spills have occurred between 1985 and 2009. The largest oil spill occurred in 2006, where approximately 5,714 bbls (260,000 gal) leaked from flow lines near a gathering center. In 2009, a 1,095 bbl (46,000 gal) oil spill occurred as well. Both of these spills occurred at production sites. Historically, industry has had 35 small spills (those less than 50 bbls, 2,100 gal) totaling 26.7 bbls (1,121 gal) in the outer continental shelf. More recently, in 2012, a gas blowout occurred at an exploration well on the Colville River Delta where approximately 1,000 bbls (42,000 gal) of drilling mud and an unknown amount of natural gas was expelled (BOEM 2011a). The Bureau of Land Management (BLM) and BOEM modelled the likelihood of spills occurring during exploration and development in the National Petroleum Reserve-Alaska and in the Chukchi Sea (BLM 2012a and BOEM 2011b, 2000, respectively). BOEM (2014) estimated an average of 2 - 3 spills per year during exploration and 10 - 12 per year during development. Spill volume averaged 1.4 bbl (BLM 2012a).

Large (≥ 1,000 bbl) or very large spills (≥120,000 bbl) were considered extremely unlikely to occur during oil and gas exploration. BOEM estimated the occurrence and frequency of large and very large spills from wells in the Chukchi Sea at 0.003 (mean spill frequency per 1,000 years) and 2.39×10^{-5} (mean spill frequency per well), respectively (BOEM 2011b). The two sources of potential large crude oil spills are from pipelines and long duration blowout resulting from a well-control incident. The BLM estimated a 28% chance that one or more large crude oil spills would occur during 50 years. Based on information on past spills, spills volumes close to the lower end of the "large spill" range (1,000 bbl) are much more likely that spill volumes in the upper end of the range (119,999 bbl). BOEM (2014) considered spill sizes of 1,700 and 5,100 bbls to be the largest spill size likely to occur from a or pipeline or facility, respectively.

The BLM determined the only potential source of a very large oil spill (> 120,000 barrels) is a well-control incident that escalates into long duration blowout when all primary and secondary safeguards fail. The approximate occurrence rates worldwide for very large oil spills are about one for every 270 billion bbl produced (BLM 2012b). More locally (at Northstar), the statistical frequency of a blowout well leading to a very large oil spill was estimated at 9.4×10^{-7} per well drilled (for volumes > 130,000 bbl; BLM 2012b). Thus, while small spills (<50 bbl) are reasonably likely to occur, very large oil spills are extremely unlikely to occur, and none have occurred on Alaska's North Slope to date.

The majority of spills are anticipated to occur during the open-water season when bears from the A-C and SBS populations utilize sea-ice habitat as a platform for feeding and resting. As the ice recedes, the majority of the bears move with it. A small portion of bears can be found along the coast during this time, but a relatively large proportion of the A-C population tend to be found in the western Chukchi Sea region of the Russian Federation. Bears from the SBS predominantly utilize the central Beaufort Sea region of the Alaskan and Canadian Arctic during this time. These areas are well outside of the geographic region of oil exploration. Additionally, industry activity will occur only on a portion of the range of Alaska's polar bear. The offshore oil and gas exploration area in the Chukchi covers approximately 23% of the range of polar bear in the Chukchi Sea; active leases are approximately 2% of that area (USFWS 2013).

The overall risk of effects to polar bears is somewhat reduced because the majority of spills are likely to occur during the open water season, rather than during the ice-covered season when bears are most susceptible to impacts of spills and potential spill response activities. During this time, polar bears concentrate in shallow waters less than 300 m deep over the continental shelf and in areas with >50% ice cover to access ringed and bearded seals (Durner et al. 2004). In these areas, bears may be exposed to any remnant oil from the previous open-water drilling season or to oil released below ice because they are in potential oil exploration areas. Spilled oil could remain trapped in or under the ice near the source of release or concentrate and accumulate in leads and openings that occur during spring break-up and autumn freeze-up periods.

Amstrup (2006) estimated the probability that polar bears could be exposed to hypothetical oil spills using satellite locations from 194 collared bears in the vicinity of two production facilities, the Northstar Facility and the proposed offshore site for the Liberty Facility. Model parameters included time of year when bear density was highest, wind and current data, and hypothetical spill size. Numbers of bears potentially oiled by a hypothetical 5,912 barrel spill (the largest spill thought probable from a pipeline breach) ranged from 0 - 74 depending month and ice conditions. The authors concluded that a spill of 5,912 barrels of crude oil from the proposed Liberty or Northstar Island could pose significant risks to individual polar bears, but no risk at the population level (Amstrup et al. 2006)

The Service also assessed the risk to Polar Bears from oil spills in the Chukchi and Southern Beaufort seas from oil exploration and development prior to issuance of authorizations under the MMPA (USFWS 2012, USFWS 2013). Based on the low likelihood of occurrence for large spills (BOEM 2011a,b; BLM 2012a,b), that analysis concluded that significant impacts to polar bears under the existing environmental baseline are possible, but highly unlikely.

Other Environmental Contaminants
Exposure to environmental contaminants other than petroleum compounds may also affect polar bear survival or reproduction in the Action Area. Persistent organic pollutants (POPs) and heavy metals are thought to pose the greatest potential threat. Contamination of the Arctic and sub-Arctic regions through long-range transport of pollutants has been recognized for over 30 years (Proshutinsky and Johnson 2001; Lie et al. 2003). Arctic ecosystems are particularly sensitive to environmental contamination due to the slower rate of breakdown of POPs, relatively simple food chains, and the presence of long-lived organisms with high lipid levels that favor bioaccumulation and biomagnification. Consistent patterns between organochlorine compounds, mercury contamination, and trophic status have been documented in Arctic marine food webs (Braune et al. 2005).

Polar Bear Research
Currently, ongoing polar bear research takes place in the Action Area. The long-term goal of these research programs is to gain information on the ecology and population dynamics of polar bears to help inform management decisions, especially in light of climate change. These activities may cause short-term injury to individual polar bears targeted in survey and capture efforts and may incidentally disturb those nearby. In rare cases, research efforts may lead to injury or death of polar bears. Polar bear research is authorized through permits issued under the MMPA. These permits include estimates of the maximum number of bears likely to be directly harassed, subjected to biopsy darting, captured, etc., and include a condition that halts a study if a specified number of deaths, usually four to five, occur during the life of the permit. Permits are typically issued for a five year period.

Other Activities
Polar bear viewing at village whale bone piles may result in disturbance of polar bears by humans on foot, ATVs, snow machines, and other vehicles. Although difficult to quantify, these disturbances are usually temporary and localized, limiting the duration and severity of impact.

Recovery

The Service has assembled a diverse team of stakeholders, known as the Polar Bear Recovery Team, to draft a Conservation Management Plan for polar bears. The plan is scheduled to become available soon, and may reflect some of the conservation priorities of the 1973 *International Agreement on the Conservation of Polar Bears* (1973 Polar Bear Agreement) signed by the nations of Canada, Denmark on behalf of Greenland, Norway, the Russian Federation, and the U.S., including prevention of overharvest and special protections for females with cubs (Prestrud and Sterling 1994). Additional considerations may include measures to minimize range contraction and rates of population decline. At the current time, the potential for recovery of the polar bear populations in the Action Area remains uncertain.

4.4 Walrus

Status in the Action Area

Although only a portion of the total range of the Pacific Walrus occurs within the Action Area, walruses are highly mobile and wide-ranging, and are not considered to belong to discrete populations. Therefore, the information described in the Status of the Species section also applies within the Action Area. In the U.S. EEZ, there are 19 known walrus haulouts, four of which are located in Bristol Bay and are used primarily in summer by bulls. Five haulouts are located on the shores of the Bering Strait and St. Lawrence Island and are especially important in spring and fall as the population moves between wintering and summering grounds. The remaining six are along the coast of the Chukchi Sea and are used by females and juveniles primarily in summers with low sea-ice. The most recent estimate of the worldwide population of Pacific walrus is 129,000 (95% CI: 55,000 - 507,000; Speckman et al. 2010). The accuracy of this estimate is not suitable for determining recent population trends, but declines are thought to have occurred since the 1970s and 1980s.

Threats and Possible Stressors in the Action Area

Recent (2007 - 2011) changes in Arctic sea-ice have altered patterns of walrus migration into and use of the Chukchi Sea (Jay et al. 2012, Figure A-25 in Status of the Species). Recently, Jay et al. (2012) observed walruses further north in the Chukchi Sea in June and July than was previously observed by Fay (1982). This coincides with recent increases in open water and lower sea-ice concentrations during these months. In September and October of 2009, 2010, and 2011, Jay et al. (2012) documented walruses foraging nearshore in depauperate prey biomass areas instead of in historical offshore areas. Walruses forage on the seafloor for benthic invertebrates such as clams, snails, seaslugs, and polychaete worms. The disappearance of sea-ice over the continental shelf likely caused walruses to haul out on shore in large numbers, a behavior that did not commonly occur previously (Fay et al. 1984). Walruses, however, continued to use Hanna Shoal as a core foraging area (Jay et al. 2012).

The NMML has documented walruses during aerial surveys in the Action Area within oil exploration areas for the past several years (NMML 2010, 2011, 2012, 2013). In 2013, NMML (2013) documented 11,974 individuals in 447 walrus sightings from June to October, all months of the Chukchi Sea portion of the survey, with largest numbers in July and August. No walrus haulouts on the northwestern Alaskan coastline were observed in 2012 (NMML 2013), although they were observed at coastal haulouts in previous years (e.g., NMML 2010).

Loss of Sea-ice

Loss of sea-ice during summer has caused walruses to become increasingly dependent on land-based haulouts, both throughout their range and in the Action Area. In August of 2007, 2009, 2010, and 2011 the pack ice retreated beyond the continental shelf, and walruses were observed hauled out on land at several locations between Point Barrow and Cape Lisburne in 2007 (Thomas et al. 2009, Clarke et al. 2011). Historical haulouts at Icy Cape have been comprised of a few thousand animals, which is much smaller than recent haulouts near Point Lay. In 2010 and 2011, walruses hauled out about three miles north of Point Lay. In early August 2011 (8 - 17 August) when sea-ice had receded north, walruses started to congregate nearshore; they formed a haulout by mid-August (NMML 2012). In 2011 the haulout formed about a month earlier than in 2010 (MacCraken, USFWS, unpublished data) and remained present into October (6-17 October; NMML 2012). In September 2009, a haulout of approximately 2,500 - 4,000 walruses was documented on land near Icy Cape (NMML 2010; Christman et al. 2010), suggesting a similar scenario to 2007 when pack-ice retreated away from offshore feeding grounds. A mortality event of 131 animals from unknown causes was documented at the Icy Cape site in 2009; the deaths were due to trampling, most likely due to a stampede due to a disturbance at a large haulout; the haulout was likely caused by the loss of sea-ice over the Chukchi Sea continental shelf (Fischbach et al. 2009).

In previous years, other investigators have linked walrus deaths at other Chukchi Sea coastal haulouts to trampling, exhaustion from prolonged exposure to open sea conditions, and separation of calves from their mothers (Fischbach et al. 2009). The potential for mortality events such as that at Icy Cape in 2009 may increase with increasing use of summer haulouts in response to loss of sea-ice over the continental shelf. However, haulout monitoring and protection programs have kept disturbances to a minimum and no large mortality events have occurred since 2009.

Subsistence Harvest

As summer sea-ice in the Chukchi Sea recedes and coastal haulouts form along the coast, the increased time walruses spend on land could provide opportunity for additional harvest. However, the Eskimo Walrus Commission passed a resolution in 2008 addressing hunting at these newly forming haulout areas, advising restraint and caution. Haulout monitoring and protection programs have been successful at managing hunting in a way that keeps disturbances to a minimum. About five animals have been harvested from the Point Lay haulout each year, typically as the haulout begins to form and relatively few animals are present.

Oil and Gas Activities

Walruses may be affected by oil and gas exploration and development due to encounters with or noise from offshore marine deep-penetration surveys, high resolution surveys, seismic surveys and exploratory drilling activities. Walruses at haul outs may be disturbed by the presence of vessels and aircraft. Impacts of most of these interactions are expected to be minimal due to the avoidance and reduction measures applied by the oil industry and included in authorizations issued by the Service under the MMPA (USFWS 2012, USFWS 2013). These authorizations require reporting of potential harassment. In 2012, industry reported 34 encounters of 184 walruses, of which, nine met the definition of Level B harassment, as defined under the MMPA. From vessels, industry reported 566 encounters involving 9,809 walrus, of which 164 MMPA met the definition of Level B harassment. No encounters occurred at terrestrial haulouts in 2012.

Small spills are likely to occur from oil and gas activities, as described in the Environmental Baseline for Polar Bears. Development in the Southern Beaufort Sea is not likely to affect Pacific walruses due to their limited range in this area. Development in the Chukchi Sea has not yet been demonstrated, and is not considered reasonably certain to occur, but exploration is planned for this area in the near future. If development were to occur, the risk of large spills occurring in the Chukchi Sea is projected to increase. BOEM (2014) estimated a 75% chance of one or more large spills occurring over the course of 77 years, and a 25% chance of no spills from development in the Chukchi Sea. The estimated chance of a very large oil spill remains exceedingly small, on the order of 10^{-4} - 10^{-5} (BOEM 2014). The likelihood of walruses contacting oil is proportional to the volume and spatial extent of the oil. For small spills the likelihood of exposure, and the number of walruses likely to contact oil if exposure does occur, are low. Large spills have a greater potential for impacts to large numbers of animals, but the probability of occurrence in the region is low (BOEM 2011b).

Material spilled into the Chukchi and during exploration would generally be spread with the currents, depending on the spill location, timing, extent of sea-ice, wind conditions, and freshwater inflows. Currents generally travel from south to north from the Pacific through Bering Strait (Figure 9). In some years there are also counter-currents created by seasonal flows and upwelling. These include the Siberian Coastal Current, which flows southward through Long Strait, and the Barrow canyon current, which brings Arctic waters into the Chukchi Sea (Weingartner et al. 2005; Woodgate et al. 2005; Woodgate et al. 2014).

Hanna Shoal (Figure 10) has shallow water and moderate to high benthic productivity (Dunton 2013). Walruses forage there in the tens of thousands (Brueggeman et al. 1990; MacCracken 2012) from June-October, and the area is considered a core area of foraging (Jay et al. 2012). This area corresponds with the oil and gas exploration area in the Chukchi Sea. Spills are most likely to occur there during the open water season when large numbers of walruses may be foraging in Hannah Shoal. The spill scenario with the greatest potential impacts to walrus would likely involve a large spill occurring within 60 km of the coast near a large haulouts. Spills under or in ice could also be problematic due to difficulty of cleanup in ice. Material not cleaned up could become part of the ice substrate and be eventually released back into the environment during the following open water season.

Figure 9. Ocean currents near Alaska from (Pearson 2004 - 2015) [Top]

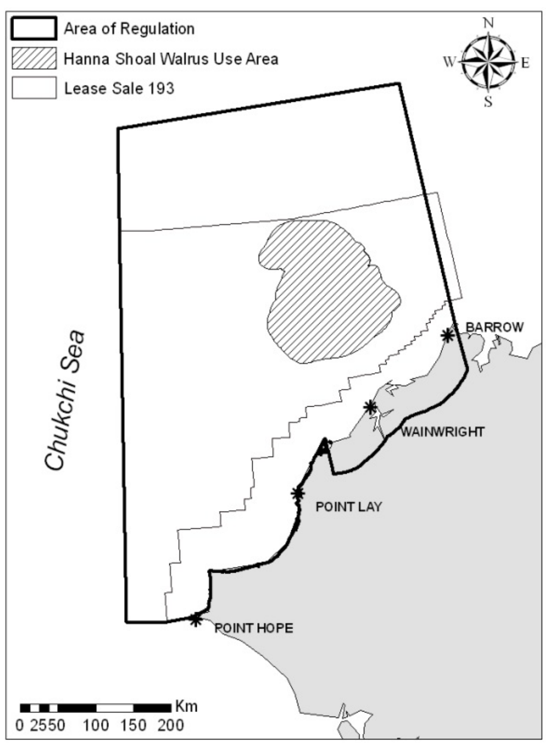


Figure 10. Hanna Shoal Walrus Use Area based on Jay et al. (2012). Image from 78 FR 1942. [Top]

The relative importance to walruses of oil and gas development and the associated risk of spills were evaluated in relation to other potential threats in a Bayesian belief network model by Garlich-Miller et al. 2011). These models incorporate three key elements; (1) important explanatory and response variables, (2) cause and effect relationships, and (3) probabilities representing the belief that a variable will be in a given state. These models are useful for formalizing and quantifying the opinions of experts (Marcot et al. 2006). Factors affecting walrus survival and recovery were ranked in order of importance. The most important factors influencing rankings were changes in harvest levels, followed by Greenhouse gas emissions, predation, disease, shipping, oil and gas development, other removals, and commercial fishing. Oil and gas development was considered to be two times more important than commercial fishing or shipping. The resulting mean probability estimate for negative effects on the population (a measure of relative contribution of each stressor) from oil and gas development was 0.12 (0.1 - 0.2) compared with 19.3 (17 - 20.8) for harvest (Garlich-Miller et al. 2011).

Although fuel and oil spills have the potential to cause adverse impacts to walruses, oil and gas exploration activities are not considered a major threat (USFWS 2012, USFWS 2013, Garlich-Miller et al. 2011). BOEM considers the likelihood of a blowout occurring during exploratory drilling in the Chukchi Sea as negligible (BOEM 2011a). Furthermore, various measures applied to and by the oil industry reduce the baseline risk of spills and the degree of impact that may result. These measures include:

- Offshore exploration activities in the Chukchi will be limited to the July 1 - November 30 open-water season to avoid seasonal pack ice;
- Onshore or near shore activities will not occur in the vicinity of coastal walrus haulouts.
- All support vessels and aircraft will be required to maintain a 1-mile buffer area around groups of walruses hauled out on land;
- Oil operators incorporate spill prevention equipment and methods during fuel transfers and hazardous material handling and storage;
- Protocols are in place to train field personnel to follow procedures and BMPs;
- Industry plans for spill prevention and response plans are required;
- Regulatory approval and oversight is required (exploratory drilling activities conducted on the outer continental shelf follow BOEM regulations at 30 CFR Part 550 and 30 CFR Part 250, respectively);
- Measures to prevent loss of well control are developed based on site-specific information and include redundant pollution prevention equipment, testing and verification that equipment is working properly, and training and testing of personnel in well control procedures;

For these reasons, any impacts associated with an operational spill are expected to be limited to a small number of animals. Oil spill risk associated with shipping is currently minimal. To date, limited shipping occurs in the Chukchi Sea due to seasonal constraints such as the formation of winter sea-ice.

Noise

Anthropogenic sources of noise in the arctic include vessels (e.g., for shipping and oil and gas activities) and airguns used during seismic surveys. The increase in human activities made possible by reductions in sea-ice is increasing the level of underwater noise in the Arctic Ocean, including in areas where this level of activity is unprecedented (Moore et al. 2012). In the Chukchi Sea, seismic activities are likely the greatest contributor to anthropogenic noise, followed by vessels. Industry minimization measures require operators to avoid walruses during seismic surveys, which may reduce likelihood of population-level effects, but cumulative impacts of sounds from multiple sources may influence the ability of walruses to communicate (Moore et al. 2012).

Recovery

The Service does not set recovery goals for species that are designated as candidates for listing. Therefore, no specific targets have been established for maintaining current population sizes or addressing threats to the species. Factors associated with climate change (i.e., loss of sea-ice) and hunting are the main threats identified thus far and are likely to continue into the foreseeable future, leaving the status of the species in the Action Area uncertain.

4.5 Spectacled Eider

Status in the Action Area

Much of range of the spectacled eider is within the Action Area; the Status of the Species section describes the current status and factors affecting this species in the Action Area. The most recent range-wide estimate of abundance of spectacled eiders was 369,122 (364,190– 374,054 90% CI; Larned et al. 2012a). Aerial surveys suggest the population growth rate is approximately stable over the long term (0.99, 90% CI: 0.98 - 1.01) and in the last 10 years (1.00, 90% CI: 0.97 - 1.03) (Larned et al. 2012a). Currently, this species consists of three primary breeding populations: those on Alaska's North Slope (ACP or Arctic Coastal Plain), the Yukon-Kuskokwim Delta (Y-K Delta), and northern Russia (Figure 11). The Y-K Delta and North Slope populations declined between the 1970s and the early 1990s (Warnock and Troy 1992; Stehn et al. 1993; Ely et al. 1994). The entire species overwinters in polynyas (areas of unfrozen sea water surrounded by ice) in sea-ice south of St. Lawrence Island where they feed on benthic invertebrates, especially mollusks and crustaceans. They may also forage on pelagic or free-floating amphipods.

Warnock and Troy (1992) documented an 80% decline in spectacled eider abundance from 1981 - 1991 in the Prudhoe Bay area. Since 1992, the Service has conducted annual aerial surveys for breeding spectacled eiders on the ACP. The 2010 population index based on these aerial surveys was 6,286 birds (95% CI, 4,877–7,695; unadjusted for detection probability), which is 4% lower than the 18-year mean (Larned et al 2011). In 2010, the index growth rate was significantly negative for both the long-term (0.987; 95% CI, 0.974–0.999) and most recent 10 years (0.974; 95% CI, 0.950–0.999; Larned et al. 2011). Stehn et al. (2006) developed a North Slope-breeding population estimate of 12,916 (95% CI, 10,942–14,890) based on the 2002–2006 ACP aerial index for spectacled eiders and relationships between ground and aerial surveys on the Y-K Delta. If the same methods are applied to the 2007–2010 ACP aerial index reported in Larned et al. (2011), the resulting adjusted population estimate for North Slope breeding spectacled eiders is 11,254 (8,338–14,167, 95% CI).

The Y-K Delta spectacled eider population is thought to have declined by about 96% from the 1970s to 1992 (Stehn et al. 1993). Evidence of the dramatic decline in spectacled eider nesting on the Y-K Delta was corroborated by Ely et al. (1994), who found a 79% decline in eider nesting near the Kashunuk River between 1969 and 1992. Aerial and ground survey data indicated that spectacled eiders declined 9–14% per year from 1985–1992 (Stehn et al. 1993). Further, from the early 1970s to the early 1990s, the number of pairs on the Y-K Delta declined from 48,000 - 2,000, apparently stabilizing at that low level (Stehn et al. 1993). Before 1972, an estimated 47,700–70,000 pairs of spectacled eiders nested on the Y-K Delta in average to good years (Dau and Kistchinski 1977).

Fischer et al. (2011) used combined annual ground-based and aerial survey data to estimate the number of nests and eggs of spectacled eiders on the coastal area of the Y-K Delta in 2011 and evaluate long-term trends in the Y-K Delta breeding population from 1985 - 2011. In a given year, the estimated number of nests reflects the minimum number of breeding pairs in the population and does not include non-nesting individuals or nests that were destroyed or abandoned (Fischer et al. 2011). The total number of spectacled eider nests on the Y-K Delta in 2011 was estimated at 3,608 (SE 448), the second lowest estimate over the past 10 years. The average population growth rate based on these surveys was 1.049 (90% CI: = 0.994–1.105) in 2002–2011 and 1.003 (90% CI: = 0.991–1.015) in 1985–2011 (Fischer et al. 2011). Log-linear regression based solely on the long-term Y-K Delta aerial survey data indicate positive population growth rates of 1.073 (90% CI: = 1.046–1.100) in 2001–2010 and 1.070 (90% CI: = 1.058–1.081) in 1988–2010 (Platte and Stehn 2011).

Figure 11. Distribution of spectacled eiders. Molting areas (green) are used July through October. Wintering area (yellow) are used October through April. The full extent of molting and wintering areas is not yet known and may extend beyond the boundaries shown. [Top]

Critical Habitat Designation and Use

In 2011, critical habitat was designated within Ledyard Bay and Norton Sound for molting spectacled eiders (66 CFR 9146). Critical habitat also includes areas on breeding habitat on the Y–K Delta and wintering habitat in the Bering Sea between St. Lawrence and St. Matthew Islands. These areas total approximately 10,098,827 hectares (100,988.3 square kilometers; 38,991.6 square miles; 24,954,638 acres). The PCEs for Y–K Delta Unit include all portions of the vegetated intertidal zone, and all open water inclusions within that zone. The PCEs for the Norton Sound Unit and the Ledyard Bay Unit include all marine waters greater than 5 m (16.4 ft) and less than or equal to 25 m (82.0 ft) in depth, along with associated marine aquatic flora and fauna in the water column, and the underlying marine benthic community. The PCEs for the wintering unit include all marine waters less than or equal to 75 m (246.1 ft) in depth, along with associated marine aquatic flora and fauna in the water column, and the underlying marine benthic community.

Threats and Possible Stressors in the Action Area

Oil Spills

Spectacled eiders face the greatest potential for exposure to spills along the nearshore coast near their North Slope breeding and molting habitats. Eiders may pass though the Chukchi Sea Planning Area while *en route* to North Slope breeding habitat. Recent information about spectacled and other eiders indicates that they probably make extensive use of the eastern Chukchi Sea spring lead system (Matt Sexson, unpublished data; Figure 12). Spring aerial observations have documented dozens to several hundred common and spectacled eiders in open water leads and several miles offshore in relatively small openings in rotting sea-ice in the eastern Chukchi Sea (Figure 12; USFWS 2010). Surveyors recorded a single spectacled eider in Klondike Prospect area on 8 September and a single spectacled eider off transect in Burger Prospect area on 16 September (Gall and Day 2010; Figure 8). Birds also stage near oil and gas developments in the Southern Beaufort Sea prior to or after the breeding season. Risk of exposure to spills varies with the amount of time spent in the area and the locations used. Males are less likely to spend time in the area and when they do stage here, they spend less time and use areas closer to shore than do females. These differences are likely a result of seasonal changes in ice cover (Petersen et al. 1999, TERA 2002).

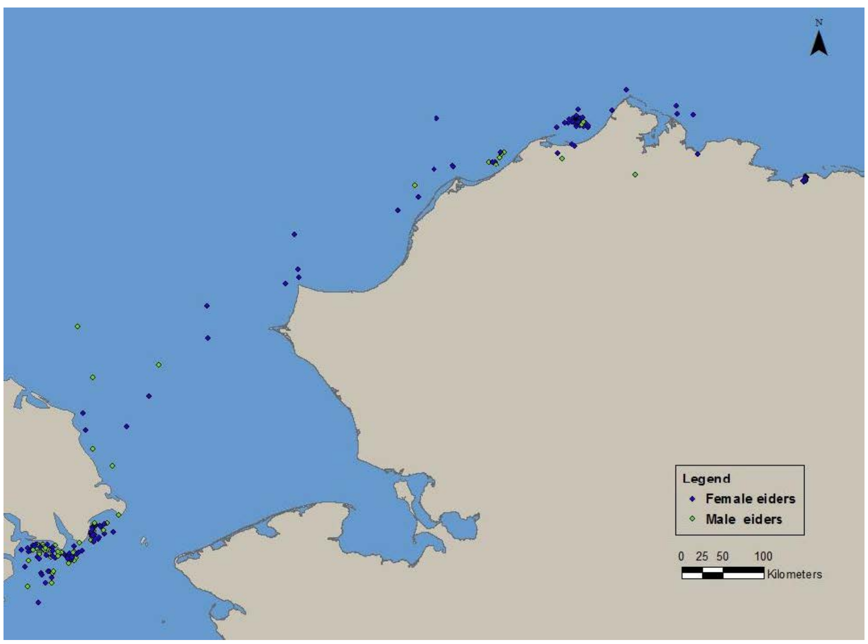


Figure 12. Spectacled eider satellite telemetry locations for 12 female and 7 male spectacled eiders in the eastern Chukchi Sea from 1 April – 15 June 2010 and 1 April – 15 June 2011. Additional locations from the northern coast of Russia are not shown. Eiders were tagged on the North Slope during the 2009 and 2010 breeding seasons. Data provided by Matt Sexson, USGS Alaska Science Center (USGS, unpublished data). [Top]

Stehn and Platte (2000) estimated the probability that waterfowl, including spectacled eiders, could be exposed to hypothetical oil spills using information from six systematic aerial surveys flown in late June, July, and August, 1999 and 2000 in the vicinity of the proposed offshore site for the Liberty Facility in the Southern Beaufort Sea. Model variables included spill duration, timing, oil spill trajectories obtained from MMS, and hypothetical spill size. Aerial survey results yielded 148 birds observed during two surveys in seven total locations in July and August. Adjusted population estimates for the area were 540 birds in July and 30 in August. A mean estimate of 40 -

52 birds (maximum 139) were exposed to oil in July, and a mean of 0 (maximum 1) was exposed in August. The estimated proportion of the population exposed was 0.002 - 0.003 (max 0.096) in July, and 0 in August. Of the species considered, spectacled eiders were among the least likely to have a high proportion of their populations exposed to oil because of their widespread distribution or tendency to occur farther from the spill source (Stehn and Platte 2000). Spills occurring on the terrestrial nesting habitat may affect individuals, but generally have a limited ability to spread beyond the immediate spill area or to affect many nesting birds.

Spectacled eiders use molting areas from July to late October/early November. Females from the North Slope molt in Ledyard Bay, along the Russian coast, and near St. Lawrence Island. A substantial portion of the Ledyard Bay Critical Habitat Unit (LBCHU) overlaps with the Chukchi Sea Planning Area. An oil spill in the Chukchi Planning Area could reach the LBCHU and potentially affect the physical and biological features important to migrating and molting spectacled eiders. Most spills projected to occur from the oil and gas exploration are expected to be of very low volume. Small spills would have to occur directly adjacent to or within the LBCHU to affect the habitat or the eiders, and no exploration or development is currently planned in the area. As such, baseline risks of impacts from spills in the LBCHU are minimal. However, oil development is gradually spreading westwards across the North Slope from the original hub at Prudhoe Bay; expansion of industrial development is likely to continue.

Relatively few spills occur in the Northwest due to low population density and limited industrial activity, but spills that do occur can be large; a 200,000-gallon magnesium oxide spill occurred at a mining operation in 1998 (ADEC 2007; Figure 13). Listed species could be affected by an upland spill such as this if contaminants released to surface water were to flow downstream to marine habitat in the Bering and Chukchi seas. To date, no such events have resulted in measurable impacts to listed species. However, future development may increase spill potential in the Northwest; the U.S. Army Corps of Engineers (USACE) is currently investigating options for a deepwater port on the Seward Peninsula (Joling 2014).

The risk of oil spills in the Alaska has increased since 2009 (DNV and ERM 2010a, 2010b). Eight Arctic nations have signed onto agreements that acknowledge the need for improved safety information and response (Arctic Council 2011, 2013). These agreements recognize the increased marine shipping traffic, potential for oil pollution, and the need for greater response capacity in the harsh Arctic environment.

Risk of spills in the wintering area in the lead complexes south/southwest of St. Lawrence Island are minimal. Currently there is no planned oil or gas development in the area and limited shipping. Shipping that does occur in this area generally avoids areas with ice cover where the spectacled eiders are most likely to be found.

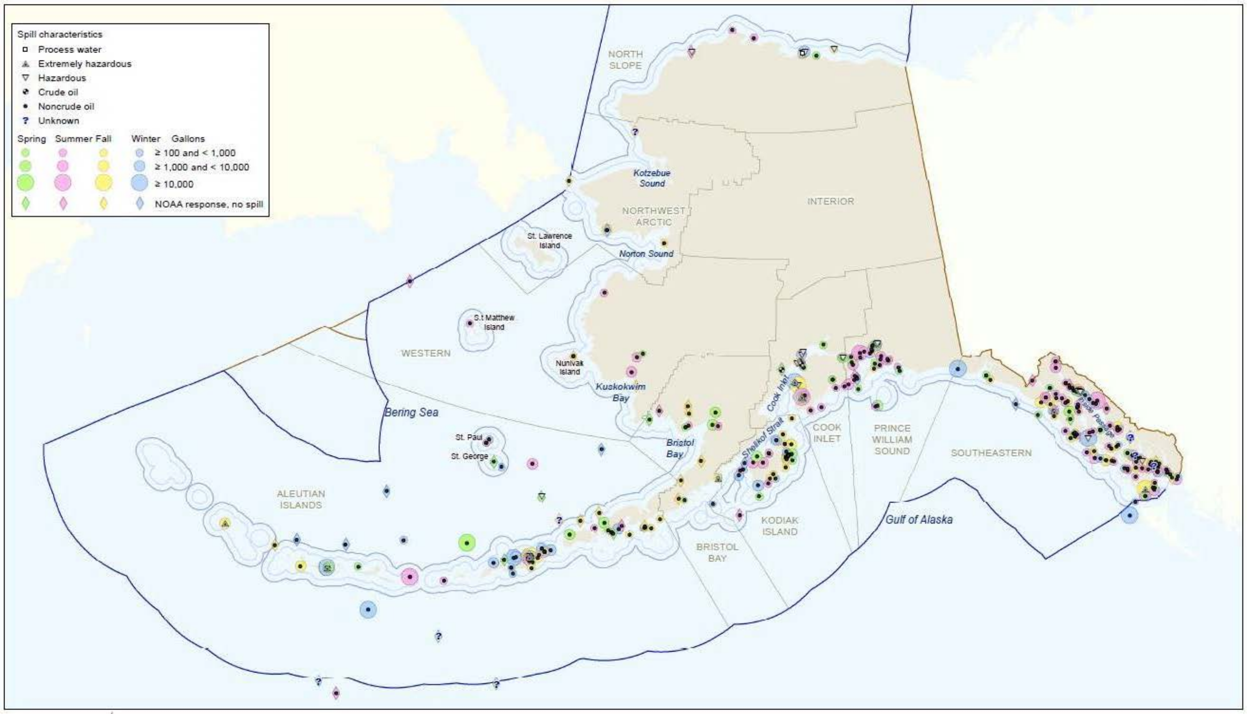


Figure 13. Hazardous materials spills reported in Alaska marine waters from 1995 - 2012 (adapted from a figure created by Windward Environmental, LLC (2014) for the Unified Plan BA using data available in 2012.) [Top]

Research

The Service has issued permits under Section 10 of the ESA to authorize take of endangered or threatened species for purposes of propagation, enhancement, or survival. Annual reporting requirements associated with these permits for spectacled indicate 11 spectacled eider adults and five eggs have reportedly died as an indirect result of research activities since. Scientific, field-based research is increasing on the ACP as interest in climate change and its effects on high latitude areas continues. While many of these activities have no impacts on listed eiders as they occur in seasons when eiders are absent from the area, or use remote sensing tools, on-the-ground activities and tundra aircraft landings are likely to disturb a small number of listed spectacled eiders on the breeding grounds each year. There has been little research outside of the breeding habitat.

Incidental Take

Activities occurring across the range of the spectacled eider have been reviewed for compliance with section 7 of the ESA. Lethal and non-lethal incidental take has been issued for various types of projects including oil and gas development and exploration, infrastructure development, subsistence harvest, wastewater facilities, powerlines, and research. Levels of authorized take have ranged from zero to 12 adults and two to 130 eggs/ducklings. The majority of the incidental take has been for loss of eggs/ducklings, which is of much lower significance for survival and recovery of the species than the death of an adult bird. For example, spectacled eider nest success recorded on the Y-K Delta ranged from 18 - 73% (Grand and Flint 1997), and average clutch size was five eggs (Petersen et al. 1999). From nests that survived to hatch, duckling survival to 30-days ranged from 25 - 47% on the Y-K Delta (Flint et al. 2000). Over-winter survival of one-year old spectacled eiders was estimated at 25% (P. Flint pers. comm.), with annual adult survival of 2-year old birds (that may enter the breeding population) of 80% (Grand et al. 1998). Using these data (in a very simplistic scenario), for every 100 spectacled eider nests on the Y-K Delta, between two and 17 adult females would be expected to survive and recruit into the breeding population (USFWS 2014b). To date, incidental take of spectacled eiders has not reached a level of concern for management of the species.

Recovery

The Spectacled Eider Recovery Plan (USFWS 1996) presents research and management priorities with the objective of recovery and delisting so that protection under the ESA is no longer required. Although the cause or causes of the spectacled eider population decline is/are not known, factors that affect adult survival are likely to be most influential on population growth rate. These include lead poisoning from ingested spent shotgun pellets, which may have contributed to the rapid decline observed in the Y-K Delta (Franson et al. 1995; Grand et al. 1998), and other factors such as habitat loss, increased nest predation, over harvest, and disturbance and collisions caused by human infrastructure. Under the Recovery Plan, the species will be considered recovered when each of the three recognized populations (Y-K Delta, North Slope of Alaska, and Arctic Russia): 1) is stable or increasing over 10 or more years and the minimum estimated population size is at least 6,000 breeding pairs, or 2) number at least 10,000 breeding pairs over three or more years, or 3) number at least 25,000 breeding pairs in one year. Spectacled eiders do not currently meet these recovery criteria.

4.6 Steller's Eider

The range of the Steller's eider is entirely within the Action Area; see the *Status of the Species* section for more information. Here, we consider further the existing environmental baseline risks from spills.

Status in the Action Area

The Arctic Coastal Plain Near Barrow

The vicinity immediately near Barrow supports the largest known concentration of nesting Steller's eiders in North America. Standardized ground surveys of 135 km^2 near the Barrow road system conducted since 1999 found an average density of 0.66 birds per km^2 (Rojek 2006) and estimated a Steller's eider breeding population of 84 birds (Rojek 2008). The highest numbers of Steller's eiders observed during ground surveys at Barrow occurred in 1999 with 135 males and in 2008 with 114 males (Safine 2011). Total numbers of nests found (those found viable [containing one or more viable eggs] and post-failure) ranged from 0–78 during 1991–2011, while the number of viable nests ranged from 0–27. Steller's eider nests were found in 12 of the 19 years sfrom 1991 to 2010 (Safine 2011). Most recently, 47 Steller's eider nests were found in 2014. The average population size of Steller's eiders breeding in the ACP was estimated at 576 (292–859, 90% CI; Stehn and Platte 2009).

Yukon-Kuskokwim Delta

Since the early 1990's, only a few pairs of Steller's eiders have nested on the Y-K Delta (Paul Flint, USGS, pers. comm.; Brian McCaffery, USFWS pers. comm.). In no single year have more than three nests been found, despite extensive ground-based nest search efforts throughout the Steller's eider critical habitat area. Most recently, one Steller's eider nest was found near the mouth of the Tutakoke River on the central Yukon-Kuskokwim Delta in 2013 (Sowl 2013).

Critical Habitat Use and Designation

In 2001, the Service designated 2,830 miles^2 (7,330 km^2) of critical habitat for the Alaska-breeding population of Steller's eiders at historic breeding areas on the Y-K Delta, a molting and staging area in the Kuskokwim Shoals, and molting and wintering areas in marine waters at Seal Islands, Nelson Lagoon, and Izembek Lagoon (USFWS 2001). No critical habitat for Steller's eiders has been designated on the ACP. The Primary constituent elements of Steller's eider critical habitat in the Y-K Delta unit include all land within the vegetated intertidal zone, along with all open-water inclusions within that zone. The primary constituent elements for units designated for molting and wintering are marine waters up to 9 m (30 ft) deep and the underlying substrate, the associated invertebrate fauna in the water column, the underlying marine benthic community, and where present, eelgrass beds and associated flora and fauna (66 CFR 8850). The invertebrate fauna, including gastropods, bivalves, crustaceans, echinoderms, and macrobenthic invertebrates provide food for Steller's eiders (Petersen 1980

Threats and Possible Stressors in the Action Area

Oil Spills

Fuels and oils are toxic to Steller's eiders (Holmes et al. 1978, Holmes et al. 1979, McEwan and Whitehead 1980, Leighton et al. 1983, Holmes 1984, Leighton 1993, Rocke et al. 1984, Yamato et al. 1996, Glegg et al. 1999, Trust et al. 2000a, Esler et al. 2000) and their prey (e.g., amphipods and snails; Newey and Seed 1995 as cited in Glegg et al. 1999, Finley et al. 1999), and exposure of Steller's eiders to oil in harbors in Alaska has been documented (Miles et al. 2007). Therefore, we believe that petroleum hydrocarbons entering the marine environment from anthropogenic sources are likely to adversely affect Steller's eiders and their habitats.

Before fall migration in breeding and non-breeding years some Steller's eiders rest and forage in coastal waters of the Chukchi and Beaufort Sea (Figure 14). In breeding years, flocks of males have been found to stage along the coast near Barrow and may remain in the area until the second week of July. In non-breeding years, flocks are composed of both sexes and depart earlier (North Slope Borough Department of Wildlife Management, unpublished data). In breeding years, females may use the coastal areas later in the season. In 2008, 10 - 30 Steller's eider adult females and juveniles were observed daily from late August to mid-September (USFWS, unpublished data). In 2011, Safine (2012) investigated post-hatch movements of 10 Steller's eider hens with VHF transmitters and found females and fledged juveniles in nearshore waters of the Chukchi and Beaufort seas within approximately 18 km of Point Barrow from late August through early September. A small spill would likely affect a limited number of individuals near the spill site, but large spills that occur in near Point Barrow during the breeding season could affect a large number of Steller's eiders.

Steller's eiders congregate on the Kuskokwim Shoals during the molting season and prior to moving northward as the sea-ice breaks up and recedes. Over 15,000 Pacific wintering Steller's eiders have been observed in Kuskokwim Bay at one time (Larned and Tiplady 1996). Satellite tracking and band recovery data described in Martin (2001) and Rosenberg et al. (2011) suggested disproportionately high use of Kuskokwim Shoals by molting Alaska-breeding Steller's eiders. In 2000 and 2001, two of three and five of ten marked birds molted in this area, respectively (Martin 2001). Although samples sizes were small, the apparent importance of this area to molting eiders prompted the Service to designate approximately 3,813 km^2 in the Kuskokwim Shoals as critical habitat (USFWS 2001). Currently, there is no oil development in the region; potential hazards due to shipping are limited to risk of spills from fuel barges *en route* to local villages. However, a large-scale gold mine is planned in the region in the near future. Project proponents have identified transportation of large amounts of fuel and other hazardous materials via the Kuskokwim River as a possible component of the project (Donlin Gold 2015).

After molting in the Kuskokwim Shoals, Alaska-breeding birds dispersed to various wintering locations along the Alaska Peninsula, some of which have also been designated as critical habitat. Several of these areas are harbors with significant levels of vessel traffic and industry, especially near Unalaksa (Dutch Harbor), Akutan, and Cook Inlet, and Kodiak. Spill risk in the Aleutians is generated by high levels of shipping, as described in the Environmental Baseline sections for the short-tailed albatross and sea otter. Cook Inlet and Kodiak Island also support substantial shipping associated with urban centers and fishing industries. Kodiak is listed as number four among the top 50 ports in the U.S. based on fisheries harvest volume. Vessel traffic ranges from small fishing and recreational vessels to large oil tankers and freight vessels. Both crude (though uncommon) and refined oil products are shipped through Cook Inlet and the waters adjacent to Kodiak Island. The Kodiak Area SCP (ADEC and EPA 2010) summarizes findings from a risk assessment completed in 1998. Important conclusions highlight the risk of ammonia spills from fish processing facilities, the large volumes of fuel stored by the USCG in Kodiak, and large number of underground storage tanks on former defense sites. Foreign-flag freight vessels, also pose a spill risk, especially early in transit when vessels carry large quantities of bunker crude oil (ADEC and EPA 2010). Hazards highlighted by the Cook Inlet SCP also include the area's strong tidal currents and seasonal ice (ADEC and EPA 2010).

Indeed, Larned (2000), expressed concern for the survival and reproductive success of the large number of Steller's eiders observed in harbors. The likelihood of exposure to spills in these areas is higher than in undeveloped areas, resulting in a substantial possibility that spill exposure can cause adverse effects to individual listed eiders. However, the tendency to disperse to various areas during the winter greatly reduces the risk that the listed population as a whole could be exposed to spills during winter.

Figure 14. Distribution of Alaska-breeding Steller's eiders during the non-breeding season, based on locations of 13 birds implanted with satellite transmitters in Barrow, Alaska, during June 2000 and June 2001. Marked locations include all those at w which a bird remained for at least three days. Onshore summer use areas comprise locations of birds that departed Barrow, apparently without attempting to breed in 2001 (USFWS 2002). [Top]

Incidental Take: Research

The Service has issued permits under section 10 of the ESA to authorize take of endangered or threatened species for purposes of enhancement of propagation or survival. Annual reporting requirements reveal that 1,179 adults and 89 eggs were authorized to be taken as an indirect result of research activities between 1997 and 2012 (Table 7). These include permits issued to salvage and opportunistically collect up to 68 Steller's eider eggs from the Alaska-breeding population for a captive breeding program at the Alaska Sea Life Center. To date, 31 eggs have been taken. The eiders taken in these research programs have provided biological information and the eggs have been used to establish a captive breeding population of the species to ultimately improve our understanding of their reproduction in the wild and help future efforts to recover the species.

A total of 37 Steller's eiders were reported as actually taken, *incidental* to research activities, from 1997 to present. Because those birds were all from the wintering population, we applied the correction factor and determined that approximatelyonebird from the Alaska breeding population has died incidental to research activities. In addition to incidental take, since listing there have been 16 permitted and 16 actual, direct and *intentional* takings of Steller's eider adults on the wintering grounds. It is statistically unlikely that any of those individuals were from the North American breeding population.

Table 7. Incidental (i.e., unintentional), lethal take permitted by the Service for Steller's eiders under §10 of the ESA.

	1997	1998	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012*
Adult	965	12	18	26	29	16	14	24	28	18	25	0	3	1	0
Chick	5	4	5	19	7	7	7	7	7	7	0	0	7	7	0
Egg	0	0	108	114	0	24	24	24	44	20	0	0	0	0	0
Nest	0	0	0	20	3	3	3	5	5	5	2	0	<1	0	0

*As of May 1, 2012 [Top]

Incidental Take: Other Federal Actions

Since listing, permits have been issued for the incidental, lethal take of about 100 Alaska breeding Steller's eiders (Table 8). Although reporting is required upon issuance of an incidental take permit, it is not consistently provided, so we do not know how many eiders have been affected by disturbance, non-lethal, or lethal take. The level of take that has been authorized has not been expected to cause management concerns for the species.

Table 8. Incidental take of Steller's eiders permitted by section 7 of the ESA from 1997 to present.

Action	Year	Incidental Take	Estimated	Life Stage	Lethal
Akutan Mooring Basin	2003	Contaminants	9	Adults	N
Akutan Mooring Basin	2003	Collisions	1	Adults	Y
Akutan Transportation	2007	Disturbance	20	Adults	N
Alaska State's Mixing Zones Regulation	2011	Contaminants	36	Adult	Y
Barrow Airport Expansion	2006	Habitat Loss	29	Eggs/Chicks	N
Barrow Gas Fields Well Drilling Program	2011	Loss of	22	Eggs/ducklings	N
Barrow Global Climate Change Research	2005 & 2007	Collisions	1	Adults	Y
Facility Phase 1 & 2	2005 & 2007	Habitat Loss	25	Eggs/Chicks	N
Barrow gravel pad and 60-man camp	2012	Loss of	22	Eggs/ducklings	N
Barrow Hospital	2004 & 2007	Habitat Loss	17	Eggs/Chicks	N
Barrow Landfill	2003	Habitat Loss	1	Nest/y for 45 y	N
Barrow Tundra Manipulation Exp.	2005	Habitat Loss	1	Eggs/Chicks	N
	2005	Collisions	2	Adults	Y
Barrow Wastewater Treatment	2005	Habitat Loss	3	Eggs/Chicks	N
BLM Northern the National Petroleum Reserve-	2008	Disturbance	12	Eggs/Chicks/y	N
Alaska	2008	Collisions	<1	Adult	Y
BP Alaska's Northstar Project	2009	Collisions	≤ 1 /year	Adult	Y
Chignik Bay Tank Farm	2002	Contaminants	5	Adults	N
Chignik Dock	2002	Contaminants	4	Adults	N
Chignik Lagoon Tank Farm	2001	Contaminants	14	Adults	N
Chukchi Sea Lease Sale 193	2007	Collisions	1	Adults	Y
Fairweather Seismic	2003	Disturbance	66	Adults	N
False Pass Harbor	2001	Contaminants	4	Adults	N
USFWS Sport-harvest Regulations	2006	Harvest	1	Adults	Y

Goodnews Bay Processor	2008	Disturbance	28	Adults	N
Intra-service on Subsistence Hunting Regulations	2005	Harvest	17	Adults	Y
	2006	Harvest	14	Adults	Y
	2007	Harvest	Unspecified	Adults	Y
	2008	Harvest	Unspecified	Adults	Y
	2009	Harvest	Unspecified	Adults	Y
	2010	Harvest	Unspecified	Adults	Y
	2011	Harvest	4	Adult	Y
	2012	Harvest	4	Adults	Y
Nelson Lagoon Tank Farm	2003	Contaminants	20	Adults	N
	2003	Collisions	1	Adults	Y
NOAA National Weather Service Office in Barrow	2008	Collisions	1	Adults	Y
	2008	Disturbance &	< 10	Eggs/ducklings	N
NPDES-GP	2001	Collisions	1	Adults	Y
Oil and Gas Activities in the Beaufort and	2012	Collisions	1	Adults	Y
Sandpoint Harbor	2002	Contaminants	11	Adults	Y
	2002	Habitat Loss	1	Adults	N
	2002	Collisions	1	Adults	Y
Unalaska harbor	2007	Habitat Loss	1	Adults	N
	2007	Contaminants	1	Adults	N
	2007	Collisions	1	Adults	Y

[Top]

Recovery

The Steller's eider Recovery Plan (USFWS 2002) establishes criteria for reclassifying the species from threatened to endangered when either: (a) the population has ≥ 20% probability of extinction in the next 100 years for three consecutive years; or (b) the population has ≥ 20% probability of extinction in the next 100 years and is decreasing in abundance. The Alaska-breeding population would be considered for delisting from threatened status if it has ≤ 1% probability of extinction in the next 100 years, and each of the northern and western subpopulations are stable or increasing and have ≤ 10% probability of extinction in 100 years. A revision of the population viability analyses (PVA) for both the Alaska-breeding population and the Pacific population of Steller's eiders (Runge 2004) concluded that without reintroduction of breeding birds to the wild population, the listed population is at high risk of extinction (Swem and Matz 2008). Continuing efforts are needed to achieve recovery goals.

4.7 Summary

Habitat conditions throughout much of the range of listed species in Alaska are relatively pristine. Risks of spills are greatest in areas of oil and gas development, in urban areas and centers of industry, and along important marine shipping routes. Oil and hazardous material spills are most likely to have localized impacts to a small amount of habitat, affecting few listed animals. Large spills, although exceedingly rare, may affect large numbers of listed animals and have widespread impacts on habitat. Causes of population decline and current threats vary by species. Changes in ecosystem processes, whether involving changes in climate or predator/prey trophic interactions (sea Status of the Species for sea otters), are more important for the long-term outlook for Alaska's listed species than any other single factor. Historic spills have not been identified as a cause of decline; the risk of future spills has not been identified as a limitation to recovery.

5.0 EFFECTS OF THE ACTION

In this section we analyze direct, indirect, interrelated and interdependent effects of the Action on listed species to determine if implementation of the Unified Plan is likely to reduce the likelihood of survival or recovery for each listed species or adversely modify critical habitat in the Action Area. This BO relied upon the statutory provisions of the ESA to complete our analysis of impacts to critical habitat, rather than on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02.

We used an ecological risk assessment framework similar to a process developed and employed by the EPA (2000; Figure 15). Ecological risk assessments are formatted to include the following steps: problem formulation; exposure analysis; hazard analysis; and risk analysis. Our Effects Analysis followed these steps, replacing the term, "Hazard Analysis"` with "Response Analysis" because some outcomes of oil spill response may be beneficial rather than negative.

The Exposure Analysis is a population-level assessment, using a hypothetical worst-case scenario, and based solely on the spatial scale of the response actions worst-case scenario relative to the distribution of the listed species and critical habitat. In it, we considered whether the implementation of the Unified Plan could reduce the likelihood of survival or recovery for each listed species or adversely modify critical habitat under worst-case scenario conditions. The Response Analysis is an individual-level impact assessment, and consideration of the effects of spill response actions on quantity, quality, or availability of physical or biotic features (PCEs) impacting the value of critical habitat at any spatial scale.

The Risk Characterization Analysis combines evaluations of Exposure and Response, with factors that modify likelihood of occurrence. To credibly identify an ecological risk, there must be exposure, an adverse response to that exposure, and a measurable and significant likelihood of occurrence. We predicted impacts to current population viability of listed species by evaluating changes in an individual's fitness (e.g., impacts to survival, growth, and reproduction) and evaluating whether individual impacts would affect the population. If we predicted a reduction in either 1) population viability or 2) the conservation value of critical habitat, we evaluated the probability of appreciably reducing survival or recovery of the listed species.

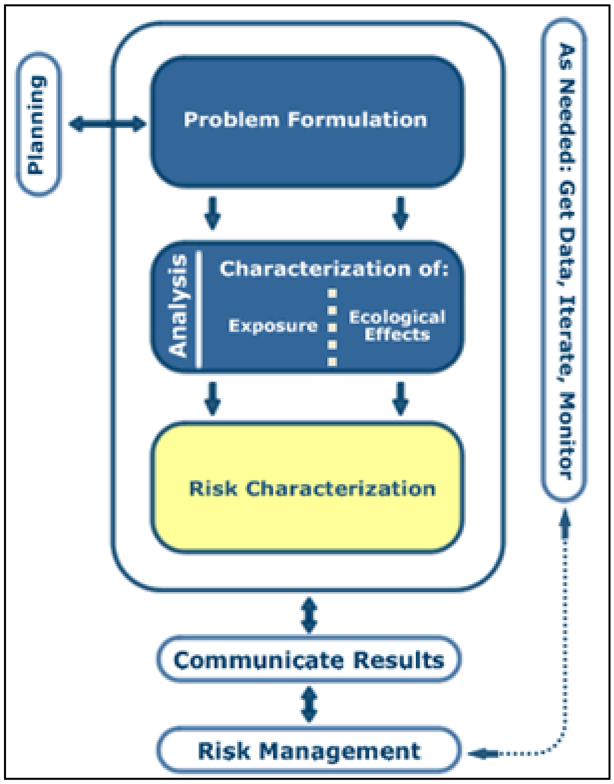


Figure 15. The standard steps of an ecological risk assessment (EPA 2000). [Top]

5.1 Exposure Analysis

Methods

We evaluated the potential for population-level exposure to harmful actions proposed by the Unified Plan by first considering a plausible but hypothetical worst-case scenario oil spill that could imperil a listed population or could cause widespread degradation to the value of the designated critical habitat. The worse case scenario was selected based on what event could have the worst outcome (the largest impact) for the species and critical habitat. If the hypothetical worst-case-scenario oil spill alone was not likely to imperil the population, we assessed the scale of additive impacts of stressors resulting from spill response that would be needed to have this effect. We conducted this Exposure Analysis because the effects from a spill are inherently difficult to separate from the effects of spill response. If extinction probability is low after considering the spatial extent of a worst-case scenario oil spill combined with oil spill response activities, then it is unlikely that spill response actions alone or in smaller events could jeopardize the continued existence of a listed species. Steps for the exposure analysis for each listed species follow.

- When available, existing population models were used to assess and predict functional extinction (Mcgowan and Ryan 2010).
- The maximum extent of spill response actions were assumed by hypothesizing a plausible worst-case scenario spill (i.e., EVOS or DHS).

- Worst-case spill scenario was assigned using a reality-based assessment of the species range in proximity to the most likely type of spill (i.e., tanker accident versus oil well blow out).
- Species distribution in space and time was based on life history described in the Status of the Species section.
- Maximal extent of a hypothetical action was overlain on the geographic distribution of a listed species to evaluate potential exposure.
- Estimated number of individuals lost was compared with published estimates for minimum viable population (MVP) sizes to determine severity of population impacts given a worst-case scenario.

Assumptions

The following assumptions were made to facilitate the Exposure Analysis:

1. Within the hypothetical spill extent, 100% mortality of exposed animals was assumed. This assumption will likely overestimate impacts, but is the most conservative and protective approach for assessment of impacts for the listed species.
2. The scale of a spill response action is generally consistent with the scale of the spill. While some spill response actions, especially use of dispersants, may change the dimension of the potential impact (e.g., move spilled oil to the water column instead of the surface), we assumed no response measures vastly increase the impact of the spill.
3. A worst-case scenario in southwest and southcentral Alaska, including the Bering Sea, Bristol Bay and Aleutians, would not exceed the scale of the 1989 EVOS. On March 24, 1989, the Tanker Vessel Exxon Valdez ran aground on Bligh Reef in Prince William Sound. At least 10.8 million gallons of North Slope crude oil was spilled (EVOS 2009). Over the two months following the spill, the oil spread to the southwest along the coast, fouling beaches and marine waters as far as 800 km (500 miles) from the source of the spill. An estimated 2,100 km (1,300 miles) of shoreline in Prince William Sound, the Kenai Peninsula, Kodiak Island and the Alaska Peninsula were oiled; surface oil was detected over approximately 28,000 km^2 (11,000 mi^2) of ocean (EVOS 2009).
4. In the Chukchi and Beaufort seas, a worst-case scenario would not exceed the scale of the DHS. The DHS began on April 20, 2010, following the explosion and sinking of the Deepwater Horizon oil rig. The exploratory well flowed for 87 days. An average of 11,130 tons of gas and oil compounds were released per day (equal to about 59,200 bbls of liquid oil per day) (Ryerson et al. 2012). An estimated total of 4.9 million bbls (210 million gal) of oil was released (USCG 2011). Surface oil was detected on an aggregate total of 180,000 km^2 (68,000 mi^2) of ocean (Skytruth 2010). Total length of oiled coastline was approximately 1,728 km (1,074 miles); the oil slick traveled 357 km (222 miles) from the location of the leaking well (Norse and Amos 2010). The visible surface slick represented about 15% of the total leaked gas and oil; about 36% remained underwater (Ryerson et al. 2012). During the spill, 1.84 M gal of chemical dispersants were applied below the sea surface and to oil slicks at the surface (White et al. 2014). Appendix E provides additional information as to why subsea dispersant application is not considered in this BO.
5. Less than 1% of all Steller's eiders occurring on the wintering grounds in Alaska are from the listed population (see Status of the Species for more information). Because the

Alaska breeding population mixes with non-listed Russian-breeding birds during the non-breeding season there is no way to distinguish between populations.

Species-Specific Analyses

Northern Sea Otter

We evaluated the scale of the worst-case scenario for the listed DPS of northern sea otter by assuming an event the size of EVOS occurred within their range. The EVOS was selected because sea otters range throughout southwest Alaska where oil and gas development is limited, but shipping is common. A major international ship transit route (the Great Circle Route) passes through sea otter critical habitat in the Aluetians and is used by oil tankers. To evaluate population-level effects, the spatial extent of an EVOS-sized spill was superimposed on the range of the listed sea otter (Figure 16). We estimated the longest end-to-end measurement of the area affected by EVOS (a straight line estimate) by measuring the maximum extent from an ArcGIS shapefile (EVOS 1993). The EVOS (1993) shapefile is a convex hull polygon, and includes all detected oil, thus represents the maximum extent of the spill. We overlaid this maximum-extent polygon onto a polygon depicting the range of the listed otter. We estimated the maximum linear extent of habitat occupied by listed sea otters covered approximately 2,972 km, compared with the linear extent of EVOS (1,045 km). Comparing these values, approximately 35% (1045/2972 = 0.352) of the spatial extent of the listed sea otters could be affected by an EVOS-sized spill.

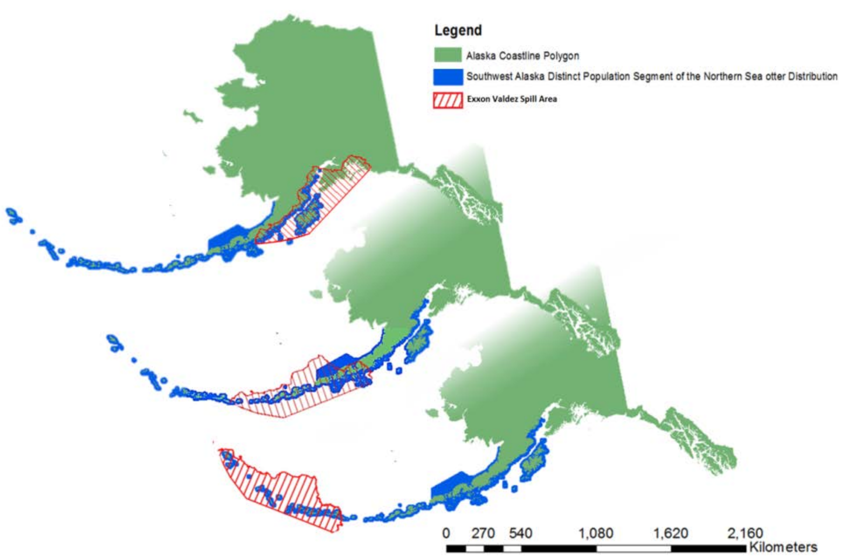


Figure 16. Exxon Valdez spill area (EVOS 1993) superimposed on the range of the listed sea otter. [Top]

To assess the maximum number of otters potentially affected, we estimated the density of sea otters within the area of a hypothetical EVOS-sized spill. Density was estimated by dividing the most recent population estimate in each sea otter management unit (USFWS 2014b) by the area of habitat potentially occupied by listed sea otters within those management units from data published by the Service (USFWS and USGS 2015; Table 9). The highest density estimate was 1.79 sea otters per km^2.

The amount of sea otter habitat affected by EVOS was documented during post-spill sea otter surveys. Approximately 17,027 km^2 was impacted by the spill: 2,358 km^2 in Prince William Sound (Bodkin et al. 2002); 4,131 km^2 in Kenai Peninsula (Bodkin and Udevitz 1994); 4,601 km^2 in Kodiak and Afognak islands; and 5,937 km^2 along the Alaska Peninsula (Degange et al. 1995). Assuming a maximum density of 1.79 otters per km^2 and an area of impact of 17,027 km^2, the total number of sea otters that would be affected in the worst-case scenario is 30,478 individuals (17,027 x 1.79 = 30,478). The current minimum population estimate of listed sea otters is 45,064 (USFWS 2014b). If a hypothetical event removed 100% of affected otters from the spill area, 14,586 would remain, representing a 67.6% decline (45,064 - 30,478 = 14,586; [1-(14586/45064)] x 100 = 67.6%).

Table 9. Density of northern sea otters by management unit (USFWS and USGS 2015).

Management Unit	Area in Range of otters (km^2)	Population estimate:	Minimum population:	Density of otters/km^2
Bristol bay	24,326	11,253	8,535	0.46
Kodiak, Kamishak, Alaska Peninsula	13,971	25,018	21,063	1.79
South Alaska Peninsula	15,235	9,758	8,158	0.64
Western Aleutian	10,149	8,742	7,309	0.86
Total	**63,681**	**54,771**	**45,064**	

[Top]

A 74% decline in the number of listed sea otters was compared to the estimate of MVP size; a MVP is the smallest size required for population persistence over a specified length of time (Shaffer 1981). A recent population viability analysis (PVA) determined the critical density below which there is a >5% probability of extinction within a 25-year period. We equate this to the MVP because it represents the minimum population size with 95% probability of continued existence in the absence of additional stressors. MVP size was estimated by region as follows: 703 in the Western Aleutians; 338 in the Eastern Aleutians; 406 in Bristol Bay; 368 in South Alaska Peninsula, 368; 507 in Kodiak, Kamishak, and Alaska Peninsula; an estimated total of 2,322 otters ensures a high probability of survival of the listed sea otter (USFWS 2014b).

Under our assumed worst-case scenario, approximately 14,586 listed sea otters would remain in areas unaffected by the spill. This value represents more than six times the estimated MVP size (i.e. the number of otters required to sustain the population; [14,586/2,322] = 6.28). Using this model, a worst-case scenario at least 40% larger than EVOS with a 100% mortality rate would be needed to place the species at risk of extinction. This is because a 40% larger area equals 1.4 times the spill area (17,027 km^2 x 1.4 = 23,838 km^2 affected). The number affected within the larger area would be 23,838 km^2 x 1.79 otters/km^2 = 42,670 sea otters. The total population is 45,064. Subtraction of 42,670 otters during a spill 40% larger that EVOS would leave 2,394 otters remaining (45,064 – 42,670 = 2,394). Only a spill response on an event 40% larger than EVOS could potentially jeopardize the continued existence of the listed sea otter.

We evaluated effects of oil spill response on sea otter critical habitat by considering the effects of a hypothetical worst-case scenario on the physical and biological features of the habitat of primary importance to the sea otter. The physical and biological features susceptible to oiling include food resources and kelp beds in shallow water near shore. In a worst-case scenario, we assumed that food resources were rendered unsuitable to support the affected population and kelp beds were removed within the entire spatial extent of the spill and response areas. The species-level consequences would be no different than what was described under our 100% mortality model, resulting in a 74% reduction in the number of otters. Using the MVP model above, the remaining critical habitat would be sufficient to support the listed otter population.

Short-tailed Albatross

The short-tailed albatross' oceanic range includes the Bering Sea, Gulf of Alaska, North Pacific Ocean, Russia's Sea of Okhotsk, and recently, a few birds have been observed in the Chukchi Sea. However, because they range primarily south of St. Lawrence Island in Alaskan waters, the most realistic worst-case scenario oil spill for this species is EVOS. This scenario is appropriate due to frequent use of the Great Circle Route through the Aleutian Islands by shipping vessels, including tankers.

Estimation of individual short-tailed albatross potentially affected at the spatial scale of EVOS was accomplished by calculating their core-range density. Albatrosses travel widely across vast oceans, and their habitat use is not uniform. However, at-sea observations and satellite telemetry data reveal preferred areas near continental shelf breaks and island passes. To focus our assessment on the core range of the species, we analyzed 95% kernel density from a database containing all available observation data (USFWS unpublished data). Kernel density is used for estimating distributions and habitat preference across a wide variety of taxa including albatross (Hyrenbach et al. 2002; Lichti and Swihart 2011). Using this technique, we estimated the area comprising the core density of short-tailed albatross is 1,179,457 km^2; 62.3% is within or near the U.S. EEZ (Figure 17).

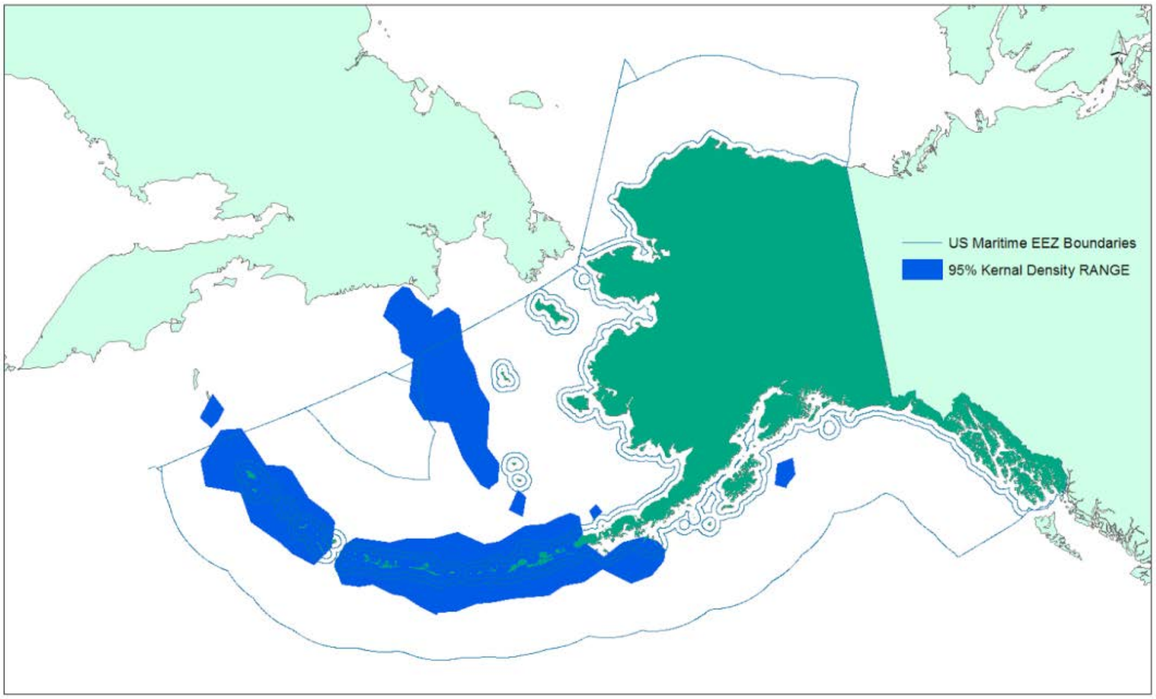


Figure 17.Short-tailed albatross range in the U.S. Exclusive Economic Zone, as estimated from 95% kernel density. [Top]

The density of albatross within the core range was calculated using the most recent population estimate of 4,354 individuals (USFWS 2014a), yielding a density of 0.0037 birds per km^2 (4,352/1,179,457 = 0.0037). This estimate assumes the entire population occurs within the 95% core range area, and is evenly distributed throughout. To assess the proportion of the population impacted by a hypothetical worst-case scenario oil spill, the density estimate of 0.0037 albatross/km^2 was multiplied by131,880 km^2, the maximum area of the EVOS spill, which was estimated with a convex hull polygon of the spill area (EVOS 1993) using ArcGIS Xtools Pro 9.0. Our area calculation overestimates published values for the area affected by EVOS because it is created from the convex hull polygon, which includes areas between points where no oil was detected. For the purposes of this effects analysis, we believe this overestimate is acceptable because it is conservative, capturing the entire range of possible impacts. Therefore, the number of albatross affected by a hypothetical worst-case scenario the size of EVOS would be 487 short-tailed albatross (0.0037 albatross/km^2 x 131,880 km^2 = 487 albatross).

Assuming 100% mortality from the hypothetical oil spill, the listed population of short-tailed albatross would be reduced by 11.2% (487/4,354 x 100 = 11.2%). Finkelstein et al. (2010) estimated the minimum number of individuals necessary to sustain the short-tailed albatross population is 100 adults. Finkelstein (2010) further postulates that for short-tailed albatross, a quasi-extinction threshold of 100 adults may be conservative given their ongoing recovery from near extinction in the early 20th century when population numbers may have fallen below 100 breeding-age adults (Austin 1949). Thus, the number of albatross remaining after our hypothetical worst-case event would be nearly 39 times the MVP size of 100 adults (4,354 – 487 = 3867). According to our model, an oil spill at least 8.7 times larger than EVOS would appreciably reduce survival or recovery of short-tailed albatross (8.7 x 131,880 km^2 = 1,147,356 km^2 affected; 1,147,356 km^2 x 0.0037 albatross/km^2 = 4,235 albatross affected, 4,354 – 4,235 = 119 albatross remaining). Because these conditions are highly unlikely to occur given the current state of oil and gas use, transportation, and development within the action area, we have determined that baseline conditions plus spill response actions would be highly unlikely to cause species-level impacts to the short-tailed albatross.

Polar Bear

We estimated the number of polar bears affected by a hypothetical worst-case scenario oil spill by overlaying the geographic extent of DHS with the geographic distribution of polar bears (Figure 18). The DHS was selected because it is the worst spill in U.S. history and resulted from oil and gas exploration, and the polar bear's range overlaps regions of offshore oil and gas exploration and development. Using the convex hull polygon technique described above, we utilized cumulative daily satellite imagery (NOAA and UNH 2015) and delineated 405,569 km^2 as the spatial extent of the DHS. Due to the deep water source of the spill and subsurface use of dispersants in the DHS, the extent of surface oil may not fully represent the area of impact in the Gulf of Mexico, but it was the best available spatial geographic information available at the time of this analysis.

An estimated 20,000 - 25,000 polar bears (Obbard et al. 2010) range over land and water spanning an area of about 24 M km^2 (Figure 18). Based on current population estimates, the combined size of the two U.S.-managed subpopulations is 2,907 (2,000 for the A-C stock + 907 for the SBS stock = 2,907). We estimated the combined marine range of the SBS and A-C stocks as defined by IUCN/PBSG 2009) using ArcGIS Xtools Pro 9.0 to be 1,591,928 km^2. Our effects analysis considered a hypothetical, worst-case scenario oil spill similar to the DHS-sized well blowout with an area of 405,569 km^2. This area covers a small fraction, just 1.7% of the polar bear's global range ([405,569 km^2 / 24,000,000 km^2] x 100 = 1.7%) and approximately 25% of the 1,591,928 km^2 in the combined range of the SBS and A-C stocks ([405,569 / 1,591,928] x 100 = 25%). Assuming habitat impacts equate to a proportional impact to the population, we expect a 25% decline in the A-C and SBS stocks or a loss of 727 bears; 3.6% of the minimum estimated global population size ([727/20,000] x 100 = 3.6%). Our estimate of the proportion of the global population affected by the worst-case scenario used the minimum estimated population size because it represents a larger proportional impact to the population and therefore is a more conservative estimate of impacts to the population.

To ensure our analysis did not underestimate effects, we hypothesized the DHS-sized oil spill eliminated all of the individuals in the SBS and A-C stocks. This extremely unlikely exposure scenario would result in a loss of 2,907 polar bears from the global population. Using the lower bound for the global population estimate of 20,000 bears, and subtracting 3,000 bears from both U.S.-managed sub-populations in their entirety (recognizing that the 2,907 estimate implies false precision where numbers are actually uncertain), approximately 17,000 polar bears would remain in the global population. Reed et al. (2003) used PVA to estimate MVPs for 102 vertebrate species, one of which was polar bears. The authors defined the MVP as having a 99% probability of persistence for 40 generations and estimated the MVP size for polar bears at 4,519 animals (Reed et al. 2003). The estimate for the remaining population is 3.8 times the MVP of 4,519, leaving a considerable safety factor for the global polar bear population.

Using these estimates and assumptions, an event would have to occur on a scale five times greater than our hypothetical event to leave behind a population size near the MVP for polar bears (5 x 3,000 = 15,000 bears lost; 20,000 – 15,000 = 5,000 bears remaining). Such an event would then have to be followed by spill response actions as described in the Unified Plan that further reduced the population below the MVP. Hence, spill response actions would need to be five times greater than the effects of this worst-case spill event. Considering the entire geographic distribution of the polar bear, a hypothetical worst-case scenario oil spill would have to decimate eight out of the 19 largest populations. These populations occupy approximately 5,794,330 km^2, or an area 14.3 times larger than the maximum extent of impact of DHS (405,569 km^2 x 14.2869 ≈ 5,794,330 km^2). In conclusion, it is extremely unlikely that polar bears could be exposed to a spill response scenario at a scale that could jeopardize their continued existence.

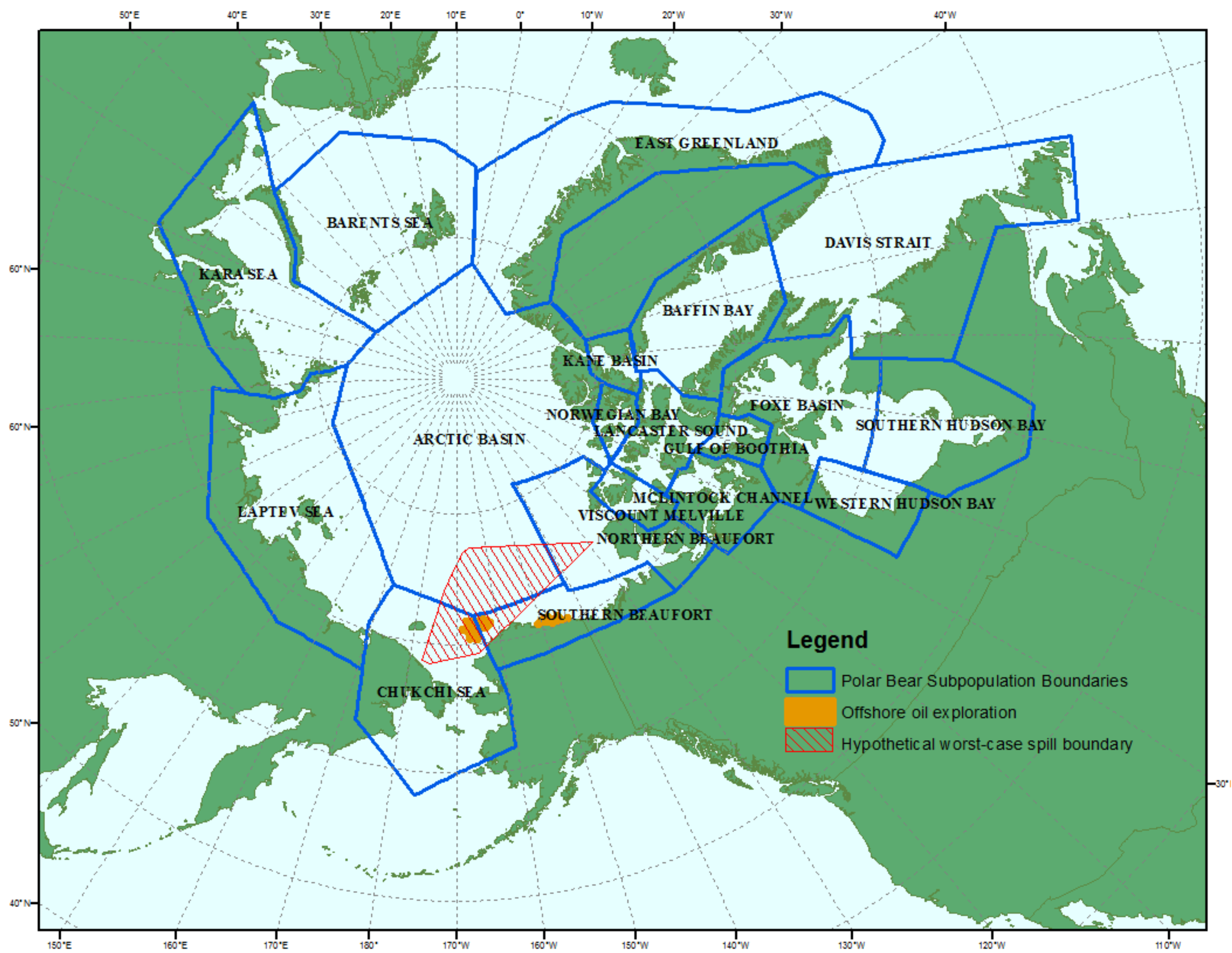


Figure 18. Polar bear range and subpopulations, with hypothetical worst-case scenario spill superimposed. [Top]

Pacific Walrus

We estimated the number of Pacific walrus affected by a hypothetical worst-case scenario oil spill by overlaying the geographic extent of DHS with the geographic distribution of the walrus. The DHS was selected because as with polar bears, the range of the walrus overlaps oil and gas exploration areas. We calculated number of walruses affected in two ways: first, by assuming walruses were lost in proportion to the amount of habitat affected; second, by calculating numbers of walruses lost based on numbers of haulouts affected. As with polar bears, the geographic extent of surface oil from a DHS-like oil spill is hypothesized to cover 405,569 km^2.

Population surveys, haulout monitoring, and satellite tracking studies indicate Pacific walruses generally occur in three areas during summer and autumn: Bering Sea, western Chukchi Sea and eastern Chukchi Sea. Most males occupy the Bering Sea; juveniles and adult females are distributed in Russian waters in the western Chukchi Sea near Wrangel and Herald islands, and another subset of females and young are in the eastern Chukchi Sea with high densities in the Hanna Shoal area (Fay 1982; Jay et al. 2012). Pacific walrus across their range are most vulnerable to oil spills in the Chukchi Sea because all breeding females are distributed there as they follow the retreat of ice in the spring (Burns 1965; Fay et al. 1997), and offshore drilling is planned for this area (ASRC 2012). Given these vulnerabilities, a DHS-sized oil spill in the Chukchi Sea was considered the worst-case scenario for evaluation of the scale of spill response.

Walrus habitat in the Chukchi Sea extends to the edge of the continental shelf (the 150-m isobaths; Jay et al. 2010). Much of the Chukchi Sea is suitable habitat for walrus except for where water depths exceed 100 m (USFWS 2013). The Service estimates walruses occupy 600,000 km^2 in the Chukchi. A DHS-sized oil spill there could affect 67.6% of Pacific walrus habitat ([405,569/600,000] x 100 = 67.6). Currently, the best estimate of numbers of Pacific walruses is 129,000 animals (Speckman et al. 2011). An assumed 100% mortality rate of animals exposed to a DHS-sized oil spill that affects 67.6% of walrus habitat would result in a loss of 87,197 individuals (129,000 x 0.676 = 87,179).

Habitat use by walruses in the Chukchi Sea is highly variable from year to year depending on conditions of sea-ice. Historically, tens of thousands of walruses gathered in coastal areas along the Russian shores of the Chukchi Sea (Fay 1982; Kochnev 1999, 2004, 2006). During recent years of limited sea-ice, large haulouts consisting of greater than 10,000 animals have been documented along both the eastern (U.S.) and western (Russian) shores (Ovsyanikov et al. 2007; Kavry et al. 2008; Fischbach et al. 2009; Clarke et al. 2011). Twelve haulout sites are known along the Russian coast and 11 along the U.S. Coast; four additional haulouts are commonly seen along the shores of Wrangel and Herald islands (Garlich-Miller et al. 2011). If a DHS-sized oil spill were to occur from the Chukchi Sea oil and gas exploration area, it could affect 16 haulouts, based on the maximum distance oil was observed from the DHS well site. Assuming an equal distribution among haulouts and loss of 100% of animals at affected sites, a DHS-sized event would result in loss of 59% of the population (12+11+4=27; [16/27] x 100 = 59%). This degree of impact would result in loss of 76,444 animals (129,000 x 0.59 = 76,444).

Of these two methods of estimating the impacts to walruses, the former would result in a greater degree of impact than the latter, and is therefore is more conservative. In order to ensure that our analysis does not underestimate potential impacts, we assumed the worst-case scenario resulted in loss of 87,197 animals. Under this scenario, 41,803 walruses (129,000–87,179 = 41,803) would remain.

An estimate of MVP is unavailable for Pacific walrus. The polygynous mating system of walruses (Fay et al. 1984) necessitates inflating the theoretical MVP compared to random breeding systems because the effective population size must be greater to maintain similar genetic diversity (Franklin 1980; Soule 1980; Thompson 1991). Minimum population sizes ranging from 1,000 - 10,000 have been recommended for conservation of wild vertebrates (Traill et al. 2007; Thompson 1991; Salwasser et al. 1984; Belovsky 1987; Soule 1987). Reed (2003) used PVA to estimate MVPs for 102 vertebrate species and found the mean and medians were 7,316 and 5,816 individuals (respectively), and recommended that in the absence of sufficient information to conduct a PVA reflecting species' demographic parameters, adopting an MVP of 7,000 adults is a conservative value to ensure persistence of wild species.

An estimated population size of 41,803 Pacific walrus remaining after a hypothetical worst-case scenario oil spill the size of the DHS in the Chukchi Sea is six times greater than the Reed (2003) conservative MVP size of 7,000 animals ([41,803 / 7000] = 5.9). This level of impact alone is not likely to imperil the species. However, an oil spill 40% larger than DHS with a 100% mortality rate may cause concern for the species. Multiplying 1.4 by 405,568 km^2 to represent a spill 40% larger than DHS yields a 567,796-km^2 area. This larger area is approximately 95% of the total available walrus habitat in the Chukchi Sea ([567,796 / 600,000] x 100 = 94.6). An equivalent reduction in the population would leave 6,924 walruses remaining (129,000 – [129,000 x 0.946] = 6,924). Therefore a spill would need to exceed the scale of DHS by 40% or more to potentially jeopardize the species. In conclusion, Pacific walrus are not likely to be exposed to spill response actions at a scale that could have species-level impacts. The listed population is too dispersed relative to the scale of the Action.

Spectacled Eider

We estimated the number of spectacled eiders affected by a hypothetical worst-case scenario oil spill by overlaying the geographic extent of EVOS with the geographic distribution of the eiders where the entire world population congregates during winter: the designated critical habitat in the polynyas between St. Lawrence and St. Matthew islands. During winter, 370,000 spectacled eiders congregate in large, dense flocks in pack ice openings south of St. Lawrence Island in the central Bering Sea (Larned et al. 1995c; Larned et al. 2012). Spectacled eiders from all three known breeding populations use this wintering area (USFWS 1999a); no other wintering areas are currently known. An EVOS-sized event occurring here would have the potential to affect a substantial portion of the designated critical habitat and could affect the entire listed population. Because spectacled eiders occupy three major breeding areas (coastal areas in Russia, the North Slope, and the Y-K Delta), a major spill event occurring in their breeding range would not affect the entire population, even if that event were a well blowout the size of DHS. Therefore, an event in the wintering habitat was selected as the worst-case scenario based on the potential to affect the largest number of birds. EVOS was selected because there is no oil or gas development in this region of the Bering Sea.

The area provides physical and biological resources (the PCEs) of critical habitat necessary for the survival of wintering spectacled eiders. These include marine waters greater than 5 m (16.4 ft), and less than or equal to 25 m (82.0 ft) in depth, along with associated marine aquatic flora and fauna in the water column, and the underlying marine benthic community.

The area affected by a hypothetical EVOS-sized spill would exceed the size of the designated critical wintering habitat (Figure 19). Spilled oil could affect all the birds in the area and could reduce the quantity and quality of benthic invertebrates eaten by eiders. If we assume that exposure to such an event would result in 100% mortality of eiders and complete loss of the food values present in the critical habitat unit, we must conclude that the species would be in peril of extinction and the value of the critical habitat would be severely degraded. Any additional stressors imposed by spill response activities that further reduced the fitness of individuals or caused additional habitat degradation, no matter how large those stressors were, could cause the continued existence of the species to be jeopardized or could adversely modify the critical habitat.

The worst-case scenario evaluation for this species indicates that there is potential for exposure and associated impacts at the species level. This scenario relies on assumptions that allow the analysis to overestimate the effects that would be observed in a real world situation. It does not address the variables that would determine actual exposure levels or the likely individual responses of spectacled eiders if such an event were to occur. It is therefore not intended to evaluate the effects of such a scenario under real-world conditions. To do this, we consider potential stressors arising from spill response in the Response Analysis section and we incorporate the level of risk faced by the species given the existing environmental baseline in the Risk Assessment section below.

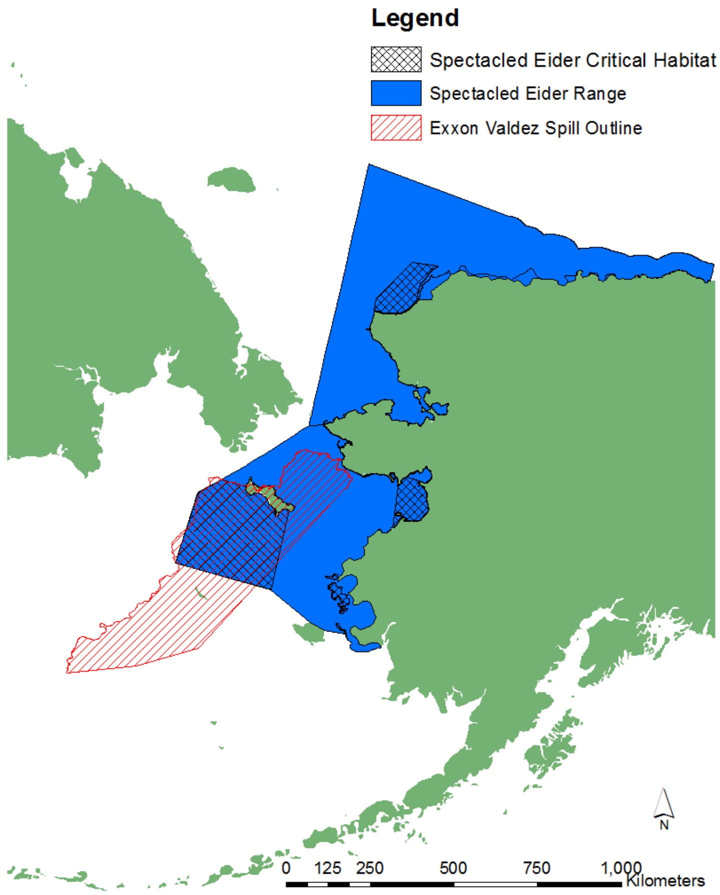


Figure 19. Map of Alaska and Russia showing critical habitat for spectacled eiders with the spatial extent of the Exxon Valdez oil spill superimposed over critical habitat designated for winter use. [Top]

Steller's Eider

Two hypothetical worst-case scenario oil spills were evaluated as for the Steller's eider: a large and prolonged hypothetical spill like the DHS, occurring near the breeding grounds in the Arctic Coastal Plain (ACP); and a hypothetical spill like EVOS occurring near the Kuskokwim Shoals Critical Habitat Unit (KSCHU) near the coast of the Y-K Delta. The reason we considered two scenarios for Steller's eiders was to evaluate potential for jeopardy AND adverse modification of critical habitat. The worst-case scenario was different for the listed species than for the habitat. The worst-case scenario for the species is a North-slope blowout affecting the large majority of Steller's eiders as they stage near the breeding habitat, but there is no critical habitat on the North Slope. The worst-case scenario for the designated critical habitat would be a large spill in a designated unit, but this type of event would not affect the entire population. Therefore, both scenarios were evaluated. For the other species with designated critical habitat, the evaluations of the worst-case scenario for habitat did not differ from the worst-case scenario for the species. A DHS-sized spill was considered a plausible scenario for the listed Steller's eiders that nest on the ACP because nearshore coastal oil development occurs in the Southern Beaufort Sea.

Eiders stage along the coast near the Barrow Triangle prior to and after the nesting season as well as non-breeding years. It is not currently known whether all Alaska-breeding Steller's eiders stage in these areas, but evidence suggests this section of coastline provides important habitat for a large proportion of the listed population. The DHS affected approximately 1,728 linear km of coastline. A well blowout of this size in the Southern Beaufort Sea could affect an area nearly twice the length of coastline adjacent to Steller's eider breeding areas between Wainwright and the mouth of the Sagavanirktok River (approximately 900 linear km of coastline). We assume that if a DHS-type spill occurred during a breeding year, it could impact 90% of the North Slope breeding population and the remaining 10% would include non-breeders and birds nesting on the Y-K Delta. Although we are uncertain about the accuracy of this estimate, a small number of Steller's eiders are known to remain along the Alaska Peninsula and Kachemak Bay during the summer; approximately 100 have been observed in Kachemak Bay, while a few may spend the summer at Izembek Lagoon (Chris Dau, USFWS, unpublished data). It is not known whether Steller's eiders delay breeding until their second year, as some other eider species do (Baillie and Milne 1982), but for this analysis we assume the number of non-breeders plus the Y-K Delta population is not greater than 10% of the population.

The current estimated size of the ACP Steller's eider population is 576 individuals (95% CI: 292–859) (Stehn and Platte 2009), and on the Y-K Delta only a dozen or so birds are thought to breed (USFWS unpublished data). A worst-case scenario leading to 100% mortality of 90% of the population would leave only 60–80 animals, including Y-K Delta birds. However, because Steller's eiders stage asynchronously in coastal waters along the ACP; males use the area in June and July, females with broods can stay through September, we have unquestionably overestimated potential impacts. The actual degree of exposure to a DHS-sized event and the resulting impacts would vary among segments of the population.

Runge (2004) estimated a starting population size of 2,500 breeding female Steller's eiders had a 100% probability of declining below a MVP size of 50 birds in 20 years. This model incorporated input parameters with a high degree of uncertainty and assumed no immigration or emigration from Russian-breeding Steller's eiders (Runge 2004). This assumption may be incorrect, thus, these extinction probabilities for the Alaska-breeding population may be overestimated (Swem and Matz 2008). A reassessment of parameters used in Runge's (2004) PVA revealed unresolvable uncertainties in vital rates and resultant extinction probabilities, but still suggested that the Alaska-breeding population of Steller's eiders may now be critically imperiled (Swem and Matz 2008). Without significant increases in adult survival and reproductive success, or use of management techniques such as population augmentation, the listed entity is likely to become extinct within a few decades at most (Swem and Matz 2008). If 60–80 birds remained after a worst-case scenario oil spill, any additional stressor imposed by spill response activities could further reduce likelihood of survival of the species.

An EVOS-like oil spill occurring near the KSCHU during the molting season (August through September) is the worst-case scenario when considering impacts to Steller's eider critical habitat. The KSCHU is located in remote western Alaska at the mouth of the Kuskokwim River.

Currently, there is no oil development in the region, and potential hazards due to shipping are limited to risk of spills from fuel barges *en route* to local villages. However, a large-scale gold mine is proposed in the region, and fuel and hazardous material transportation to and from the mine is planned using barges on the Kuskokwim River (Donlin Gold 2015).

Steller's eiders congregate on the KSCHU both during the molting season in the fall and prior to moving northward as the sea-ice breaks up and recedes in the spring. Over 15,000 Pacific wintering Steller's eiders have been observed in Kuskokwim Bay at one time (Larned and Tiplady 1996). Satellite tracking and band recovery data described in Martin (2001) and Rosenberg et al. (2011) suggests disproportionately high use of KSCHU by molting Alaska-breeding Steller's eiders. In 2000, two of three, and in 2001, five of ten marked birds from Alaska-breeding Steller's eiders molted in this area (Martin 2001). Although samples sizes were small, the apparent importance of this area to molting eiders prompted the Service to designate approximately 3,813 km^2 in the KSCHU as critical habitat (USFWS 2001). After molting in the KSCHU, Alaska-breeding birds disperse to various wintering locations along the Alaska Peninsula and Cook Inlet, some of which have also been designated as critical habitat.

Steller's eiders generally feed in shallow water within 200 m of the coast but may use areas farther from the coast where water is shallow and benthic invertebrate food resources are available (Fox and Mitchell 1997; Bustnes and Systad 2001). The amount of habitat (area) within 200 m or in waters less than 9 m [30 ft] deep affected by EVOS is not available for comparison, but would be similar to that estimated for sea otters. Post-EVOS sea otter surveys targeted similar nearshore habitats to those used by eiders (Bodkin and Udevitz 1994; Degange et al. 1995; Bodkin et al. 1999), and estimated a total of 17,027 km^2 affected by EVOS. This would far exceed the 3,813 km^2 of critical habitat in the KSCHU. Spilled oil could reduce the quantity and quality of benthic invertebrates eaten by eiders. Steller's eiders rely on high-calorie foods during molt to support the increased energetic requirements associated with replacing feathers (Peterson 1981).

In the hypothetical worst-case scenario oil spill, we assumed that 100% of the food resources in KSCHU would be rendered unsuitable to support the survival of the species. Using the proportions of listed eiders tracked via satellite telemetry to molting grounds on the KSCHU from Martin (2001), we concluded an EVOS-like spill could significantly impact the KSCHU and have adverse effects on two-thirds of the listed Steller's eiders. Therefore, at the scale of a worst-case scenario oil spill, the additive impacts of associated response activities are likely to further adversely affect the listed population of Steller's eiders and their designated critical habitat. See the Response Analysis section for our evaluation of the potential stressors arising from spill response, and the Risk Assessment section for an assessment of the level of risk faced by the species given the existing environmental baseline.

Exposure Analysis Conclusions

In summary, our exposure analyses indicated the listed populations of Steller's and spectacled eiders are most vulnerable to the additive effects of a worst-case scenario oil spill plus response actions. Northern sea otters, short-tailed albatross, polar bears, and Pacific walruses are dispersed across extensive geographic ranges such that no spill and associated spill response activity would be likely to have widespread impacts to the entire designated critical habitat or the species as a whole.

5.2 Response Analysis

In the previous section, we evaluated risk to populations from exposure to stressors caused by the implementation of the Unified Plan. In this section, we used the best available science to evaluate potential responses leading to reductions in an individual's fitness (mortality, morbidity, reduced reproduction, or other effects) or reduced conservation value of designated critical habitat as a result of implementation of the Unified Plan. Where data are limited, we considered effects to proxy species. Habitat evaluations included consideration of impacts to food resources eaten by listed species or their prey. We acknowledge when positive effects would result from mitigating exposure to oil, but do not analyze them in this section. Positive effects that minimize risk are discussed in the Risk Characterization Analysis.

Method and Assumptions

We evaluated individual responses to implementation of the Unified Plan. Actions in the Unified Plan include natural attenuation; mechanical countermeasures (booming; constructing barriers, dams, pits, and trenches; culvert blocking, skimming/vacuuming; sorption; flushing and flooding; steam cleaning and sandblasting; removing contaminated soil, sediment, vegetation, or natural debris); non-mechanical countermeasures (application of approved chemical dispersants by vessel or aircraft; *in situ* burning); tracking and surveillance (use of aircraft, all-terrain vehicles, or heavy machinery; installation of buoys; sampling); waste management (waste handling, storage, transport, treatment, and/or disposal; decontamination); and wildlife protection mitigation measures (recovery of contaminated carcasses; deterrence; pre-emptive captures and relocation; capture, treatment, and release of contaminated wildlife; strategic avoidance).

We evaluated *direct* and *indirect* responses to stressors. Direct responses are immediate impacts reducing an individual's fitness. Indirect responses are those that occur later in time or are mediated through deleterious effects on habitat (including food resources), and are reasonably certain to occur. We also consider interrelated and interdependent[4] actions. When considered biologically feasible, effects analyses assumed that listed individuals or designated critical habitat were exposed to an action, even if the probabilities of exposure are very low.

Spill response actions apply to a wide variety of spill types, but the most frequent and largest spills are of petroleum products, collectively referred to as "oil". For this reason, our analyses focus on the effects of oil, but the concepts discussed also apply to a wider variety of commonly spilled substances.

Following an oil spill, the composition of chemicals within the complex oil mixture changes via a process called "weathering". Important weathering processes include evaporation, dissolution,

[4] Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification; interdependent actions are those that have no significant independent utility apart from the action that is under consideration (50 CFR § 402.02); e.g., a private action activity that would not occur but for the proposed federal action.

biodegradation, emulsification, and photo-oxidation (Gong et al. 2014). Smaller, two-ringed polycyclic aromatic hydrocarbons (PAHs) are not very persistent in the environment. They can readily volatilize into the atmosphere, and more readily disperse in the water column relative to larger PAHs, where they are quickly degraded (Yamada et al. 2003). Thus, the relative concentration of larger-ringed PAHs is increased in weathered oil relative to fresh oil (Couillard 2005; Sammarco 2013; Martin 2014). The larger, more persistent PAHs are responsible for many of the serious toxic effects at low concentrations, such as dioxin-like activity, photo-enhanced toxicity, carcinogenicity, and fish cardio-toxicity. Thus, to determine efficacy of mitigation or response activities, it is imperative to characterize weathering and distribution, and the identity, toxicity, bioavailability, and environmental partitioning of the specific chemicals that remain in the aquatic environment (Adams 2014).

Natural Attenuation

Natural attenuation might be a spill response strategy when it is expected to be less harmful or of equal benefit to other response actions. Animals can be exposed to naturally attenuated oil through external physical contact (i.e., direct contact at the surface and in the water column, or for eggs, with parent feathers or nest material); ingestion through grooming, preening, or eating contaminated prey, and inhalation of volatile and aerosolized components (fumes) at the water's surface. The potential adverse consequences of natural attenuation of oil are described in Appendix F as comparison to effects of other spill response actions. Effects of exposures to oil include mortality (of adults, eggs, and young), skin and eye irritation, loss of fur or feather insulation leading to hypothermia, reduced growth, and symptoms of poisoning from ingestion including organ damage, DNA damage, and energetic costs from metabolism and detoxification. These and additional effects can manifest at the ecosystem level, resulting in radical changes in ecosystem structure and function (e.g., trophic cascade effects), such as occurred post-EVOS (Peterson et al. 2003). Natural attenuation represents a "no-action" scenario, but because the spill itself is not an action in the Unified Plan, adverse effects from the oil spill are not attributable to its implementation.

Mechanical Countermeasures

Oil spill response activities included in mechanical countermeasures are: booming, construction of barriers, dams, pits, and trenches, culvert blocking (in the Deflection and Containment phase of spill response); skimming, vacuuming, and sorption (in the Recovery phase); and flushing/flooding, steam cleaning and sand blasting, mechanical cleaning of sand, and removal of contaminated soil, sediment, vegetation, or natural debris in the (Removal/Cleanup phase). Although mechanical countermeasures may be employed in offshore areas (e.g., skimming), most will be employed nearshore, thus effects on the pelagic short-tailed albatross are considered discountable.

Steller's Eider, Spectacled Eider, Sea Otter, and Walrus

Habitat for eiders, otters and walrus could be degraded by spill response actions that disturb benthic invertebrates, especially sediment flushing, pressure washing or steam cleaning, dredging, soil removal, and removal of aquatic vegetation (specifically kelp). Many of these activities can damage or remove benthic invertebrates, causing a reduction in availability of food resources for listed species. Other actions can drive fresh spilled oil into substrates, where contaminants may be more protected from active weathering than in open water or at the soil-water interface. These pockets of spilled oil may remain in place for years while gradually being released and taken up by benthic invertebrates, resulting in repeated exposures to foraging species over many seasons. Oil from EVOS has persisted in mussel beds in PWS for many years (Jewett et al. 2002; Carls et al. 2004) and is resistant to subsequent restoration efforts (Irvine et al. 2006). Aggressive cleaning of beaches can prolong or prevent natural recovery (Albers 2003). Although most disturbed intertidal and subtidal invertebrate communities would eventually recover, there would likely be a time lag in benthic prey productivity.

Areas where impacts to benthic invertebrates are of particular concern include designated CHUs and other habitats that are integral to reproduction or survival. These include Hanna Shoals (walruses), Ledyard Bay (spectacled eiders), Kuskokwim Shoals (Steller's eiders), molting and wintering areas along the Alaska Peninsula (Steller's eiders), and nearshore marine or freshwater feeding habitats near breeding areas on the Y-K Delta and near Barrow (spectacled and Steller's eiders), eastern Norton Sound (spectacled eiders).

Steller's and spectacled eiders may be affected by construction activities designed to corral or deflect oil in terrestrial nesting habitats and in freshwater lakes, streams, and ponds near the nesting habitat. These actions could result in temporary or permanent reductions in productivity from removal of nest sites or disturbance (see Disturbance section, below). Nesting areas on the Y-K Delta and Barrow, nesting ponds within those areas, and even individual nest sites (bowls) are re-used over multiple years (USFWS unpublished data). Destruction of nest sites, freshwater nesting pond shorelines, or shallow marine feeding area shorelines could have negative and potentially long-term effects on productivity.

Polar Bears
Mechanical countermeasures could elicit several different responses in polar bears. Noise from vessels and human activity may disturb bears, displacing them from the area, or could potentially attract bears due to their curious nature. Activities attracting bears could result in unintentional harassment, deterrence to prevent human/bear interactions, or lethal take of the bear. Unintentional harassment would most likely be infrequent, short-term, and temporary. Use of nonlethal techniques to move a bear away from humans would be much less likely, infrequent, short-term, and temporary. Lethal take of a polar bear from bear-human interaction related to spill response activity is extremely unlikely (78 FR 35364).

Non-mechanical Countermeasures
Non-mechanical countermeasures include application of chemical dispersants by vessel or aircraft and *in situ* burning.

Dispersants
Chemical dispersants displace oil from the water's surface into the water column, and their use is considered an environmental tradeoff. The decision to use dispersants must weigh the benefits to species and habitats that might be fouled by a surface slick against increased oil exposure and toxicity experienced by pelagic and benthic organisms. Benefits of dispersant use might be realized if untreated oil threatens highly aggregated, surface-dwelling animals or particularly

sensitive coastal areas; the tradeoff being negative impacts of dispersed oil on water-column organisms. While dispersants themselves are considered less toxic than direct oil exposure, acute and chronic effects of exposure to dispersants and dispersed oil on listed species is largely unknown. Key considerations for listed species in the Action Area include: 1) length of time dispersed oil remains in the water column, 2) fouling of benthic habitat via formation of oil-particulate aggregates, and 3) effects of dispersed oil exposure to pelagic organisms.\

The Baffin Island Oil Spill (BIOS) was an experimental attempt at examining effects of dispersed vs. undispersed oil on the biota of nearshore areas in the Arctic (Cross et al. 1987). Chemically dispersed oil was released from a diffuser pipe placed near the bottom of the study bay. Concentrations of dispersed oil exceeding 160 ppm were measured during the release. Three years of monitoring indicated that, while there was some organismal stress (e.g., gaping clams) immediately after the spill, the chemically dispersed oil had no significant long-term effects on the sediments or the biota. In comparison, a similar amount of oil was allowed to remain on the beach of a nearby bay without treatment, and gradually leached off the beach into the subtidal area where it was taken up by benthic organisms. Oil in sediments of both the dispersed and undispersed oil apparently caused a reduction in urchin densities two years after the releases, which may lead to alterations in macroalgal communities in subsequent years. The authors concluded that both dispersed and untreated oil apparently caused relatively minor damage to only a few species of shallow water epibenthos (Cross et al. 1987).

Biodegradation rates of oil in water in Alaskan field conditions are uncertain. Oil biodegradation is dependent on microbial growth, may be much slower in open-ocean than in laboratory conditions (NRC 2005). Furthermore, results from experimental studies to determine effects of dispersants on oil biodegradation rates may not accurately or realistically reflect natural situations because of the un-natural test conditions that are used (NRC 2005). However, microbial communities capable of metabolizing Prudhoe Bay crude oil have been found in Alaskan waters (McFarlin et al. 2014).

The environmental fate and behavior of PAHs in the aquatic environment is complex, and depends on chemical and physical properties of the spilled oil (viscosity, droplet size, composition, density and concentration), the suspended solids in the water column (mineralogy, grain size, organic matter content, density and concentration) and environmental conditions (temperature, pH, salinity, pressure, and hydrodynamic conditions). Dispersed oil can adhere to suspended particulate matter in the water column to form oil-suspended particulate matter aggregates (OSAs), some of which sink to the ocean floor, becoming a source of contamination to benthic organisms. The predominant PAHs in sediments are usually the higher-ringed PAHs (Neff 1985; Albers 2003; Lance et al. 2012). This phenomenon is well characterized in a general sense, as there are accumulations of large-ringed PAHs in sediments of industrial water bodies throughout the world (Neff 1985, Albers 2003). In a mesocosm study of PAH fate, smaller PAHs decreased rapidly from the water column and did not reach the benthos, but larger PAHs were vertically transported to the sediment where they posed a chronic toxicity hazard to benthic biota (Yamada 2003).

Dispersants can enhance the ability of PAHs to interact with and adhere to suspended particulate matter by several mechanisms, including increased dispersion of the oil into the water column and lowered viscosity of the oil. Following the DHS, researchers found that the presence of Corexit 9500 greatly increased sediment uptake of dispersed oil and PAHs (Gong et al. 2014). In contrast, other studies have shown a reduced rate of PAH sedimentation following dispersant application (Yamada 2003), demonstrating that the environmental fate of PAHs is complex and dependent on many factors. Weathered oil residues containing higher-ringed PAHs at elevated concentrations can be absorbed on sediments and persist for decades in some situations (Reddy 2002).

Oil and dispersed oil toxicity varies depending on the oil type, specific chemicals in the mixture, and on the bioavailability of those chemicals, environmental conditions, and other spill response strategies. The higher-molecular-weight PAHs (3- to 5-ring) are associated with the most serious toxic effects at very low concentrations, but they are only minimally bioavailable to aquatic organisms following a spill because they are not very water soluble. Often, when spilled oil is chemically dispersed, the concentrations of higher-molecular-weight PAHs in the water increase dramatically, and are much more bioavailable for uptake by aquatic organisms (Couillard 2005; Mu 2014; Wu 2012; Adams 2014; Martin 2014). However, under various exposure conditions, including a spiked-then-declining scenario, toxicity of chemically-dispersed North Slope crude to the copepod *Calanus glacialis*, juvenile Arctic cod *(Arctogadus glacialis),* and larval sculpin was much less than that of mechanically dispersed crude oil (Gardiner et al. 2013).

Dispersant use promotes the possibility and severity of photo-enhanced toxicity because it greatly increases the solubility of the larger PAHs (some 3-ringed and especially 4-ringed) that are phototoxic (Barron 2003). Weathered, Alaska North Slope crude was more toxic to Pacific herring (*Clupea pallasi*) embryos in the presence of sunlight, and application of dispersant further enhanced toxicity (Barron 2003).

Birds – Spectacled Eider, Steller's Eider, and Short- tailed Albatross

The use of dispersants during an oil spill can cause direct impacts (feather fouling or ingestion of toxic components) and indirect impacts (prey reduction, increased predation). Dispersants are complex mixtures of surfactants and solvents, and they are specifically designed to lower surface water tension (Singer et al. 1995). Reduction of surface water tension is associated with feather wetting causing birds to lose buoyancy when they are exposed to dispersant in seawater (Stephenson and Andrews1997). Mallards (*Anas platyrhynchos*) exposed to Corexit 9527 (1.2 ml of a 50% mixture into a 60 L swimming tank) exhibited a loss of buoyancy, but there was no significant increase in the basal metabolic rate (Lambert 1982). Molting birds are more vulnerable to wetting (Stephenson 1997), and at the same time have elevated energy demands due to the cost of feather synthesis.

Several studies have compared impacts of dispersants on water repellency of feathers. Birds exposed to Corexit 9527 remained wet for much longer than birds exposed to water (controls), and longer than oiled birds, suggesting the insulating properties of their plumage were affected, despite efforts to preen. Mixing of oil and dispersant appeared to increase the damage to plumage leading to progressive waterlogging (Lambert et al. 1982). In another comparison, feathers submerged in solutions of seawater, seawater with Prudhoe Bay crude oil, or a mixture of seawater, Prudhoe Bay crude oil, and the dispersant Corexit 9500, indicated plain seawater or seawater plus Prudhoe Bay crude oil did not cause feather wetting. In contrast, feathers from both treatments containing Corexit 9500 (either in the presence or absence of Prudhoe Bay crude) quickly lost water repellency and "the feathers appeared folded in on themselves when removed from the solutions" (Duerr 2011).

Surfactants present in chemically treated oil may bind to the hydrophobic waxes in plumage, reducing the insulation properties of the feathers (Jenssen 1994). Oil-dispersant mixtures may be more potent at eliciting thermoregulatory effects than crude oil alone, and there may be taxonomic differences in sensitivity to dispersants (e.g.,common eiders [*Somateria mollissima*] may be more sensitive to the mixtures than mallards (Jenssen and Ekker 1991). Because even a thin sheen of oil could affect feather structure, use of dispersant would have to be highly effective (little or no remaining sheen or oil plus dispersant mixture) to mitigate oil exposure to birds from surface slicks (O'Hara and Morandin 2010).

A dosing study of Prudhoe Bay crude oil and Corexit 9527 on nesting Leach's storm-petrels (*Oceanodroma leucorhoa*) indicated that external exposure of adults to oil or an oil-dispersant mixture resulted in reduced survival of young to fledging (Butler et al. 1988). Significant differences in parental attendance at the burrow were observed at intermediate and high levels of oil and oil/dispersant exposure. But, only chicks exposed externally to an oil-dispersant emulsion via parental contact exhibited significantly reduced survival, with surviving chicks displaying reductions in weight gain and wing growth compared to controls and oil-exposed birds. They attributed decreased growth and survival of chicks whose parents were exposed to oil/dispersant mixture to a prolonged absence or death of the treated adult, as growth and survival reductions were similar to deficits observed in single-parent nests.

Oil and oil-dispersant mixtures are highly toxic to bird eggs. Albers (1979) found lower hatch success of eggs treated with Prudhoe Bay crude oil, Corexit 9527, and various oil-dispersant mixtures relative to untreated eggs; both Corexit 9527 alone and a 5:1 oil:dispersant mixture were both more embryotoxic than crude oil alone, and least toxic was a 30:1 oil:dispersant mixture. Eggs treated with 20 µl experienced reduced hatching success relative to controls, 15.5 µl induced 50% egg mortality, and 40 µl caused complete hatching failure (100% embryo mortality; Wooten et al. 2012). Albers and Gay (1982) found significantly reduced hatching success in birds exposed to oil relative to controls, and a more variable response in birds exposed to an oil-dispersant (Corexit 9527) mixture likely due to the physical and variable behavior of dispersed oil. Birds that encountered coalesced oil patches after dispersant use passed that oil onto eggs, resulting in reduced hatching, while those who did not encounter the coalesced oil had hatching success similar to controls.

In studies of immune system response to chemical toxin exposure, mallards were exposed to sublethal concentrations of South Louisiana crude oil, Bunker C fuel oil (BCFO), Corexit 9527, and oil-Corexit mixtures (Rocke et al. 1984). Ingestion of oil or oil-Corexit mixtures had no effect on avian cholera antibody-producing capabilities. A temporary nervous system disorder (lack of motor coordination and reduced mobility) was noted in birds receiving the highest dose of Corexit (5.0 ml/kg of a 1:10 dilution), which had resolved the next day. Oil and oil-Corexit mixtures did not induce this reaction. Ingestion of BCFO and Corexit mixtures induces a highly significant increase in liver weights and decrease in spleen weights, and a higher percentage mortality in treated mallards challenged with avian cholera relative to controls.

Marine mammals – Sea Otter, Polar Bear, Pacific Walrus
Information on effects of dispersants on sea otters, polar bears, and walrus is sparse, with limited information on sea otters, although the widespread use of dispersants in the DHS sparked toxicity studies using Corexit formulations on rodents as mammalian test species, with endpoints focusing on neurotoxicity, pulmonary and cardiovascular function, and other effects. Like marine birds, dispersants can adversely affect marine mammals from either/both direct or indirect exposure. For example, Williams et al. (1988a) found that sea otter pelts oiled or exposed to fresh crude oil plus Corexit 9527 increased the thermal conductance (i.e., decreased the insulative quality) of the fur.

One year after the DHS, dolphins exposed to chemically dispersed oil exhibited hypoadrenocorticism (a decreased secretion of corticotropic hormone causing immune dysfunction and other symptoms consistent with adrenal toxicity), and were five times more likely to have moderate to severe lung disease, than unexposed dolphins (Schwacke et al. 2013). Forty-eight percent of the dolphins from exposed populations were given a guarded or worse prognosis, and 17% were graded as poor or grave, indicating that they were not expected to survive (Schwacke et al. 2013). It is not known whether dispersant use worsened the outcome for this population, as the effects of dispersed oil cannot be compared with or separated from the effects of oil alone.

Indirect Effects on Invertebrate Prey of Listed Species
Dispersant use may result in increased concentrations of toxic components - primarily PAHs into the water column, and OSAs into sediments. However, discerning cause and effect and reaching conclusions regarding the relative influence of dispersed oil versus oil versus dispersant alone is difficult and highly dependent on the toxicity testing details, including exposure methods and duration and analytical techniques to quantify PAH concentrations (Fingas 2008).

The environmental conditions sought for dispersant use as outlined in the Unified Plan (e.g., calm seas and unweathered oil), could result in more negative effects to pelagic and benthic prey compared to other response methods. In areas such as spectacled eider critical habitat units in the Bering Sea, Ledyard Bay and Norton Sound; Steller's eider critical habitat units on the north side of the Alaska Peninsula; and Pacific walrus foraging habitat across the Chukchi Sea, negative impacts to benthic invertebrates is of particular concern.

Benthic invertebrates are important as food for Steller's eiders, spectacled eiders, sea otters, and walruses, and have pelagic larval life stages. Epstein et al. (2000) found that dispersed oil caused impaired settlement rates, the appearance of morphological and behavioral deformations, rapid tissue degeneration, and high toxicity to coral larvae species. Alameda et al. (2014) investigated effects of oil, Corexit 9500A, and dispersant-treated oil on the survival and growth rates of barnacle nauplii and the larval acorn worms. Growth rates were significantly reduced after exposure to chemically dispersed crude oil and Corexit 9500A at concentrations commonly found in the water column after dispersant application in crude oil spills. Hansen et al. (2012) found that following exposure of copepods to chemically and naturally dispersed oil, the dispersants slightly increased the specific toxicity of the oil at median and low dosage levels, but reduced the toxicity at high levels.

Pelagic fish and invertebrates, particularly squid, are important as prey for short-tailed albatross. While no information is available regarding effects to squid, various investigators have examined the effects of dispersants on fish. Effects differ by species and exposure levels. Use of dispersants was found to increase the exposure of the ovoviviparous Rockfish (*Sebastes schlegeli*) to oil in the water column (Jung et al. 2009). McEachern (2014) conducted toxicity tests of chemically dispersed oil on the early life stages of the red drum (*Sciaenops ocellatus*). Fish exposed to dispersed oil presented with one or more gross abnormalities including: cardiac edema, skeletal abnormalities, yolk sac edema, finfold abnormalities and decreased growth. Dussauze et al. (2014) studied impacts of chemically dispersed oil on adult polar cod (*Boreogadus saida*). Oil alone reduced O_2 consumption but dispersants did not produce this effect or increase oil toxicity; no difference in contamination levels were observed between fish exposed to oil and dispersed oil. Lin et al. 2009 found age-related differences among Chinook salmon (*Oncorhynchus tshawytscha*) exposed to oil and dispersed oil, and concluded that dispersant treatment significantly decreased the lethal potency of crude oil to salmon smolts.

Walruses may be particularly sensitive to large-scale impacts to benthic invertebrates. Walruses require approximately 29 - 74 kg (64 - 174 lbs) of food per day (Fay 1982) and must periodically haulout onto ice or land to rest between feeding bouts. Their seasonal migrations along the ice-edge take them northward over the highly productive continental shelves of the Bering and Chukchi seas in the summer (Garlich-Miller et al. 2011). Aerial surveys in the eastern Chukchi Sea found that 80–96% of walruses were closely associated with sea-ice and that the number of walruses observed in open water decreased significantly with distance from the pack ice (78 FR 35364). As ice edges retreat more rapidly due to climate change, females are forced to travel longer distances from the land-based haulouts (Udevitz et al. 2009). Therefore, foraging habitat closer to shore is becoming more valuable to walruses and thus more important to protect from negative effects of an oil spill and oil spill response activities. In 2010 and 2011, more than 20,000 walruses hauled out near Point Lay and many traveled to the Hanna Shoal area to feed before returning to Point Lay (78 FR 35364).

In-situ Burning

In-situ burning is used to reduce the volume of spilled oil and the concentrations of toxic volatile compounds in saltwater, freshwater, wetland, and upland environments. Because *in-situ* burning works best when oil is corralled, it may be considered for use in leads or polynyas. When in proximity to in-situ burning, listed species could be adversely affected directly through exposure to smoke or ingestion of burned residues. Indirect effects of this activity are also possible, if benthic prey or aquatic habitats are smothered by burned residues sinking to the seafloor.

Toxic constituents of smoke generated by *in-situ* burning include carbon dioxide, water, particulates (“soot”), sulfur dioxide and nitrogen dioxide (eye and respiratory irritants), carbon monoxide, and PAHs and other volatile compounds (Allen and Ferek 1993; Scholz et al. 2004). PAHs in the oil may be higher than in the smoke plume (Fingas et al. 1993), although concentrations of PAHs with five or more rings (the more toxic ones) were 10–20 times greater in smoke than in oil from an experimental burn of Alberta Sweet crude oil (Benner et al. 1990). Other toxins produced by combustion of organic materials such as polychlorinated dibenzodioxins and dibenzofurans may also be present (Aurell and Gullett 2010).

Concentrations of particulates, PAHs and other toxic components in the smoke would vary with burn efficiency, type of oil, and burn conditions, but the Newfoundland Offshore Burn Experiment (NOBE) showed that, "past a mile or two downwind," particulates were the only contaminant of concern (Barnea 1999). Particulates, small pieces of solid or liquids (e.g., dusts, soot, fumes, mists, fogs, sprays) that remain suspended in the air long enough to be inhaled, make up about 10–15% of oil smoke plumes (Barnea 1999; Scholz et al. 2004), making the plumes very black. Inhalation of *in-situ* burn smoke would likely result in short-term respiratory distress for all listed species, and birds could become disoriented if caught in the smoke cloud.

The residue that remains after burning can be: semi-solid (gel-like), as from diesel burning (Buist 1998); tarry lumps, as from burning medium crude (Fingas et al. 1994); stiff and taffy-like, as from burning North Slope crude during the EVOS (Allen 1990 as cited *in* Scholz et al. 2004); or a brittle solid (Buist et al. 1994, as cited *in* Scholz et al. 2004). Burn residues can float or sink, depending on density, slick thickness, and burn efficiency (NOAA 2015), and the properties of the original oil (e.g., specific gravity and percent of distillation residue after burning; Scholz et al. 2004). Residues may foul feathers or fur (NOAA 2015). For example, although burn residues from heavy oils did not stick to feathers, burn residues from diesels and lighter crudes did (Buist and Trudel 1995 as cited *in* Scholz et al. 2004). Residues could be ingested by fish, birds, and marine mammals. Effects of ingestion of burn residues would likely be similar to ingestion of weathered oil (Leighton 1995) for sea turtles (who readily ingest and are fouled by tarballs; Van Vleet and Pauly, 1987) and birds (Stubblefield et al. 1995). Weathered oils, although generally less toxic than fresh, can still cause a wide variety of negative effects upon ingestion, including gastrointestinal and organ injury, and toxic metals can be enriched in the burn residue compared to the parent oil (Scholz et al. 2004).

The amount of PAHs in oil is often reduced by >99% during *in-situ* burning (ADEC et al. 2008). An efficient burn will remove most of the volatile toxic materials from the residue; an inefficient burn will be less effective (ADEC et al. 2008). Burn residues are generally higher in metals and higher-molecular weight PAHs than unburned materials. Although toxic, they are thought to be relatively stable in (i.e., don't dissolve from) the burn residue, which reduces their availability to aquatic biota. The NOBE experiment demonstrated low acute toxicity of burn residues to sand dollars, oyster larvae, inland silversides (*Menidia beryllina;* Daykin et al. 1994), rainbow trout (*Oncorhynchus mykiss*), three-spine sticklebacks (*Gasterosteus aculeatus)* and sea urchin fertilization (Blenkinsopp et al. 1997); and burn residues showed no acute toxicity to amphipods and very low sublethal toxicity to marine snails (burying behavior) (Gulec and Holdway 1999) (NOAA 2015). When burn residues sink, however, they may smother benthic habitats and animals, especially in embayments, dense communities, or small freshwater waterbodies. Sunken oil residues cannot be effectively cleaned up (NRC 1999).

In terrestrial habitats with highly organic substrates, including tundra habitats where spectacled and Steller's eiders nest, *in-situ* burning can liquefy oil, allowing it to sink into the substrate if the water table is low (Scholz et al. 2004). Weathering rates would be slow in cold, generally acidic and often anaerobic Arctic conditions, so relatively fresh oil may persist for years, even after burning. Although less toxic than fresh oil, burn residues in terrestrial habitats can smother plants and microbes, be very sticky or dense, and be difficult to remove by natural processes such as rain (Scholz et al. 2004).

Non-mechanical countermeasures summary

The effects of non-mechanical countermeasures on listed species depend on the spill type, the bioavailability of those chemicals, environmental conditions, and spill response strategies used. Dispersant use and *in situ burning* may lead to direct toxicity, uptake of contaminants by pelagic and benthic organisms, loss of insulative properties of feather and fur, embryotoxicity, and smothering of benthic invertebrates. Use of dispersants reduces the impacts of oil exposure for some species, while increasing impacts to other. Generally, when dispersants are used effectively and appropriately, the net environmental effects are not substantially worse than those of the spill (Lessard and Demarco 2000; EPA 2013). In many cases, when impacts of dispersants plus oil have been documented to be worse than effects of oil alone, the differences are often only slight (i.e., Albers 1979; Lambert et al. 1982). However, when the use of dispersants results in exposure to spills that would not otherwise affect listed species, the impacts can be severe. Similarly, *in situ* burning can significantly decrease the toxicity of spilled substances before they are incorporated into the water column, thereby benefitting pelagic and benthic species, but can spread airborne particulate pollution, causing impacts to avian species.

[Top]

Disturbance

Disturbance is a negative effect that may occur during all response activities. Disturbance (e.g., forced movement of animals in response to human actions or activities, see Appendix B for complete definitions) may have no direct adverse effect if it is brief or temporary; however, longer disturbances can result in increased energetic expenditures, displacement from optimal feeding areas, injury, and mortality, especially for vulnerable individuals such as molting birds or dependent young. Disturbance would cause incidental take by harassment if it significantly disrupts normal behavior patterns such as breeding, feeding or sheltering.

The Unified Plan identifies measures for reducing the potential to disturb to listed species. The Wildlife Protection Guidelines (ARRT 2012) specify that during an oil spill, the Service may provide, through the Federal Aviation Administration and USCG, advisories to aircraft or mariners requesting pilots and vessel operators to avoid walrus haulouts and migratory bird concentration areas. Pilots and captains can then select alternate routes, thereby avoiding the wildlife areas and preventing disturbance. Copies of advisories are provided by the FOSC to all federal and state agency and agency-contracted on-site personnel. In addition, a news release may be prepared by Service representatives for distribution by the FOSC to appropriate news media representatives. Service personnel may also recommend that agency on-site monitors accompany nearshore and/or shore-based activities to help minimize or eliminate unacceptable levels of disturbance.

Northern Sea Otter

Sea otters may be disturbed by spill response activities including vessel traffic, aircraft overflights, and onshore activities. Behavioral reactions to disturbance may include: increased alertness; vigilance; agonistic behavior; escape behavior; or temporary or permanent abandonment of an area (van Polanen Petel et al. 2006). In addition to behavioral responses, otters may exhibit physiological responses (e.g., increased heart rate, hormonal response; loss of immune function, decreased body weight, impaired reproductive function, and abnormal thyroid function (Harms et al. 1997; Tempel and Gutierrez 2003). Either type of response results in a diversion from one biological activity to another. That diversion may cause stress (Goudie and Jones 2004), which redirects energy away from fitness-enhancing activities such as feeding and mating (Frid and Dill 2002). The consequences of behavioral modification have the potential to be biologically significant if they impact growth, survival, and reproduction.

Sea otters in Alaska have been observed avoiding areas with heavy boat traffic but returning to those same areas during seasons with less traffic (Garshelis and Garshelis 1984). Northern sea otters may exhibit escape behaviors in response to the presence and approach of vessels, including: 1) diving and/or actively swimming away from a boat; 2) entering the water when previously hauled-out; and 3) disbanding and scattering of groups (Udevitz et al. 1995). Conversely, southern sea otters only exhibited mild behavioral changes in response to boats passing within hundreds of meters and appear to have habituated to boat traffic (Riedman 1983; Curland 1997). Southern sea otters exposed to recorded noises associated with oil and gas activities exhibited no changes in the presence, density, or behavior, however, they displayed repeated, slight reactions to airborne engine noise (Riedman 1983, 1984).

Sea otter behavior is suggestive of a dynamic response to disturbance, abandoning areas when disturbed persistently and returning when the disturbance ceased. The potential adverse consequences of disturbance are relatively rare among sea otters; they appear to be generally resistant to the negative effects of sound and visual distraction, evidenced by changes in presence, distribution, or behavior in response to such disturbance (Riedman 1984; Ghoul et al. 2012a,b; Reichmuth and Ghoul 2012). Additionally, when sea otters have displayed behavioral responses to acoustic stimuli, they quickly become habituated and resume normal activity (Davis et al. 1988, Ghoul et al. 2012b). Some degree of disturbance from vessel traffic may occur during a spill response, but the impacts are expected to be short in duration, and impacts to the fitness of an individual are not anticipated. While large, ongoing spill response actions are more likely to cause repeated disturbances and may result in impacts to individual fitness, habituation to the presence of project vessels and noise associated with ongoing actions are expected as well.

Collisions between vessels and sea otters may occur during spill response actions. Sea otters occupy waters up to 91 m deep (300 ft, 50 fathoms) and spend several hours a day foraging. Collisions are infrequent and usually involve smaller, fast-moving vessels, including skiffs rather than larger vessels (V. Gill, BOEM, pers. comm.). Sluggish reaction time resulting from exposure to oil or other spilled material may reduce the ability of the animal to avoid the oncoming vessel.

Short-Tailed Albatross

While little is known about the effects of disturbance on Short-tailed Albatross in the marine environment, they are reported to voluntarily follow fishing vessels at sea, which suggests that the presence of spill response vessels would not cause disturbance to birds in the general area. While nesting on land they are very resistant to disturbance (USFWS 2008). Hazing and deterrence efforts at sea, discussed under the Wildlife Protection Measure section, would cause take by disturbance to these animals.

Polar Bear

Though polar bears are curious and may investigate novel activities, they also may move away from noise and vessels, aircraft, or humans (Ireland et al. 2009). Of four polar bears observed in the Beaufort Sea in 2006 during oil and gas seismic surveys, one was feeding and did not alter its behavior, two (a mother and cub) entered the water, and one was observed already swimming and continued to swim (Funk et al. 2006). The energetic costs of retreating from vessels or aircraft may be minimal if the event is short and the animal is otherwise unstressed. For example, retreating from an active icebreaker may produce minimal effects for a healthy animal on a cool day; however, on a warm spring or summer day, a short run may be enough to overheat a well-insulated polar bear (78 CFR 35364).

If a vessel were to encounter a swimming bear, it will most likely result in temporary behavioral disturbance only. Indeed, observations from monitoring programs report that when bears are encountered in open water swimming, bears have been observed retreating from the vessel as it passes (USFWS unpublished data in 78 CFR 35364). Icebreaker support for spill response in frozen seas could introduce loud noise into the environment, especially if a ship has to reverse and repeatedly ram thick ice (Davis and Malme 1997). Transient or hunting bears on the ice may have their movements or hunting behaviors altered or interrupted by these disturbances. In 2012, four industry operators in the Chukchi Sea reported seven responses to their activities by polar bears that met the MMPA definition of Level B take (about 13% of observed bears). We interpret these reported interactions to indicate that most vessel/polar bear interactions would result in only minor, short-term behavioral changes.

In rare cases, human-bear encounters could cause harm to individual bears. Examples include if a female is separated from her cub(s), or if normal activities such as resting, feeding, or nursing are disrupted to the point that the individuals involved are physiologically impacted, or if the bear must be hazed or killed to protect human life. The possibility of harmful impact likely varies with the number, duration, or intensity of the encounters, and the bear's physiological state prior to the encounter.

Walrus

Walrus are sensitive to most disturbances, and we anticipate this to be the case for any spill response activity. As social animals, walrus travel and haul out to rest in densely packed groups of a few individuals to several thousand (Gilbert 1999; Kastelein 2002; Jefferson et al. 2008). Disturbance reactions are variable, depending on age, sex, and size and haulout substrate (Fay et al. 1984). Females with calves appear to be most sensitive to disturbance, and animals on shore are more sensitive than those on ice (Fay et al. 1984). When hauled out groups are disturbed and stampede, calves and young are vulnerable to trampling injuries and mortality (Fay 1980; Fay and Kelly 1980). In 2007, more than 3,000 calves died along the Chukotka coast due to stampedes caused by humans and polar bears. The potential for disturbance events to result in animal injuries, mortalities or mother-calf separations increases with the size of walrus aggregations (78 FR 35364).

In addition to trampling injuries, disturbed walrus may suffer increased stress and energy expenditure, and interference with feeding or communication. Cows and calves are especially wary; cows may spend less time with calves on land; calves may spend too much time in the water, resulting in impaired thermoregulation. Severe, prolonged or repeated disturbances could potentially displace individuals or herds from preferred feeding or resting areas (78 FR 35364).

Reactions of walruses to aircraft are thought to vary with aircraft type, range, and flight pattern, in addition to group composition and size. Helicopters are more likely to elicit responses than fixed-wing aircraft, and walruses are particularly sensitive to changes in engine noise and are more likely to stampede when aircraft turn or bank overhead, although researchers conducting aerial surveys for walruses in sea-ice habitats have reported little reaction to small fixed-winged aircraft above 305 m (1,000 ft) (78 FR 35364).

The reaction of walruses to vessel traffic appears to be dependent upon vessel type, distance, speed, and previous exposure to disturbances. Underwater noise from vessel traffic could "mask" ordinary communication between individuals. Icebreaking vessels have the greatest potential for disturbances since these operations typically require the vessel to accelerate, reverse direction, and turn rapidly, maximizing propeller cavitations and resulting noise levels. Icebreaking activities can displace some walrus groups up to several kilometers away; however most groups of hauled out walruses showed little reaction beyond 800 m (0.5 mi) (Brueggeman et al. 1990). Environmental variables such as wind speed and direction are also thought to contribute to variability in walruses' response to vessels (78 FR 35364).

Spectacled and Steller's Eider

Oil spill response activities could disturb eiders and potentially result in breeding depression or displacement from preferred nesting habitat. Disturbance during the nesting and brood-rearing period (approximately June 5–August 15) could adversely affect individuals by: 1) displacing adults and or broods from preferred habitats during pre-nesting, nesting, and brood rearing, leading to reduced foraging efficiency and higher energetic costs; and 2) flushing females from nests or shelter in brood-rearing habitats, exposing eggs or ducklings to inclement weather and predators. Hens may also damage eggs as they are flushed from a nest (Major 1989) and may abandon nests entirely, particularly if disturbance occurs early in the incubation period (Livezy 1980, Götmark and Ählund 1984). We anticipate that mechanical countermeasures such as construction of barriers, dams, pits, and trenches in and around freshwater nesting areas will have greater temporary effects on nesting birds than marine activities.

Disturbance during staging, molting, or wintering could also affect energetic balances during these crucial times, resulting in infirmity or mortality, depending on disturbance severity and the particular location. For example, the only known wintering area (and critical habitat) for spectacled eiders is around polynyas south of St. Lawrence Island, in a relatively shallow area with a rich benthic bivalve prey base. Disturbance and displacement from this habitat could negatively affect the energy balance of wintering birds by causing increased energy expenditure and barring access to critical food items. Evidence for disturbance impacts to Steller's eiders during winter is ambiguous; in Kachemak Bay and Unalaska, wintering Steller's eiders appear unaffected by human activities on adjacent shorelines, but sensitivity to boat traffic in the Izembek Lagoon Critical Habitat Unit has been documented (Ward et al. 1996).

The severity of disturbance and displacement will likely depend upon the duration, frequency, and timing of the disturbing activity. Response activities for a large oil spill could continue for many months; even responses to small spills occurring during the very short summer nesting season could result in disturbance to individuals and reduced productivity for that year.

Tracking and Surveillance

Tracking and surveillance activities involving aircraft, vessels, all-terrain vehicles, or heavy machinery are used to monitor spill extent and behavior, and to determine spill exposure risk to sensitive environmental resources including listed species. Tracking buoys and sampling devices may also be deployed. These activities would primarily result in disturbance to listed species, which was discussed above (Disturbance section). Disturbance may have no direct effects if it is brief or temporary; however, it can result in increased energetic expenditures, displacement from optimal feeding areas, injury, and mortality, especially of vulnerable individuals such as molting birds or dependent young.

Waste Management

The Unified Plan describes methods to handle, store, transport, treat, decontaminate, and dispose of waste including: open burning, incinerating, landfilling, bioremediating, and recycling. The methods and treatments depend on the type and amount of material spilled and the resources available for waste management. The Unified Plan specifies that waste management should be conducted in compliance with legal requirements and in a manner that minimizes environmental and public health impacts.

When waste management is conducted as specified by the Unified Plan, residual materials produced by or remaining after waste treatment may be released in the environment within lawful limits established by ADEC and EPA. Treated effluents would be required to meet state water quality standards, reducing risk, but can potentially further degrade waterbodies previously affected by a spill or other sources of contaminants.

The RP is responsible for developing and implementing the waste disposal plan for a specific incident, and oversight of the plan is normally the responsibility of the ADEC. Impacts to listed species and critical habitat from materials discharged during improper, illegal, or insufficient waste management or from accidents involving waste materials are not authorized by the Unified Plan.

Extreme weather or other conditions may increase the likelihood of accidental releases during handling or transport of wastes. Some wastes (e.g., oil emulsions, oily water, and hazardous wastes) cannot be treated in Alaska and must be transported to the contiguous United States. In these cases, longer transport distances could increase the probability that a spill, associated with the Action, will occur. These activities may contribute a small incremental increase in risk of spills in Alaska. Furthermore, accidental spills of large quantities of dispersants could occur when building, maintaining or resupplying stockpiles.

Wildlife Protection Measures

The Unified Plan specifies measures that may be taken to protect wildlife from exposure to spill materials including deterrence (i.e hazing), and pre-emptive capture and relocation. Additionally, measures include subsequent treatment, and release of contaminated wildlife; recovery of contaminated carcasses; and strategic avoidance of sensitive areas. Recovery of carcasses may cause incidental disturbance during cleanup efforts, but is primarily beneficial, especially for preventing exposure to scavenging polar bears. Strategic avoidance of sensitive areas also considered beneficial if it reduces the disturbance from spill response activities without compromising exposure risks.

Hazing involves utilizing visual, auditory, and other exclusionary methods to deter animals away from spilled material. Techniques include: 1)causing avoidance by installing balloons, reflector tape, snow fencing, or electric fencing; 2) using noisemakers such as horns, alarms, propane exploder cannons, pistols with caps, screamers, bangers or firing shotguns with cracker shells, rubber bullets, or bean bags. The selection of the appropriate deterrent methods depends on the species involved, the surrounding environment, and the spill situation. In some cases, the animals must be deterred repeatedly and frequently because of behavioral patterns or habituation to the disturbance.

The primary adverse effect of deterrence is disturbance. The physiological and behavioral consequences are the same as described in the Disturbance section, however this disturbance is intentional to reduce exposure to toxic chemicals. While the disturbance is intentional, the activity is still considered incidental to the Action. Herding Pacific walruses away from a spill site may be feasible for those animals already in the water, but as specified in the Unified Plan, hauled-out animals should be left alone due to the risk of trampling if stampeding occurs.

The capture of wildlife, whether conducted pre-emptively to prevent chemical exposure or for treatment and rehabilitation, is considered an extreme spill response measure. It is intended to be conducted only when there is a significant risk to listed species (i.e., there is both a high probability of exposure to spilled material and a high likelihood of severe adverse response to exposure) and there is a reasonable likelihood of a beneficial outcome for the animal. Pre-emptive capture and relocation of polar bears is only feasible if suitable relocation sites are nearby. Their large body size and potential aggressive response behavior makes the pre-emptive capture challenging and limits the utility of this strategy to small numbers of bears only. Risks involved with capture, whether prior to, or following exposure to spills, may result in excessive energy expenditures from capture avoidance, unintentional overdose of immobilization drugs, and adverse physical responses due to combined impacts of contaminant exposure and capture stress. Furthermore, attempting to capture Pacific walruses, either for pre-emptive prevention of spill exposure or for treatment after exposure is not currently feasible because of this species' sensitivity to disturbance and the potential danger to personnel posed by their large body size and belligerent behavior. Capture of a listed animal constitutes take by harassment at a minimum, but may result in survival of an animal that would otherwise die. The choice to conduct wildlife capture is made on a case-by-case basis.

Capture and handling of wildlife can increase exposure to infectious diseases, and animals exposed to contaminants may have suppressed immune function. Close contact in treatment facilities and during transport may result in infection to an individual. Diseases may also be transmitted across animals in shared facilities. Moreover, treated animals may spread diseases among wild populations following release. While disease transmission is considered unlikely, the Unified Plan recognizes this concern when considering undertaking wildlife protection activities. Proper quarantine procedures, involvement of wildlife health experts, and use of appropriate veterinary practices can be facilitated by Service personnel during spill response and would likely reduce the risk of disease transmission.

The Unified Plan incorporates various tools for minimizing the adverse effects of deterrence and capture efforts, including the Wildlife Protection Guidelines (ARRT 2012) and the Interagency MOA for ESA Consultation (USCG et al. 2001). The Wildlife Protection Guidelines specify who may conduct and oversee deterrence and capture activities. The guidelines include forms and checklists for evaluating circumstances, following standard procedures, obtaining equipment, and documenting decisions. The guidelines also include species-specific information and considerations, additional resources including reference information and manuals, and tools for ensuring sufficient spill response capacity. The guidelines and the MOA both specify that the Service will be consulted whenever actions may affect listed species. The Service has developed additional tools which provide guidance during spill response and ensure that our involvement will help to reduce the likelihood of potential adverse impacts from hazing and capture (see, for example, http://www.fws.gov/Contaminants/FWS_OSCP_05/FWSContingencyTOC.htm; USFWS 2005; Services' Oil Spill Response Plan for Polar Bears in Alaska (USFWS 2015). The Unified Plan also specifies that a capture and release plan must be in place prior to the capture of wildlife, and identifies Federal and State approvals that must be obtained in advance. These activities are conducted only by personnel who have been trained in wildlife protection protocols and have appropriate Federal permits. Each of the requirements identified in the Unified Plan improves the chance that wildlife protection efforts will be conducted appropriately and effectively, thus minimizing the overall number of animals impacted by the spill.

Interdependent and Interrelated Actions

Interrelated and interdependent actions are those which have no independent utility apart from the proposed action. They depend on the larger action for their justification (50 CFR §402.02). Interrelated and interdependent actions related to oil spill response activities include those not explicitly directed by the Unified Plan, but result from decisions made under the Unified Plan.

A large and concentrated influx of people and supplies can occur during an event. Depending on the size of a spill, this associated movement of people and supplies can be the equivalent of a small community and may include increased flights or marine vessel traffic, human activity, water and energy consumption, waste, noise, and heavy equipment. These actions may increase stressors on the environment in marine or coastal areas. Disturbance effects on listed species are discussed in the Disturbance section of this effects analysis.

Predator and scavenger populations (e.g., fox, gull, raven [scientific name]) may be increasing on the North Slope near sites of human habitation such as villages and industrial infrastructure (Eberhardt et al. 1983, Day 1998, Powell and Bakensto 2009), due to the availability of anthropogenic food sources in villages and oil fields, and alternative nesting/denning sites on human-built structures (Day 1998). If not handled appropriately wastes from spill responders could result in an influx of new predators and scavenger. Increased predator /scavenger populations on or near the nesting grounds of Steller's or spectacled eiders (i.e., North Slope or Y-K Delta) is likely to result in higher nest predation rates (Obritschkewitsch et al. 2001, Rojek 2008, Safine 2011.).,

Response Analysis Conclusions and Synthesis

In this response analysis, we considered the direct, indirect, and cumulative effects of potential spill response actions on listed species and their habitat. We evaluated spill response actions as stressors, and considered the environmental, biological, physiological, and behavioral responses likely to be exhibited by individuals of a listed species. We examined the available scientific and commercial data to determine if an responses to stressors would reasonably be expected to reduce an individual's fitness (i.e., survival, longevity, reproductive potential) . We also evaluated the impact of direct and indirect stressors on the quantity, quality, or availability of physical or biotic features of designated critical habitat.

We conclude that spill response actions have the potential to cause adverse effects on individuals and habitat through a variety of mechanisms. Mechanical countermeasures, particularly aggressive shoreline cleaning, dredging, and vegetation removal are likely to impact benthic food resources of Steller's eiders, spectacled eiders, otters, and in some circumstances, walruses. Use of dispersants may adversely affect listed species and habitat by increasing the spatial dimensions affected by a spill bydispersing oil into the water column. Dispersants may also facilitate formation of OSAs, which may increase the likelihood that benthic invertebrates will become contaminated. Use of dispersants may increase the bioavailability of more-toxic components of oil relative to undispersed oil. Finally, strong evidence suggests using dispersants increases the probability of feather wetting. *In situ* burning may produce smoke and residues that are toxic to animals and cause smothering of benthic invertebrates that are important prey species for Steller's and spectacled eiders, otters and walrus. Lastly, all response efforts can cause disturbance of individual animals.

We acknowledge that oil spill response is beneficial to the environment in general and actions under the Unified Plan will result in beneficial effects to listed individuals and their habitat. Mechanical response measures can reduce the amount of material in the environment and the affected area. Dispersants and *in situ* burning can reduce the concentration and thus the toxicity of spilled material and speed biodegradation. Spill tracking and surveillance can reduce exposure to animals by identifying concentrations of animals in the spill's trajectory prior to exposure. Wildlife protection measures can prevent exposure and improve survival rates for animals that have been exposed. The net benefit to listed species and habitats is evaluated in the next section.

5.3 Risk Characterization Analysis

In this section, we integrate the likelihood of population-level exposure with the severity of individual-level effects to characterize the risk from the oil spill response as described in the Unified Plan. We assess the risks to listed species from the action, given the likelihood of exposure and the likelihood and severity of harm.

Methods

We use all the information provided in this BO (e.g., description of action, baseline, status of species) to assess the probability of exposure and severity of impacts are likely to jeopardize the continued existence of a listed species or adversely modify critical habitat. Additionally, we consider protective measures specified in the Unified Plan that are likely to mitigate potential impacts.

Probability of Exposure

Some level of exposure risk from spill response exists for all listed species covered in this BO. The degree of exposure is highly dependent on the temporal and spatial overlap of the individuals and their habitat and the extent of spill response activities. Intuitively, we conclude that direct impacts are most likely where spill response actions occur and larger spills will be associated with larger spill responses. Indirect impacts may affect animals in areas outside of the spill site or may have prolonged (chronic) effects beyond the duration of the spill event. Indirect impacts from reduced forage quantity or quality may continue after the spill response ends and could therefore affect more individuals than direct impacts. Because most spills in the Action Area have been small, we anticipate this trend will continue into the foreseeable future and adverse effects of the Action will likely be temporary and localized.

The Exposure Analysis provided a framework for evaluating the consequences of maximal exposure to the Action, and demonstrated that the actions described in the Unified Plan were unlikely to pose a significant risk to the continued existence of the listed northern sea otter, polar bear, short-tailed albatross, or Pacific walrus due to an exceedingly low likelihood of exposure to the response action at a spatial scale using hypothetical worst-case scenario oil spills as a proxy. We concluded that while individuals may be harmed during a spill response event, populations of these listed species are highly dispersed, making exposure at the scale of jeopardizing their continued existence exceedingly unlikely. Of these listed species, critical habitat has been designated for the sea otter. Impacts to their critical habitat will depend on the scale of the event, but while risks posed by spill response actions implemented under the Unified Plan could reduce its conservation value, negative impacts to critical habitat as a whole is exceedingly low.

Risk from Response Activities
Choosing a spill response action involves understanding tradeoffs of environmental effects. Use of chemical dispersants during a large offshore spill of crude oil may result in a greater area of effect and degree of impact on subsurface pelagic species than an untreated spill (Trudel 1982). However, spill response activities, particularly use of dispersants, may also reduce the direct impacts and likelihood of exposure to oil on the sea surface. Spill response actions can determine the likelihood of impacts on many environmental parameters, and in many spills, several response actions are conducted simultaneously, however, the actions are intended to improve environmental protection, including protection of listed species and critical habitat.

The signal of adverse effects from spill response activities would have to measurably amplify the adverse effects of the spill to be recognizable. If a spill were to occur on a scale large enough to place the continued existence of a listed species at risk or to significantly impair critical habitat, the spill response actions would then need to impose additional stressors significant enough to jeopardize the species or adversely modify critical habitat.

Scientific literature on ecosystem-level effects of dispersants on animals and habitat indicate the impacts are not substantially worse than the effects of the oil (see Response Analysis section). Various factors govern the effectiveness and toxicity of dispersants and their effects on pelagic and benthic food webs are not fully understood. While studies concluded that direct application of dispersants to birds can present a high hazard, proper application of dispersants can limit environmental exposure by diluting both the oil and the dispersant throughout the water column, reducing its concentration. Further, dispersants are not to be applied directly to birds or other animals and are intended only for surface application.

The Unified Plan's Dispersant Use Plan (ARRT 2014) and specifications provided by EPA/USCG (EPA and 2015; Appendix D) stipulate procedures that increase the chances that dispersants will be used in an appropriate and effective manner.

Steller's and Spectacled Eiders
The Response Analysis examines available scientific and commercial data to determine responses of individuals and impacts to critical habitat given their exposure to the Action. Individuals exposed to spill response activities may experience reductions in fitness, either from direct impacts, or from the effects of the activities on habitat. Indirect effects to habitat and forage may be severe, from dispersant use in particular, as described in the Response Analysis. However, whether those individual responses translate into risks to the species will depend on likelihood of exposure on a scale of consequence to the species. For Steller's and spectacled eiders, the probability of exposure, combined with the likelihood of fitness-reducing responses, is sufficient to raise concerns about whether actual spill response actions could adversely affect enough individuals to have consequences at the population level.

The probability of large spills in areas where listed eiders occur is low. Further, spills that are likely to occur are small, resulting in a low overall level of risk to the animals or their critical habitat. The frequency of occurrence of very large and catastrophic spills, such as those used to inform the hypothetical exposure analyses, is exceedingly low.

Factors Affecting Risks

There are several programmatic measures in the Unified Plan that reduce risk to all species, but there are other factors that influence spill risk and response in remote arctic environments. We discuss these more general factors here before considering risk to listed species more specifically.

Difficulty of Spill Response in Alaska

Despite a low probability of large oil spills in the Action Area, the distance from established population centers, limited daylight in winter, persistent sea-ice, rough ocean conditions, and hostile weather increase the difficulty of spill response activities relative to more temperate and populated areas. A high-energy marine environment will facilitate dispersion of the spill, but may also impede response activities. Cameron *et al.* (2011) noted that large spills at sea are difficult to contain and may spread over hundreds or thousands of kilometers, and that the threats posed by a spill in the Arctic are magnified by the limited resources available in the region for effective response. A prompt response is critical for efficacy of *in situ* burning and use of dispersants. The window of opportunity to use dispersants is typically within hours to 1 - 2 days after a spill; thereafter, the oil may become weathered and difficult to disperse (National Research Council 2010).

Presence of sea-ice can limit detectability and access to spilled material making access difficult or impossible and allowing contaminants to drift long distances prior to melting the following spring or summer. It can also limit effectiveness of skimmers. Ice may complicate the use of dispersants. To be effective during an open-water oil spill, the dispersant must be able to reach the oil slick, mix with the oil, and cause the oil to disperse into small droplets. Dispersants work best when a moderate amount of mixing energy exists. Ice dampens the mixing energy of ocean waves, but vessel propellers or high-pressure water systems can be used as an additional source of energy (Sørstrøm et al. 2010). Recent research indicates that dispersants may be used effectively in a broken ice environment with the development of improved delivery systems and introduction of extra mixing energy (Sørstrøm et al. 2010).

In some cases, the presence of ice can aid spill response activities. Cold weather slows weathering of oil, allowing more time for effective use of spill response actions. Ice can serve as a natural containment device preventing rapid spread of oil across the ocean surface. It can also concentrate and thicken the oil, allowing for more efficient skimming, dispersant application, and *in situ* burning operations. Shore-fast ice can form a protective barrier along shorelines. But in general, the difficulties of oil spill response in icy arctic environments are expected to outweigh the benefits and increase the risks to listed species.

Factors limiting the probability of a worst-case scenario

Drilling depths and well pressures in Chukchi Sea development, as well as improvements, such as blowout prevention technology, reduce the risk of a catastrophic well blowout like the DHS occurring in Alaska. The blowout causing the DHS occurred in 5,000 ft (1,524 m) of water with well pressures of approximately 15,000 psi (approximately 103,421 kPa) (Schmidt 2012). Drilling depths for the Chukchi Sea exploration are expected at approximately 150 ft (46 m) and well pressures to not exceed 3,000 to 4,000 psi (approximately 20,684 - 27,579 kPa). Furthermore, improvements in industry and regulatory prevention measures have been made to reduce the risk of a similar event occurring in the future. Improvements have been made in blowout prevention technology, casing and cementing techniques, and requirements for redundant barriers during decommissioning. These improvements will be required for all exploratory drilling operations in the Chukchi Sea by the permitting agencies, and the BOEM/BSEE considers the likelihood of a blowout occurring during exploratory drilling in the Chukchi Sea as negligible (BOEM 2014).

The potential for an event similar to EVOS has been reduced by industry actions and the efforts of the USCG and other agencies in the years following that tragic spill. Significant improvements have been made in vessel tracking and monitoring, weather forecasting, communications, and vessel design. Double-hulled tankers are the industry standard, and single hulled vessels are being phased out. This alone is predicted to cut the risk of spills from cargo ships by a factor of four (DNV and ERM, 2010task2a). Despite these improvements, the amount of vessel traffic in areas used by listed species continues to rise. Although the likelihood that an EVOS-sized event could occur is small, we remain to be concerned because of the potential ecological harm it could cause.

Impact Avoidance and Minimization Measures

The effectiveness of BMPs for protection of wildlife during a spill depends on many factors. Actions improving response efficiency and effectiveness can reduce the size of the spill and thus the impacts to listed species and habitat. Of particular importance is the prompt availability of appropriate response resources and personnel. Indeed, one of the greatest protective devices for listed species and critical habitat may in fact be the framework provided in the Unified Plan for spill response preparedness. Components of the Unified Plan that contribute to spill response preparedness include:

- Detailed information regarding local spill risks, response strategies, and resources provided in SCPs;
- Guidance for training, spill drills, and equipment deployments;
- Resources identifying probable sources of hazardous materials and likely spill sites;
- The variety of technical guidance documents that have been prepared to supplement the Unified Plan (e.g., Nuka 2006; ACS 2010; API et al., 2001; NOAA et al., 2010).

These resources, together with industry standards (including spill prevention and response plans, equipment, and activities) and regulatory oversight, reduce the likelihood of spills and improve the response outcomes when spills do occur. Thus, the Unified Plan as a whole is a key component of reducing risk to listed species.

Incident-specific consultation

The Interagency MOA for Spill Response (USGS et al. 2001) establishes the role of Service on an advisory capacity to the Unified Command during an event. Incident-specific mitigation measures are to be provided to the Unified Command by the Service to minimize the impact of oil spill response activities to listed species. Emergency consultation is documented in a *post hoc* Biological Opinion describing the effects of the spill response activities and enumerating the amount and extent of incidental take.

Wildlife Protection Guidelines
Appendix G of the Unified Plan describes the Wildlife Protection Guidelines for Alaska (ARRT 2012). It includes BMPs for responding to oiled wildlife and wildlife threatened by spills. It is available as a resource for responders during spill response training and during a spill, and it provides guidance to the FOSC to reduce the risk of take and harm to listed individuals.

The Dispersant Use Plan
Various stipulations in the Dispersant Use Plan minimize risks to listed species; a preauthorization zone offshore of the Aleutian Islands will speed the decision making process and allow dispersants to be applied to spills promptly, when they are most effective. Preauthorization of dispersant use however, creates a risk dilemma. Preauthorization may reduce Service involvement in the decision to apply dispersants, resulting in an increased exposure risk for listed species.

Preauthorization in the offshore regions of the Aleutian Islands is intended to ensure certain vessels and facilities (including tank vessels that carry crude oil) maintain a minimum dispersant use capability in accordance with a 2009 USCG rulemaking (33 CFR 154). This preauthorized zone was identified by the ARRT as an area where additional spill response capacity is needed due to existing spill risk, distance from spill response centers, limited labor force, finite local resources, challenging weather, and other conditions. Various characteristics of the selected preauthorization zone demonstrate the ARRT's efforts to minimize risk. These include the exclusion of nearshore habitats used by several listed species, and incorporation of avoidance areas. The avoidance areas were excluded from the preauthorization zone due to concerns about potentially-harmful ecological effects of dispersing oil in areas of high documented short-tailed albatross use (see Appendix D). The preauthorization zone does not include critical habitat of any listed species under the Service's jurisdiction.

For areas outside the preauthorization zone, the decision process, criteria specified for consideration, and conditions/stipulation specified in the Dispersant Use Plan are all intended to facilitate effective dispersant use and minimize chances of adverse impacts to the environment. The decision process includes notifying EPA, DOI, DOC, and State and Tribal representatives of intent to use dispersants. Testing and monitoring protocols are initiated and followed prior to full-scale dispersant application. The following additional conditions/stipulations apply:

- The preauthorization of dispersant use (inside the Preauthorization Area) only applies to crude oil.
- Prolonged application of dispersants that exceeds 96 hours is not preauthorized.
- Additional monitoring is required for prolonged applications (>96 hours). Conditions will be assessed on a daily basis to determine whether dispersant application(s) will continue.
- Subsea dispersant use is not a potential response action identified in the Unified Plan.
- Dispersant delivery will not displace or interfere with mechanical or other response operations.
- Dispersant applications will only be carried out in daylight conditions.

- Dispersants will only be applied in areas where the water depth is ≥ 20 m (10 fathoms or 60 ft) and at sufficient distances from shore to ensure that sensitive nearshore and benthic habitats are not affected by dispersants and/or dispersed oil.
- Dispersant applications will maintain a minimum 500 m (1,640 ft) horizontal separation from swarming fish, rafting flocks of birds, marine mammals in the water, and/or marine mammal haulouts.
- Dispersants will not be sprayed on flocks of birds or other congregations of animals.
- To avoid disturbances at walrus haulouts, any dispersant-related aircraft will comply with all applicable horizontal and vertical distance restrictions issued by the Service.
- DOI and/or DOC will provide a specialist in aerial surveying of marine mammals and pelagic birds to accompany monitoring teams to help ensure compliance with the above requirements. If DOI and/or DOC cannot provide the appropriate specialist(s), a third party acceptable to the DOI and/or DOC will be identified to accompany the monitoring team.
- Any monitoring required by the incident-specific section 7 compliance will be conducted.
- Incident-specific consultation is required for any situation in which dispersant use may affect listed species or critical habitat.

These conditions reduce the likelihood that listed species will be jeopardized or critical habitat adversely modified by dispersant use.

Tracking, Surveillance, and Deterrence Activities
Tracking and surveillance allows identification of vulnerable animals during spill response activities that may be hazed or proactively relocated to minimize harm. It is probable that some spill response activities will increase disturbance through human or boat traffic in the area. It is also probable that injury to individuals will occur from hazing or capture, but if done correctly and according to the Wildlife Protection Guidelines the net effect of these activities should reduce the likelihood of harm to listed species and reduce the take of individuals potentially affected by spilled oil.

Species-specific Synthesis

Northern Sea Otter
The implementation of the Unified Plan may result in adverse effects to individual sea otters and some proportion of their critical habitat as a result of direct exposure to dispersed oil, physical manipulations of habitat associated with mechanical spill response actions, and/or chemical changes in habitat following use of dispersants or *in situ* burning. The risk of population level effects from spill response activities is low. The maximum scale of plausible impact was examined under a hypothetical worst-case scenario equivalent to EVOS. Because sea otters are distributed across the entire spatial extent of sea otter critical habitat, only a massive event, at least 40% larger than EVOS, occurring where sea otter density is highest across its range, would jeopardize the population or the adversely impact the conservation value of critical habitat (see Exposure Analysis). An alternate scenario is the scale of spill response would need to exceed the scale of the effects of the worst-case spill by 40% or more to expect a similar, catastrophic result. The likelihood of such an event is exceedingly low, and is further reduced by modern industry

protections that were not in place at the time of EVOS, such as vessel tracking and requirements that tankers be double-hulled.

The response of sea otters and their critical habitat to actions implemented under the Unified Plan will depend on intensity, scale, duration, location, and type of activity. The importance of international shipping lanes, presence of industrial centers, and the increasing level of transit through sea otter critical habitat results in a level of risk that cannot be ignored. As described in the Response Analysis, the greatest risk of large-scale or widespread adverse impact is likely to be from the use of dispersants due to impacts to benthic invertebrate food resources.

Impacts to critical habitat are of concern if they affect the "primary constituent elements (PCEs)", i.e., the biological and physical features that are essential to the conservation of the species. Mechanical spill response actions may affect each of the PCEs of sea otter critical habitat, including shallow rocky areas less than 2 m (6.6 ft) deep (PCE 1) and within 100 m (328 ft) of Mean High Tide (MHT) (PCE 2), kelp forests (PCE 3), and prey resources (PCE 4). Kelp beds may also be affected by repeated vessel traffic. Prey resources are more likely to be affected by non-mechanical spill response actions than other PCEs. Impacts from mechanical measures and vessel activities will generally be localized near the spill response site; impacts to prey resources (especially from use of dispersants) may be more widespread.

The food value of benthic invertebrate communities may be reduced following exposure to spill response actions. Benthic invertebrate communities and kelp forests may recover in suitable areas in a relatively short time period, or may not reestablish. Intertidal and subtidal communities in southwest Alaska are highly dynamic, and have undergone several phase shifts between alga- and herbivore-dominated states in recent decades (Estes et al. 2004). Growth and colonization is influenced by nutrient inputs, currents, and upwelling (Menge 2000), the scale of disturbance (Thrush et al. 1996), and the abundance of grazers such as urchins (Mann 1973). While these factors confound predictions of critical habitat response to the Action, none of the anticipated impacts will cause permanent habitat loss. If habitat is left undisturbed following spill response actions, it will continue to provide habitat for sea otters after a period of recovery. Reductions in habitat value, although temporary, could impact the survival or recovery of sea otters, if they occur on a large enough scale.

Planning and prevention components of the Unified plan and associated SCPs are the first defense tactics that will benefit the northern sea otter due to a resultant reduction in potential for spills to occur. Spill responder networks, SCPs, Wildlife Protection Guidelines, Dispersant Use Guidelines, and technical guidance documents developed for and detailed in the Unified Plan also help to improve the efficiency of a spill response in the event of a major spill. A large number of animals could be exposed to a spill and associated spill response actions, particularly during a large or prolonged event. However, the resiliency of the sea otter is demonstrated by their recovery following over-harvest during the fur trade of the 19th century and their gradual recovery from the EVOS spill. Given the current population size, the relatively small numbers needed to sustain a viable population, and their widespread distribution, it is highly unlikely that a sufficient number of individuals would be affected by the Action to cause population-level impacts.

Short-tailed Albatross

This wide-ranging, pelagic species may be susceptible to the effects of spill response activities in and outside of the dispersant-use preauthorization area. Direct exposure to dispersed oil or residual contamination following *in situ* burning may affect individuals present in the affected area or adults may carry contaminants back to breeding areas where chicks may be harmed. Potential impacts from spill response may include: impaired breathing or lung damage from the aspiration of dispersants, dispersed oil, or smoke inhalation following burning; degradation of the insulating properties of feathers following exposure to dispersants, resulting in hypothermia; and potential changes in abundance and composition of prey affected by oil and dispersant toxicity.

Molting birds may be particularly vulnerable to wetting of feathers (Stephenson 1997), while at the same time their energy demands may be elevated due to the cost of feather synthesis. Short-tailed albatrosses may molt in the Aleutian passes or the canyons of the outer continental shelf break where they may be at greatest risk of exposure due to relatively high numbers in these areas at certain times of the year.

Despite these potential risks, spill response actions are not likely to adversely many individuals. The scale of impacts from a hypothetical worst-case scenario analysis, which employed assumptions that likely overestimated impacts to albatrosses, suggest only an event 8.7 times larger than EVOS, and with adverse impacts specifically attributable to spill response actions would appreciably reduce the probability of survival and recovery of the short-tailed albatross. The likelihood of a spill of that size occurring is extremely low.

Polar Bear

Individual polar bears may be adversely affected during implementation of the Unified Plan. Impacts may arise from disturbance from aircraft or vessels, harassment during deterrence, direct exposure to dispersed oil, inhalation of smoke from *in situ* burning, and exposure to dispersed oil from feeding on scavenged carcasses. The severity of exposure will depend on any number of factors, not necessarily limited to the response activities: location and size of the spill; accessibility of the spill site; spill trajectory; time of year; weather conditions (i.e., wind, temperature, precipitation); environmental conditions (i.e., presence of ice); effectiveness of spill responses will influence impacts to polar bears.

Several factors related to their life history increase the level of risk to polar bears from spill response activities. The polar bear's curious nature may lead bears to approach spill response vessels and shore-based responders, causing safety concerns and resulting in deterrence efforts to prevent human/bear encounters. Bears may ingest dispersed oil while feeding on the scavenged carcasses of oiled seals or other animals. They may also encounter contaminated material at landfills, disposal sites, or other opportunistic foraging areas if waste materials are comingled with municipal wastes or disposed of in other inappropriate ways. The geographic distribution of polar bears overlap with significant oil and gas development in the Action Area, where spills are most likely to occur. On the North Slope, bears traverse areas of oil and gas development in the fall and during the ice-covered season when coming ashore to feed, den, or travel. Den emergence may be a time of particular vulnerability, as bears may be dehydrated, undernourished, or accompanied by a cub.

In rare circumstances, a large number of bears may be exposed to spill response activities. This could occur due to treatment of a large or prolonged spill with dispersants, resulting in a large spatial area affected. A prolonged spill response effort may also increase exposure as bears move through the affected area with changes in seasonal habitat use. Spill response near a high-density area, such as a village bone pile, could likewise increase the numbers exposed at certain times of the year. The largest level of exposure during a hypothetical worst-case scenario was estimated to be approximately 5.5% of the minimum global polar bear population size, thus the Action alone is not likely to cause population-level impacts.

Chronic exposure to contaminants is a concern for polar bears. Currently, the use of spill response techniques that contribute contaminants to the environment is extremely infrequent and does not raise concerns for cumulative exposures. Should dispersants be used repeatedly in one location, or their use generally become more common in the future, polar bears may be at greater risk of adverse effects. Chronic effects from extremely rare large scale events are possible. Spill response efforts involving collecting and removing oiled carcasses may reduce this risk. Chronic effects from small spills are unlikely due to the large home ranges and frequent movements of individual bears, as documented, for example by Pagano et al. (2012).

The current status of the polar bear in the Action Area is concerning, however. Declining survival rates, recruitment, body size, and recent low growth rate estimates for the SBS population suggest the population is declining. The A-C population status is uncertain, but may currently be faring better in the face of habitat loss from changes in sea-ice than the SBS population. With small population sizes and low reproductive rates, any loss of large numbers of polar bears (especially adult females) or prey species could exacerbate that decline. However, given the low likelihood of occurrence of large spills, the advancements in industry standards and regulatory oversight for blow-out prevention developed after DHS, and the differences in depth and pressures between the Gulf of Mexico and the southern Beaufort and Chukchi seas, the likelihood of significant impacts to the population from the Action is extremely low.

Pacific Walrus

Walruses exposed to direct, indirect, acute and chronic effects of spill response actions will respond variably, depending on the type of response action encountered. Exposure to dispersed oil, smoke, or residues from *in situ* burning may cause severe physiological impacts including neurotoxicity or reduced pulmonary and cardiovascular function. Acute exposure is likely to occur through inhalation of volatilized substances at the water surface. Chronic exposure may occur through the food chain. Walruses feed primarily on immobile benthic invertebrates, which may be affected by use of non-mechanical countermeasures; dispersed oil or *in situ* burn residues may smother or contaminate benthic invertebrates, causing loss of food resources, reduction in food quality, and bioaccumulation of contaminants. Acute adverse effects from spill response activities may arise from disturbances at haulouts. Large haulouts may contain tens of thousands of animals. Disturbances from aircraft, vessels, and onshore activities may cause a stampede, resulting in injury or death of hundreds of animals.

The walrus' tendency to congregate in large concentrations increases the potential for exposure to spill response activities occurring nearby. Large groups have been documented in the shallow waters of Hanna Shoal and in haulouts near Point Lay during summer, especially in recent years with low ice coverage. These areas are near the Chukchi Sea outer continental shelf oil and gas exploration area, and walruses may be exposed to spill response actions during oil exploration work. North Slope oil and gas development poses little risk to Pacific walruses, as they do not normally range into the Beaufort Sea, although individuals and small groups have occasionally been reported. Large groups have been observed in the southwestern Chukchi Sea along the coast of northern Chukotka during autumn (Jay et al. 2012). Although there are no existing oil and gas development or production activities in the Russian sector of Chukchi Sea, the region is thought to contain significant oil and gas reserves. In 2006, 3,700 km of seismic surveys were conducted in Russia's North and South Chukchi basins to explore for economically viable oil and gas reserves. Preliminary results were described as "very encouraging" (Frantzen 2007). Walruses using haulouts along the Bering Strait may be at greater risk in the future due to expanded Arctic shipping, but currently, the likelihood of spills in these areas is very low.

The number of walruses at risk from implementation of the Unified Plan depends on the scale of spill response, which is determined by the scale of the spill. Our evaluation of the consequences of the hypothetical worst-case scenario suggests spill response activities associated with a large-scale event must occur on a scale nearly 40% larger than the DHS to potentially jeopardize the species. Given the improbability of large spills, the high probability that most spill response actions will decrease the scale of impacts, and the low likelihood that if effects will be worsened by spill response (i.e., dispersant use), implementation of the Unified Plan is highly unlikely to cause population level impacts to walruses.

Measures identified in the Unified Plan and its Wildlife Protection Guidelines (ARRT 2012) will help to minimize risks to walruses during spill response. These include limitations on approach distances to haulouts for vessels and aircraft, guidance for use of deterrence techniques, and BMPs for avoiding use of dispersants near shore and near concentrations of wildlife. The recommendations developed during incident-specific consultation with Service biologists per the Interagency MOA (USCG et al. 2001) will be particularly valuable for reducing level of take during spill response.

Steller's Eiders

Exposure at the scale of a hypothetical, worst-case scenario could significantly affect the listed Steller's eiders population, as concluded in the Exposure Analysis, above. The potential for harm to individuals from spill response actions also exists, as described in the Response Analysis. Risk to Steller's eiders is mainly due to their small population size and higher exposure potential in some habitat areas at certain times of year. Due to the already low numbers, take of relatively low numbers of birds may have proportionally large effects on the population and this makes them vulnerable to stochastic events. Factors reducing risks to eiders include low probabilities of a spill where they congregate to molt, a dispersed population during times they do occupy areas with higher vessel traffic, a land-based nesting strategy, and a staged occupation of marine areas on the North Slope.

Apparent use of the KSCHU by a relatively large proportion of the listed Steller's eider population during molt increases the population-level risk. Though sample size is minimal, the best available evidence suggests that between one half and two thirds of the listed population uses this area during the flightless molting period. Three factors reduce risk in the KSCHU: low levels of current vessel traffic, a lack of current oil and gas development, and low human population sizes in this area. There are relatively few communities on the Y-K Delta, which limits vessel traffic. As described in the baseline section, low vessel traffic translates into low spill probability. Moreover, not all of the listed Steller's eider population molts in the KSCHU. The low likelihood of a large spill in this region combined with protective measures specified in the Unified Plan result in a low risk of harm to Steller's eiders in this CHU. However this low level of risk could change in the future, due to proposed development of a large-scale gold mine. Project proponents have identified transportation of large amounts of fuel and other hazardous materials via the Kuskokwim River as a possible project alternative (Donlin Gold 2015).

During winter, Alaska-breeding Steller's eiders inhabit harbors with significant levels of vessel traffic and industry, especially near Unalaska (Dutch Harbor), Akutan, Cook Inlet, and Kodiak. Baseline probability of spills is higher in and around these harbor areas. Nonetheless, the tendency of the listed Steller's eider population to disperse to different areas (rather than congregating in one area) during the winter reduces the probability of population level exposure from any one spill event. This tendency results in a low probability that Steller's eiders will experience substantial population-level exposure to spills and spill responses during winter. Their proximity to shipping corridors and population centers may further reduce risk by making spill response activities easier to implement (compared with more remote regions). As described above, many spill response activities are predicted to reduce rather than increase the risk of harm.

During the breeding season, Steller's eiders congregate in flocks in the near shore environment off the coast of northern Alaska where oil and gas exploration is ongoing. A factor reducing this risk is Steller's eiders occupancy of marine habitat is staged in time, such that the entire population does not occupy it at once (see Status of The Species section). This timing of occupancy limits the population level exposure potential. In order to harm a large fraction of the population, a large and long duration spill, such as a well blowout spill, would have to occur. This type of spill currently has an exceedingly low probability of occurrence.

Steller's eiders breed on land, which also reduces the probability of population level exposure during this life stage. Spills on land tend to be smaller than spills in the water, due to the lack of dilution in water or dispersion by currents. Due to the relatively small spatial extent of most land based spills, nesting Steller's eiders are likely to be much more widespread in space in comparison. Therefore, although oil spills on land may affect individuals during the nesting season, such an event is exceedingly unlikely to harm or take more than a few individuals of Steller's eiders.

The critical habitat analysis examines the relationship between population size for the listed Steller's eider populations, the size of existing CHUs, and carrying capacity. Steller's eider and sea otters eat many of the same food resources. Please refer to the Sea Otter Risk Analysis section above for a discussion of effects of spill response on food resources including marine invertebrates.

Population sizes of listed Steller's eiders on the breeding grounds have declined (based on historic estimates) which led to their ESA designation (see status of the species section). The population size is determined, in part, by the quality and quantity of physical habitat and available food resources. Factors like frequency and intensity of adverse conditions and the abundance of predators and competitors influence an area's carrying capacity. When we apply the "Destruction or Adverse Modification" standard, we think in terms of the ecological function or "ecological carrying capacity" of the designated area. We ask whether direct or indirect effects of the proposed Action are likely to reduce the "carrying capacity", where the "carrying capacity" of the entire designation is the sum of the carrying capacities of the various sub-units. Ecological carrying capacity is defined as the population size an area can indefinitely sustain or as the environment's maximal load (Hui 2006). We considered if the activities in the Unified Plan would substantially reduce the quality and quantity of Steller's eider critical habitat such that it would reduce carrying capacity.

A reduction in the ability of the critical habitat to support the population, i.e., a reduction in carrying capacity, could be an indicator of adverse modification of the habitat. The small population sizes of breeding Steller's eiders in Alaska suggest that their populations are highly unlikely to be close to the carrying capacity of the relatively large critical habitat areas designated for their use. Moreover, these areas are in relatively pristine ecological condition. By this logic, a relatively large proportion of the critical habitat area would need to undergo substantial degradation from its present condition to reduce the ecological carrying capacity, e.g., the function of the critical habitat as a whole and the conservation role that it provides for Steller's eiders. This is highly unlikely, given the current depressed population status and the large availability of these ecologically intact habitat units.

Spectacled Eiders

Spectacled eiders experience higher risks than other listed species due to higher exposure potential for the entire listed species while wintering in the CHU south of St. Lawrence Island. Spectacled eiders from all three breeding populations— the entire known global population of spectacled eiders—winter in open water leads in the pack ice in the Bering Sea between St. Lawrence and St. Mathews Islands. The probability of spills and associated response actions in the wintering area in the polynyas and lead complexes south/southwest of St. Lawrence Island is minimal, because most ships cannot or do not transit through the pack ice during winter. Currently, there is no planned oil or gas development in the area and limited shipping in winter due to extensive sea-ice. A main factor reducing the risk of population-level exposure for spectacled eiders is that the probability of spills in areas they frequent is low, making them highly unlikely to be exposed to a spill or the response action.

We also considered the risk that the Action could destroy or adversely modify the CHUs for spectacled eiders. Spill responses occurring during any time of year could affect the spectacled eider wintering CHU in the Bering Sea between St. Lawrence and St. Matthew Island. The PCEs here include all marine waters that are 75 m (246.1 ft) or less in depth, along with associated marine aquatic flora and fauna in the water column and the underlying marine benthic community. Spill responses reducing quality or abundance of benthic invertebrates will result in a reduced quality of the critical habitat for the eiders. The frequency of vessel traffic through the area is higher than in summer, particularly by fishing vessels, but there are no important shipping routes, large urban centers, large industrial facilities, or oil development. Thus, the likelihood of a very large spill response action occurring in the area is very low and incapable of significantly reducing the forage value in the CHU.

Offshore oil and gas development in the Southern Beaufort and Chukchi seas increases the probability of spectacled eiders exposure to spill response actions near North Slope habitats in the summer. Birds stage near offshore oil and gas development before and after the breeding season. Probability of exposure varies with the amount of time spent in the area and the locations used. Males are less likely to spend time in this staging area than females, and when they do stage here, males use areas closer to shore. Land-based oil development on the North Slope increases the probability of exposure of nesting birds to spills in this region. Oil development is gradually spreading westwards across the North Slope from the original hub at Prudhoe Bay; expansion of industrial development is likely to continue. As with Steller's eiders, spills on the terrestrial nesting habitat may affect individuals, but will generally have a limited ability to spread beyond the immediate spill area and are not likely to be increased in size due to response activities, and thus have very low likelihood of affecting many nesting birds.

A substantial portion of the Ledyard Bay Critical Habitat Unit (LBCHU), designated for molting spectacled eiders overlaps with the Chukchi Sea oil and gas exploration area. Spill response activities, especially dispersant use in the Chukchi Planning Area could reach the molting spectacled eiders and potentially affect the physical and biological features of this CHU. Factors associated with the low risk are that most spills projected to occur from oil and gas development are expected to be of low volume. Small spills would have to occur directly adjacent to or within the LBCHU to affect the habitat or the eiders. Currents would generally push spills or dispersed oil in this area northward. As such, risks of impacts from spill response actions in the LBCHU are minimal.

The Y-K Delta breeding population molts and stages in eastern Norton Sound. Currently, there is no oil and gas development and limited vessel traffic in the Y–K delta region or in Norton Sound. Similar to Steller's eiders, the population declines on the breeding grounds suggest that the relatively large and ecologically intact critical habitat areas are likely to have a much higher carrying capacity than the population they support at present. For this reason, a relatively large proportion of the critical habitat area would need to undergo substantial degradation from its present condition to reduce ecological carrying capacities of these areas. Low probabilities of spills in these areas lead us to the conclusion that activities in the Unified Plan are not likely to reduce the quality and quantity of spectacled eider critical molting and breeding habitat.

These factors combine to make the risk of the Action to spectacled eiders exceedingly low. A low probability of exposure (due to low vessel traffic and low spill probability), coupled with a high probability of harm (where the entire population to be exposed) still results only in moderate risk. At this point, we must also consider the possible responses to spill response activities. To determine that the Action would jeopardize the population, there must be evidence to suggest that activities associated with a response to a worst-case scenario spill would result in population level impacts above and beyond the spill itself. Our review of the best available science in the response analysis does not lead us to this conclusion.

Risk Characterization Conclusions

The probability that Alaska's listed species could be exposed to spill response actions at a spatial or temporal scale capable of affecting a sufficient number of individuals to have consequences for entire populations is extremely low. Steller's and spectacled eiders have greater potential for exposure levels of consequence to the listed populations due to their concentrations on the wintering or breeding habitats and because of their small population size to begin with (Steller's eiders). However, because most spills are small, exposure to impacts of the Action will most often be temporary and localized, occurring near the spill site, and affecting only a few individuals—far fewer than necessary for population-level effects. However, our review of the risks to listed species and critical habitat has revealed various geographic areas or time periods at which species may be particularly sensitive to effects of spill response. These are shown in Table 10. For example, we identified potential impacts from a short-term, yet massive spill with use of dispersants to sea otters in the Kodiak, Kamishak, and Alaska Peninsula CHU to be concerning, because this may be the most stable portion of the listed population and provides a buffer against impacts to the rest of the population. Because such an event is extremely unlikely, the resulting risk would be considered low to moderate. Risks for other species are likewise described.

Spill response activities may have adverse impacts to individuals ranging from loss of food resources (an indirect effect) to stress from capture and handling (a direct effect). Spill response actions may also be beneficial, particularly the actions conducted under the Unified Plan which prevent spills and reduce their size. Most of the actions implemented under the Unified Plan, given the situations most likely to trigger those actions, are intended to improve environmental protection, including protection of listed species and critical habitat.

Various factors, including logistical constraints, environmental factors, decision-making processes, BMPs and impact avoidance measures, all influence the risk of adverse effects by either altering the probability of exposure or the species' response. The Service recognizes the considerable benefits of the Unified Plan, but acknowledges that adverse effects to individuals of listed populations are likely to occur as a result of the activities proposed. However, we conclude, based on the baseline and the status of the species, there are no likely situations in which implementation of the Unified Plan (apart from and in addition to any impacts of a spill) could result in severe and widespread exposure to harmful activities sufficient to threaten the continued existence of a species.

Table 10. Risk summary table. This table highlights potential situations of concern for listed species and critical habitat.

Species	Sensitive Habitat Area	Event	Location	Frequency of event(s) needed to generate Risk	Scale of event(s) needed to generate Risk	Duration of event(s) needed for Risk	Severity of risk given frequency, scale, duration	Likely-hood of occur-rence	Explanation
Sea Otter	Kodiak, Kamishak Alaska Peninsula Critical Habitat Unit	Massive spill response with dispersants	South-central Alaska	Infrequent	Extreme	Short	Low/Moderate	Extremely unlikely	Otters in the Kodiak, Kamishak, and Alaska Peninsula Critical Habitat Unit are the most stable portion of the listed population. They may be of particular importance as a buffer against baseline stressors
Short-tailed albatross	Aleutian Passes	Medium Spills response with dispersants	Aleutian Islands	Repeated	Moderate	Short	Low/Moderate	Moderate	Short-tailed albatross molting in the passes may experience additional mortality due to accumulation of toxins if exposed repeatedly over time
Spectacled eider	Norton Sound, Ledyard Bay	Medium Spills response with dispersants	Chukchi, Bering Sea	Infrequent	Large	Short	Moderate	Unlikely	Large numbers of spectacled eiders congregate in the molting areas
Spectacled eider	Winter Habitat S. of St. Lawrence	Large Spill response with dispersant, in-situ burning	Bering Sea	Infrequent	Large	Medium	High	Unlikely	The entire population of spectacled eiders overwinter in this area and if exposed to large-scale, high intensity or repeated spill response events may suffer severe impacts
Steller's eider	North slope nesting habitat	Large spill response	North Slope	Repeated	Moderate	Short, during nesting	Moderate	Moderate	Spill response activities during nesting could cause nest failures, which may have population-level effects if repeated
Steller's eider	Kusko-kwim shoals	Large Spill response with dispersants	Bering Sea	Infrequent	Moderate	Short, during staging or migration	Moderate	Unlikely	High concentrations of listed Steller's eiders are present in this Critical Habitat Unit
Steller's eider	Barrow nearshore	Medium spill response with dispersants	North Slope	Repeated	Moderate	Long	Moderate	Unlikely	Spill response activities in staging areas following the breeding season could affect a high proportion of the population if events are repeated or occur over an extended time period.
Pacific walrus	Hanna Shoal, Point Lay	Large Spill response with dispersants	Beaufort Sea	Repeated	Large	Short or long	Moderate	Moderate	Walrus in this area may accumulate toxins, particularly if large scale spill response is repeated periodically, resulting in impacts to multiple generations.
Pacific walrus	NE Chukotka Peninsula	Large Spill response with dispersants	Southern Chukchi Sea	Infrequent	Large	Short or long	Low/Moderate	Unlikely	Walrus aggregate as the ice begins to move south, increasing vulnerability of the species
Polar bear	Coastal Alaska Denning habitat, sea ice	Massive Spill response with dispersants	Chukchi Sea, Bering Sea	Infrequent	Extreme	Long	Low/Moderate	Unlikely	Polar bears may be at risk when exposed to extreme widespread dispersed oil

5.4 Effects Analysis Conclusions

The literature on the effects of spill response activities indicates there are tradeoffs in the environmental impacts of spill response. Under some scenarios, including dispersant use, spill response may be worse than the spill itself. In other scenarios, spill response actions have demonstrably improved the outcome from that of an unmitigated oil spill. The best available information leads us to conclude that effects of the proposed actions in the Unified Plan are of low population-level risk to all listed species considered (Table 11).

Table 11. Effects Analysis Conclusions Table.

Listed Species/ Critical Habitat	Exposure Analysis	Response Analysis	Risk Characterization	Conclusion
Sea Otter	Worst-case scenario insufficient to cause concerns for survival and recovery of species	Spill response actions may cause take	Moderate risk of effects to individuals, extremely low likelihood of impacts to listed species	The Action is not likely to Jeopardize listed species
Sea Otter Critical Habitat	Worst-case scenario insufficient to cause significant decline in conservation value of critical habitat	Spill response actions may reduce physical and biological habitat features important to the species	Moderate risk of effects to local habitat areas, extremely low likelihood of impacts to critical habitat as a whole	The Action is not likely to adversely modify critical habitat
Short-tailed albatross	Worst-case scenario insufficient to cause concerns for survival and recovery of species	Spill response actions may cause take	Moderate risk of effects to individuals, extremely low likelihood of impacts to listed species	The Action is not likely to Jeopardize listed species
Polar bear	Worst-case scenario insufficient to cause concerns for survival and recovery of species	Spill response actions may cause take	Moderate risk of effects to individuals, extremely low likelihood of impacts to listed species	The Action is not likely to Jeopardize listed species
Pacific walrus	Worst-case scenario insufficient to cause concerns for survival and recovery of species	Spill response actions may cause take	Moderate risk of effects to individuals, low likelihood of impacts to listed species	The Action is not likely to Jeopardize listed species
Spectacled eider	Worst-case scenario could cause jeopardy	Spill response actions may cause take	Moderately high risk of effects to individuals, low likelihood of impacts to listed species as a whole	The Action is not likely to Jeopardize listed species
Spectacled eider Critical Habitat	Worst-case scenario could degrade conservation value of habitat	Spill response actions may reduce physical and biological habitat features important to the species	Low risk of effects to local habitat areas, extremely low likelihood of impacts to critical habitat as a whole	The Action is not likely to adversely modify critical habitat
Steller's eider	Worst-case scenario could cause jeopardy	Spill response actions may cause take	Moderately high risk of effects to individuals, low likelihood of impacts to listed species as a whole	The Action is not likely to Jeopardize listed species
Steller's eider Critical Habitat	Worst-case scenario could degrade conservation value of habitat	Spill response actions may reduce physical and biological habitat features important to the species	Moderately high risk of effects to local habitat areas, low likelihood of impacts to critical habitat as a whole	The Action is not likely to adversely modify critical habitat

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6.0 CUMULATIVE EFFECTS

Cumulative effects are the effects of future State, tribal, local or private actions that are reasonably certain to occur in the Action Area. Future Federal actions that are unrelated to the proposed action are not considered in this section if they require separate consultation pursuant to section 7 of the ESA.

6.1 Further Oil and Gas Development

Further oil and gas development, including a proposed natural gas line, whether in Federal or State waters or in the terrestrial environment on State, private, Native-owned, or Federal lands, would require Federal permits (such as section 404 of the Clean Water Act authorization from the U.S. Army Corps of Engineers (COE), and National Pollution Discharge Elimination System permits from the Environmental Protection Agency) and, therefore, are not considered cumulative impacts under the ESA.

6.2 Community Growth

Community growth is anticipated to continue in many places statewide (U.S. Census Bureau 2013). The spatial footprint and population sizes of many cities and villages will likely increase, along with associated infrastructure such as roads, power lines, communication towers, landfills, and gravel pits. These activities may impact listed species. The scale of impacts will depend not only on the amount of growth, but the location in relation to habitat of listed species. As the human population grows, so does the probability of impacts to listed species and critical habitat. Community growth may be most important to the listed Steller's eiders given the proximity of important habitat areas to existing communities. Many of the activities that may affect these habitats require Federal permits and are not considered cumulative impacts, but other activities may cause disturbance or impact the quality of habitat.

6.3 Commercial Fishing

Reduction in the extent and duration of sea-ice may increase the potential for commercial fishing, but the likelihood and magnitude of these activities are unknown at this time. Under the Arctic Fisheries Management Plan, NMFS currently has prohibited all commercial fishing in the Arctic. Commercial fishing is an important industry in the Bering Sea. Commercial fisheries in the Action Area are managed by the North Pacific Fisheries Management Council and the NMFS, and the issuance of regulations require section 7 consultations. These activities, therefore, are not considered cumulative effects.

6.4 Increased Marine Traffic

Increased marine traffic could impact listed species through disturbance, collisions, and more significantly from accidental fuel spills. In the Chukchi and Beaufort seas, decline in the extent of Arctic sea-ice in the summer and increase in the length of the ice-free season has prompted interest in shipping within and through Arctic waters via the Northwest Passage (Brigham and Ellis 2004). Ships operating, or that could operate in the area, include military vessels, pleasure craft, cruise ships, barges, scientific research vessels, and vessels related to oil, gas, or mineral development. The potential increase in the number of vessels operating in Arctic waters has been matched by an increase in USCG activities. The USCG conducted a number of major exercises in Arctic waters in recent years for which section 7 consultations were conducted.

Shipping through the Northwest Passage could involve routes through the Bering Sea as well as Arctic waters. However, we have no data on the number of vessels that may operate in these waters, the routes that may be selected, or the magnitude of potential risk they pose. In addition, all international commercial shipping currently taking place utilizes the Northern Sea Route in Russian waters, not the Northwest Passage that includes U.S. waters. As more information becomes available, we will consider these impacts in future section 7 consultations.

Thousands of vessels transit the Great Circle Route through the Aleutians each year and the level of use is expected to double into the next several decades (Nuka 2005). DNV and ERM (2010) conducted an evaluation of existing and future spill risk through the Aleutians. Using models incorporating the frequency of use, the occurrence and consequences of spills, and projected future conditions, they estimated the amount of material spilled to increase by 48–83% by 2034 and frequency of accidents to increase by 11%. However, the average amount of material spilled per accident is expected to decline due to increasing numbers of vessels with double hulled protection (required for new tankers) (DNV and ERM 2010b). Increased spill risk in the Aleutians will increase baseline risk of contaminant exposure for listed species. New and improved risk reduction measures have been proposed and would benefit listed species (Nuka 2005; See Recommendations Section).

6.5 Increased Scientific Research

Interest in scientific research across the Action Area is increasing as concerns about effects of climate change grow. While research is often conducted by universities and private institutions, many activities are funded by the National Science Foundation or operate from U.S. Coast Guard vessels and are therefore considered in other section 7 consultations.

6.6 Subsistence Harvest

Subsistence harvest of polar bears, sea otters, and walruses are expected to continue in the Action Area in the future. The Service will continue to work with Native groups and others nationally and internationally to participate in the management of subsistence harvest in order to minimize potential for these impacts to alter the probability of continued survival of the species.

7.0 CONCLUSIONS

Section 7(a)(2) of the ESA requires Federal agencies to ensure that their activities are not likely to: (1) jeopardize the continued existence of listed species; or (2) result in the destruction or adverse modification of designated critical habitat. In addition, the lead Federal agencies have requested conference for the Pacific walrus, a candidate species. We have evaluated the effects of the Action on sea otters, short-tailed albatrosses, spectacled and Steller’s eiders, polar bears, and Pacific walruses to ensure that their continued existence will not be jeopardized. A conclusion of “jeopardy” for an action means that the action could reasonably be expected to reduce appreciably the likelihood of both the survival and recovery of the species. A conclusion of "adverse modification" means that the action could reasonably be expected to appreciably diminish the value of critical habitat for the survival and recovery of this species.

This programmatic consultation, evaluates the decision-making processes incorporated into the Unified Plan; we determine if they are sufficient to identify and prevent individual spill response actions likely to increase the extinction risks of endangered or threatened species or reduce the value of designated critical habitat for the conservation of those species. To do this, we considered the impacts of typical spill response actions, and assessed the impacts relating to the scale of exposure during a spill response by considering a hypothetical worst-case scenario oil spill. We also considered the benefits of BMPs, preventative measures, incident-specific consultation during a spill response, and other risk-reducing factors. Our conclusion is based on the comprehensive consideration of direct and indirect effects of the Action, interdependent and interrelated actions, and cumulative effects considered against the environmental baseline and status of the species. We concluded that the effects of the Action alone are largely beneficial to listed species, although not wholly beneficial; incidental take of individuals from listed species is likely to occur on an incident-specific basis. Our rationale for each listed species follows:

7.1 Sea otter

It is the biological opinion of the Service that **the proposed action will not jeopardize the southwest DPS of northern sea otters and will not result in adverse modification of designated critical habitat**. This opinion is based on the following evidence:

- Because of the current population size, widespread distribution, and recent stabilizing population trends of some portions of the listed entity, an extremely large spill response event would have to occur before enough animals could be affected to impact the listed species as a whole.
- The expanse of designated critical habitat makes it unlikely that actions implemented under the Unified Plan would reduce the value that the critical habitat as a whole provides to the conservation of the species.
- The hypothetical worst-case scenario spill, combined with the spill response activities likely to be conducted for an event of that scale would not impact a sufficient portion of the listed population to lower the probability of survival or recovery of the species.
- Typical spill response actions will be relatively small in scale. These events will have only localized impacts to the PCEs of habitat (including food resources, shallow nearshore areas, and kelp beds) and will affect a limited number of animals.
- The likelihood of large spill response actions, which may have extensive impacts to large numbers of otters and areas of habitat, is extremely low.
- During a large spill response event, the initiation of section 7 consultation per the Interagency MOA will trigger incident-specific involvement from the Service. Any necessary and feasible actions to prevent spill response activities from jeopardizing the sea otter or adversely modifying critical habitat will be implemented at that time.
- Critical habitat for the sea otter is not within the preauthorization zone for use of dispersants. The Service will provide additional review and recommendations prior to use of dispersants which may affect otters, thereby reducing risks to this species.

- The beneficial effects of spill prevention and response actions specified in the Unified Plan are likely to have an impact on large numbers of sea otters.

7.2 Short-tailed Albatross

It is the Service's biological opinion that **the implementation of the Unified Plan will not jeopardize the survival and recovery of the short-tailed albatross in the wild**. No critical habitat has been designated for this species; therefore, none will be affected. This opinion is based on the following evidence:

- Because of the current population size, increasing population trend, and widespread distribution of this species, an extremely large spill response event would have to occur before enough animals could be affected to impact the listed species as a whole.
- The hypothetical worst-case scenario spill and the spill response activities likely to be conducted for an event of that scale would not impact a sufficient portion of the listed population to lower the probability of survival or recovery of the species.
- Typical spill response actions will be relatively small in scale. These events will have only localized impacts to a limited number of animals.
- The likelihood of large spill response actions, which may have extensive impacts to large numbers of animals, is extremely low.
- During a large spill response event, the initiation of section 7 consultation per the Interagency MOA will initiate incident-specific involvement from the Service. Any necessary and feasible actions to prevent spill response activities from jeopardizing the species or adversely modifying critical habitat will be implemented at that time.
- Areas frequently used by the short-tailed albatross have been excluded from the dispersant use preauthorization zone (see Appendix D). The Service will provide additional review and recommendations prior to use of dispersants during most spills, thereby reducing risks to the albatross.
- The beneficial effects of spill prevention and response actions specified in the Unified Plan are likely to have an impact on large numbers of short-tailed albatross.

7.3 Spectacled Eider

It is the Service's biological opinion **that the Action, as proposed, is not likely to jeopardize the continued existence of the spectacled eider or adversely modify spectacled eider critical habitat**. This conclusion is based on the following factors:

- Because of the current population size, stable population trends, and widespread distribution of this species outside of the wintering area, there is a very low likelihood that impacts from spill response activities would affect enough animals to impact the listed species as a whole.
- The likelihood of spills and associated spill response actions in the wintering area is extremely low due to its geographic location away from shipping lanes, urban and industrial centers, and oil and gas development.
- Typical spill response actions will be relatively small in scale. These events will have only localized impacts to a limited number of animals.
- Typical spill response actions will be small in scale and will have only localized, temporary impacts affecting the PCEs of critical habitat (which include open water and

adjacent vegetated habitats used for nesting, and marine waters with invertebrate food resources). Thus, it is unlikely that actions implemented under the Unified Plan would reduce the value that the critical habitat as a whole provides to the conservation of the species.
- The likelihood of large spill response actions, which may have extensive impacts to large numbers of animals and large areas of critical habitat, is very low.
- If spill response activities are to occur within the range of spectacled eiders, initiation of section 7 consultation per the Interagency MOA will trigger incident-specific involvement from the Service. Any necessary and feasible actions to prevent spill response activities from jeopardizing the species or adversely modifying critical habitat will be implemented at that time.
- Critical habitat and other important habitat areas for the spectacled eider are not within the preauthorization zone for use of dispersants. The Service will provide additional review and recommendations prior to nearly all uses of dispersants which may affect eiders, thereby reducing risks of negative impacts.
- The beneficial effects of spill prevention and response actions specified in the Unified Plan are likely to have an impact on large numbers of spectacled eiders.

7.4 Steller's eider

It is the biological opinion of the Service that **the proposed action will not jeopardize the Steller's eider and will not result in adverse modification of designated critical habitat**. The following points summarize our evaluation:

- Because of the widespread winter distribution of this species, it is very unlikely that impacts from spill response in those wintering areas would affect enough animals to impact the listed species as a whole.
- The tendency for Steller's eiders to stage near North Slope oil and gas development areas in phases rather than all together makes it unlikely that all but a large or ongoing spill response effort may affect more than a few individuals.
- The existing low level of development and transportation in staging and molting areas in the Kuskokwim Shoals CHU makes it unlikely that spill response actions in this area will affect more than a few individuals, and therefore will likely have negligible population-level effects.
- Typical spill response actions will be relatively small in scale. These events will have only localized impacts to the PCEs of critical habitat (including small lakes, ponds, and pools and nearby nesting habitats, and shallow marine waters with invertebrate food resources and/or eelgrass beds) making it unlikely that actions implemented under the Unified Plan would reduce the value that the critical habitat as a whole provides to the conservation of the species.
- Typical spill response actions will be small, with the potential to affect only a limited number of animals, and would not impact a large enough portion of the listed population to lower the probability of survival or recovery of the species.
- The likelihood of large spill response actions, which may have extensive impacts to large numbers of animals and large areas of critical habitat, is extremely low.

- During any spill response event that may affect the species, initiation of section 7 consultation per the Interagency MOA will trigger incident-specific involvement from the Service. Any necessary and feasible actions to prevent spill response activities from jeopardizing the species or adversely modifying critical habitat will be implemented at that time.
- Critical habitat and other important habitat areas for the Steller's eider are not within the preauthorization zone for use of dispersants. The Service will provide additional review and recommendations prior to nearly all uses of dispersants which may affect eiders, thereby reducing risks of negative impacts.
- The beneficial effects of spill prevention and response actions specified in the Unified Plan are likely to have an impact on large numbers of Steller's eiders.

7.5 Pacific Walrus

The Service's biological opinion regarding the implementation of the Unified Plan is that it will not jeopardize the survival and recovery of the Pacific walrus. No critical habitat has been designated for this species; therefore, none will be affected. This opinion is based on the following evidence:

- Because of the current population size and widespread distribution of this species, an extremely large spill response event would have to occur before enough animals could be affected to impact the Pacific walrus as a whole.
- The hypothetical worst-case scenario spill, combined with the spill response activities likely to be conducted for an event of that scale would not impact a sufficient portion of the population to lower the probability of survival or recovery of the species.
- Typical spill response actions will be relatively small in scale. These events will have only localized impacts to a limited number of animals.
- The likelihood of large spill response actions, which may have extensive impacts to large numbers of animals and result in population-level consequences, is extremely low.
- During a large spill response event, the initiation of section 7 consultation per the Interagency MOA will trigger incident-specific involvement from the Service. Any necessary and feasible actions to prevent spill response activities from jeopardizing the species or adversely modifying critical habitat will be implemented at that time.
- Important habitat areas such as haulouts and foraging area are not within the preauthorization zone for use of dispersants. The Service will provide additional review and recommendations prior to use of dispersants which may affect walruses, thereby reducing risks to this species.
- The beneficial effects of spill prevention and response actions specified in the Unified Plan are likely to have an impact on large numbers of Pacific walrus.

7.6 Polar Bear

The Service concludes that the Action, as proposed, is not likely to jeopardize the continued existence of the polar bear. No critical habitat for this species is designated at this time; therefore, none will be affected. This conclusion is based on the following factors:

- Based on the current population size and widespread distribution of this species, an extremely large spill response event would have to occur before enough animals could be affected to impact the species as a whole.
- The hypothetical worst-case scenario spill, combined with the spill response activities likely to be conducted for an event of that scale would not impact a sufficient portion of the population to lower the probability of survival or recovery of the species.
- Typical spill response actions will be relatively small in scale. These events will have only localized impacts to a limited number of animals.
- The likelihood of large spill response actions, which may have extensive impacts to large numbers of animals, is extremely low.
- During a large spill response event, the initiation of section 7 consultation per the Interagency MOA will trigger incident-specific involvement from the Service. Any necessary and feasible actions to prevent spill response activities from jeopardizing the species or adversely modifying critical habitat will be implemented at that time.
- The dispersant use preauthorizatioin areas do not overalap with the range of the polar bear. Therefore the Service will provide additional review and recommendations prior to use of dispersants which may affect polar bears, thereby reducing risks to this species.
- The beneficial effects of spill prevention and response actions specified in the Unified Plan are likely to have an impact on large numbers of polar bears.

Although the Service concludes the Action is not likely to jeopardize the continued existence of listed species and is not likely to destroy or adversely modify critical habitat, considerable uncertainty exists regarding the type, location, and magnitude of activities that may result from the Action. Our conclusion assumes: 1) the hypothetical worst-case scenarios developed for this analysis do not underestimate the level of impact that could actually occur because of spill response activities; 2) the BMPs and impact avoidance and minimization measures within the Unified Plan are fully implemented; and 3) other assumptions used for the analysis in this BO are valid. If changing conditions prove these assumptions wrong and suggest impacts to listed species or critical habitat have been underestimated, it may be necessary to reinitiate section 7 consultation in accordance with 50 CFR 402.16.

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8.0 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The Service provides the following conservation recommendations:

1. This section 7 consultation has highlighted the need for cross-agency staff training and expertise in oil spill response. Lack of staff resources could limit the information readily available during a spill, and hinder the FOSC’s ability to make informed decisions

regarding threatened and endangered species. We recommend that the EPA and USCG work with the Service to identify and develop additional means for increasing the Service's capacity to respond during a spill.

2. Annual meetings of the ARRT should assess the previous year's spill response activities, consider avoided and realized impacts to listed species and critical habitat, evaluate effectiveness of incident-specific and emergency consultation processes, and review progress in addressing conservation recommendations in this BO. A summary report of findings should be provided to the Service.
3. When operating marine vessels during spill response, all operators should abide by "Boat Operation Guidance to Avoid Disturbing Sea Otters," included in Appendix B.
4. The ARRT should develop site-specific Ecological Risk Assessments (Aurand et al. 2000) for threatened and endangered species and sensitive habitat areas listed on Table 10 (Sensitive Habitat Areas in Effects Section). The Service should be involved in the preparation of the Risk Assessments that would inform the development of strategies to minimize impacts. Risk Assessments should be incorporated into SCPs and the Service should be notified of their completion.
5. The following recommendations are considerations to improve the use and availability of decision-making tools when dispersants are being considered
    a. Information on toxicity and effectiveness of dispersant formulations should be incorporated into SCPs or the Dispersant Use Plan to provide decision makers with the best available science on which to base incident-specific decisions. This information should include: effects on the range of organisms and habitats likely to be impacted by dispersants in specific regions; effects from real-world quantities and application methods; environmental effects not captured in acute toxicity studies, such as sublethal, synergistic, and long-term effects; and specific application instructions or regional use restrictions.
    b. Information should be updated regularly to address changes to the EPA's dispersant schedule, new scientific literature, and other sources of new information.
    c. Information incorporated into SCPs or the Dispersant Use Plan should include sufficient information on the dispersants to determine whether the combination of dispersant and oil (or other hazardous product) will increase or decrease the persistence, bioaccumulation potential or toxicity relative to the dispersant alone. Data should also be sufficient to determine the potential for dispersants to persist or accumulate, or to contribute to short- and long-term adverse effects in the region of use.
    d. Data incorporated into SCPs or the Dispersant Use Plan should help the team to determine whether and under what circumstances use of the dispersant will cause less harm to wildlife and the environment than responding to the oil spill without use of the dispersant.
    e. EPA and USCG should recommend the use of only the most effective, least toxic dispersants available when threatened and endangered species may be affected.
6. Due to the large numbers of walruses that could be encountered in the Hanna Shoal area from July through September, additional mitigation measures, such as seasonal restrictions, reduced vessel traffic, or rerouting vessels, may be appropriate for activities

within this area. Service biologists should be consulted prior to use of dispersants in these areas. We recommend EPA and USCG continue coordinating and planning with the Service on this issue.

7. Important areas for short-tailed albatrosses have been identified outside of the preauthorization zone, particularly along the continental shelf edge in the Gulf of Alaska and Bering Sea, and on both sides of the Aleutian Archipelago. Specific areas of concentration include the great canyons of the western Bering shelf, especially Zhemchug and St. Matthews canyons, Ingenstrem Rocks (Buldir Pass) in the western Aleutians, near Seguam Pass in the central Aleutians, Near Strait, Samalga Pass, and the shelf-edge south of Umnak/Unalaska islands (Piatt et al. 2006). Service biologists should be consulted prior to use of dispersants in these areas.
8. Potential effects of oil spill preparedness drills and other pre-spill activities on listed species and critical habitat should be evaluated through section 7 consultation.
9. Service biologists should be consulted prior to use of dispersants in important molting and wintering areas. Service biologists should be contacted to identify these areas when a spill occurs. The Service's Information, Planning, and Conservation (IPaC) IPaC decision support system (https://ecos.fws.gov/ipac/) can be a helpful tool to identify important habitat locations if a Service biologist is not immediately available.
10. A no transit zone for vessel traffic should be established in winter in spectacled eider critical habitat south/southwest of St. Lawrence Island similar to the voluntary no traverse zone in eastern Norton Sound during molt.
11. To better document initiation and conclusion of emergency section 7 consultation during and after an incident, we recommend including the standardized emergency consultation form, which was developed by the Services, as an appendix to the Unified Plan.
12. We recommend working with the Service to clarify State and Federal authorizations and requirements required for response organizations to conduct hazing and capture during a spill. This information could be used to update Annex G, Wildlife Protection Guidelines.
13. Calculate/estimate the carbon footprint of a spill activity and add to the factors considered when determining go or no go on an action.

9.0 INCIDENTAL TAKE

Take of endangered or threatened species may occur when a site-specific response or action is undertaken in compliance with requirements of the Unified Plan. These site specific actions will be subject to additional section 7 consultation and incidental take statements, as appropriate, during and following a spill event, as per the Interagency MOA outlining procedures to streamline ESA compliance before, after, and during spill response (USCG et al. 2001).

Although we have evaluated the general nature of the effects of the Unified Plan on listed species, we cannot fully assess the potential effects of specific future actions under the Unified Plan because information on the location, timing, design, and other aspects of these actions are not available at this time. Consequently, we cannot provide an exemption from the prohibitions against take, as described in section 9 of the Act, for the incidental take that may result from these future actions that require separate review and authorization by USCG and EPA. We will review the effects of those actions, and through emergency section 7(a)(2) consultation, issue incidental take statements in the future, if appropriate, when formal consultation is requested on specific discretionary actions. It is appropriate to defer incidental take in the context of a consultation that evaluates a broad program that sets bounds on future site-specific activities.

Spill drills and other preparedness activities are the only actions conducted under the Unified Plan that are not eligible for emergency consultation and therefore must be consulted on separately if they may affect listed species. Contact the Service for consultation on these actions. In the event the action agencies propose any other site-specific action under the Unified Plan that is likely to cause take of a listed species, but is not eligible for incident-specific emergency consultation, consultation on the Unified Plan should be reinitiated.

10.0 REINITIATION STATEMENT

This concludes consultation on the proposed action. 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) new information reveals effects of the action that may affect listed species or critical habitat in a matter or to an extent not considered here; (2) the action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this evaluation; or (3) a new species not covered here is listed or critical habitat designated that may be affected by this action.

Modifications listed below would constitute changes to the proposed action that may cause impacts not considered in this BO and trigger reinitiation. This is not intended to be a comprehensive list of all modifications that could warrant reinitiation, additional triggers are possible:

1. Changes in the dispersant formulations approved for use in Alaska.
2. Changes to the area designated as preauthorized for dispersant use other than the approval of avoidance areas for the protection of listed species.

Consultation should be reinitiated when the Unified Plan is updated or every five years, whichever occurs first, unless no substantial changes in the status of listed species, existing and baseline, proposed action, or potential effects have occurred. This period is intended to match the normal 5-year schedule for updates to the Unified Plan.

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11.0 LITERATURE CITED

The Service has done our best to ensure this list is complete, but please contact us in the case of missing references.

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[Top]

APPENDIX A. STATUS OF THE SPECIES

Northern sea otter

Species Description

The southwestern Alaska Distinct Population Segment (DPS) of the northern sea otter was listed as threatened on August 9, 2005 due to population declines documented in the 1980s and 1990s (70 FR 46366). The sea otter is a mammal in the family Mustelidae and it is the only species in the genus *Enhydra*. Three subspecies are recognized: 1) the Asian northern sea otter (*E. l. lutris*), which occurs west of the Aleutian Islands; 2) the southern sea otter (*E. l. nereis*), which occurs off the coast of California and Oregon; and 3) the Alaskan northern sea otter (*E. l. kenyoni*), which occurs from the west end of the Aleutian Islands to the coast of the State of Washington (Wilson et al. 1991). Adult males average 130 cm (4.3 ft) in length and 30 kg (66 lb) in weight; adult females average 120 cm (3.9 ft) in length and 20 kg (44 lb) in weight (Kenyon 1969). Sea otters lack blubber and depend entirely upon their fur for insulation (Riedman and Estes 1990). They molt gradually throughout the year (Kenyon 1969).

Status and Distribution

Distribution and Population Structure

The northern sea otter has a range that extends from the Aleutian Islands in southwestern Alaska to the coast of the State of Washington. Three stocks of sea otters are recognized in Alaska: southwest, southcentral and southeast (Figure A-20). The southwest Alaska stock ranges from Attu Island at the western end of the Near Islands in the Aleutians, east to Kamishak Bay on the western side of lower Cook Inlet, and includes waters adjacent to the Aleutian Islands, the Alaska Peninsula, the Kodiak archipelago, and the Barren Islands (USFWS 2005) and is currently estimated to contain about 55,000 animals (USFWS 2014b).

Within the range of northern sea otters (*E. l. kenyon*i), there may be physical barriers to movement across the upper and the lower portions of Cook Inlet, and there are morphological and some genetic differences between sea otters that correspond to the southwest and south-central Alaska stocks (USFWS 2005). Genetic analyses show some similarities between sea otters in the Commander Islands, Russia, and Alaska (Cronin et al. 1996), which indicates that movements between these areas has occurred, at least over evolutionary time scales. All existing sea otter populations have experienced at least one genetic bottleneck caused by the commercial fur harvests from 1741 - 1911. As part of efforts to re-establish sea otters in portions of their historical range, otters from Amchitka Island (part of the Aleutian Islands) and Prince William Sound were translocated to other areas outside the range of what we now recognize as the southwest Alaska distinct population segment, but within the range of *E. l. kenyoni* (Jameson 2002).

Sea otters generally occur in shallow water areas near the shoreline. They are most commonly observed within the 40 m (131 ft) depth contour (USFWS 2008a), although they can be found in waters up to 100 m (328 ft) deep. Most foraging dives take place in waters less than 30 m (98 ft) deep (Bodkin et al. 2004). As water depth is generally correlated with distance to shore, sea otters typically inhabit waters within 1-2 km (0.62–1.24 miles) of shore (Riedman and Estes 1990). Much of the marine habitat of the sea otter in southwest Alaska is characterized by a rocky substrate. In these areas, sea otters typically are concentrated between the shoreline and the outer limit of the kelp canopy (Riedman and Estes 1990), but they also occur further seaward. Sea otters also inhabit marine environments that have soft sediment substrates, such as areas in Bristol Bay and the Kodiak archipelago. As communities of benthic invertebrates differ between rocky and soft sediment substrate areas, so do sea otter diets.

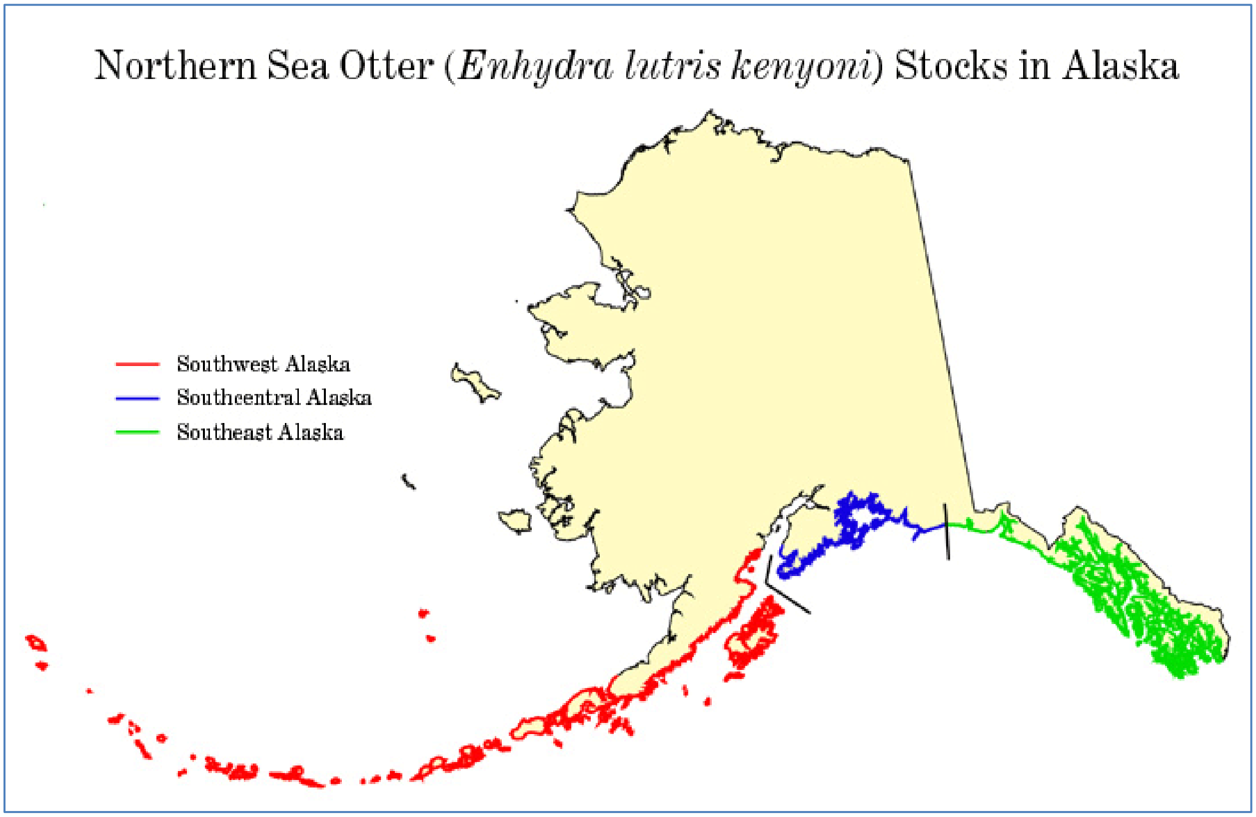

Figure A-20. Northern sea otter stocks in Alaska. [Top]

Population Trends

Historically, sea otters occurred throughout the coastal waters of the North Pacific Ocean from the northern Japanese archipelago around the North Pacific Rim to central Baja California. Between 1741 and 1911, sea otters were hunted to the brink of extinction by Russian and American fur hunters. Prior to commercial exploitation, the worldwide population of sea otters was estimated at 150,000 - 300,000 animals (Kenyon 1969; Johnson 1982).

Sea otters were protected from further commercial harvests under the International Fur Seal Treaty of 1911. At that time, only 13 small remnant populations were believed to have persisted. The total worldwide population may have been only 1,000 - 2,000 animals. Two of these remnant populations (Queen Charlotte Island and San Benito islands) declined to extinction (Kenyon 1969; Estes 1980). The remaining 11 populations began to grow in number, and expanded to recolonize much of the former range. Six of these remnant populations (Rat Islands, Delarof Islands, False Pass, Sandman Reefs, Shumagin Islands, and Kodiak Island) were located within the bounds of the southwest Alaska DPS. Because of the remote, pristine nature of southwest Alaska, these remnant populations grew rapidly during the first 50 years following protection from further commercial hunting. The population in southwest Alaska had grown in numbers and re-colonized much of the former range by the mid- to late-1980s. At that time, numbers were believed to be around 92,800 - 126,900 in southwest Alaska.

Aleutian Islands

From the mid-1960s to the mid-1980s, otters expanded their range, and presumably their numbers as well, until they had recolonized all the major island groups in the Aleutians. Although the maximum size reached by the sea otter population is unknown, a habitat-based computer model estimates that the population in the late 1980s may have numbered approximately 74,000 individuals in the Aleutians (Burn et al. 2003). But in a 1992 aerial survey of the entire Aleutian archipelago, only 8,048 otters were counted (Evans et al. 1997); approximately 19% fewer than the total reported for a 1965 survey Kenyon (1969). In April 2000, 2,442 sea otters were counted; a 70% decline from the count eight years previous (Doroff et al. 2003). Along the more than 5,000 km (3,107 miles) of shoreline surveyed, sea otter density was at a uniformly low level, which clearly indicated that sea otter abundance had declined throughout the archipelago. Doroff et al. (2003) calculated that the decline occurred at an average rate of 17.5% per year throughout the Aleutians.

Alaska Peninsula

Remnant colonies along the Alaska Peninsula expanded through the 1950s and early 1960s, (Kenyon 1969). Schneider (1976) estimated 17,000 sea otters on the north side of the Alaska Peninsula in 1976 (Burn and Doroff 2005), which he believed to have been within the carrying capacity for that area. In 1986, an estimated 6,474–9,215 sea otters occupied this area (Burn and Doroff 2005). By May 2000, estimates had dropped 27–49% from 1986 (Burn and Doroff 2005). Declines were also occurring along the south side of the Alaska Peninsula between the mid-1960s and early 2000s (Kenyon 1969; Brueggeman et al. 1988; DeGange et al. 1995). Rates of decline as high as 93% were documented in some areas (Burn and Doroff 2005). Overall, the combined counts for the entire Alaska Peninsula have declined by 65–72% since the mid-1980s. The estimated number of sea otters along the Alaska Peninsula was 9,658 as of 2014.

Kamishak Bay, the Kodiak Archipelago and Cook Inlet

The eastern extent of the population decline of the1960s-1990s appears to occur at about Castle Cape. Populations around Kodiak, Katmai, Kamishak, and lower Cook Inlet are stable or increasing (Coletti et al. 2009, Estes et al. 2010). In 2002, Bodkin (2003) found sea otters to be relatively abundant within Kamishak Bay (6,918 otters). In 1994, there were an estimated 9,817 otters in the Kodiak archipelago (USFWS, unpublished data). An aerial survey of the Kodiak Archipelago conducted in 2004 resulted in an estimate of 11,005 sea otters (CV = 0.19; USFWS unpublished data).

Population trends in southwest Alaska changed during the period 2003 - 2011. Declines leveled off and average growth rates approached zero. Some variation was evident but the overall trends were consistent among islands. These results suggest that population declines may have recently stabilized in the western Aleutian Islands, although there is still no evidence of recovery (USGS unpublished data, USFWS unpublished data).

Life History

Breeding Biology

There is variation in age of first reproduction, but generally, male sea otters appear to reach sexual maturity at 5–6 years of age and females reach sexual maturity at 3–4 years (Garshelis et al. 1984; von Biela et al. 2007). The interval between pups is typically one year. The presence of pups and fetuses at different stages of development throughout the year suggests that reproduction occurs at all times of the year. Most areas that have been studied show evidence of one or more seasonal peaks in pupping (Rotterman and Simon-Jackson 1988). Similar to other mustelids, sea otters can have delayed implantation of the blastocyst (developing embryo) (Sinha et al. 1966). As a result, pregnancy can have two phases: from fertilization to implantation, and from implantation to birth (Rotterman and Simon-Jackson 1988). The average time between copulation and birth is 6–7 months. Female sea otters typically will not mate while accompanied by a pup (Lensink 1962; Kenyon 1969; Garshelis et al. 1984).

Estimating the rate of recruitment of sea otters into a population is difficult primarily because of asynchronous pupping and an inability to reliably distinguish males from females and juveniles from adults externally. For long-lived species, we expect that survivorship of offspring is related to maternal age and experience, and that recruitment rate is more sensitive than survival rate to environmental fluctuations (Eberhardt 1977). The maximum life span of a wild sea otter is believed to be 23 years (Nowak 1999).

Movement Patterns

Sea otters in Alaska are non-migratory and generally do not disperse over long distances (USFWS 2008a). They usually remain within a few kilometers of their established feeding grounds (Kenyon, 1981); however they are capable of long distance travel. Translocated populations are known to shift and expand their distribution in favorable habitats, sometimes traversing distances up to 350 km (217 mi) over a relatively short period (Ralls et al. 1992; Jameson 2002). Juvenile males (1–2 years of age) are known to disperse up to 120 km (75 mi) from their natal (birth) area; young females traveled up to 38 km (23.6 mi) (Garshelis and Garshelis 1984; Monnett and Rotterman 1988; Riedman and Estes 1990). Routine movements between feeding and resting areas as large as 35 - 60 miles (57 - 97 km) have also been observed by VanBlaricom et al. (2001).

Once a population has become established and has reached equilibrium density within the habitat, the home ranges of sea otters are relatively small. Home range and movement patterns vary depending on the gender and breeding status. In the Aleutian Islands, breeding males remain for all or part of the year within the bounds of their breeding territory, which constitutes a length of coastline anywhere from 100 m (328 ft) to approximately 1 km (0.62 miles). Sexually mature females have home ranges of approximately 8–16 km (5–10 miles), which may include one or more male territories. Male sea otters that do not hold territories may move greater distances between resting and foraging areas than territorial males (Lensink 1962; Kenyon 1969; Riedman and Estes 1990; Estes and Tinker 1996). Typical daily movement distances may exceed 3 km at rates of speed up to 5.5 km per hour (Garshelis and Garshelis 1984).

Sea otter movements are also influenced by local climatic conditions such as storm events, prevailing winds, and in some areas, tidal states. Sea otters tend to move to protected or sheltered waters (bays, inlets, or lees) during storm events or high winds. In calm weather conditions, sea otters may be encountered further from shore (Lensink 1962; Kenyon 1969). In the Commander Islands, Russia, weather, season, time of day, and human disturbance have been cited as factors that induce sea otter movement (Barabash-Nikiforov 1947; Barabash-Nikiforov et al. 1968).

Threats

Predation

Available information suggests that predation by killer whales (*Orcinus orca*) may be the most likely cause of the sea otter decline in the Aleutian Islands (Estes et al. 1998). Data that support this hypothesis include: 1) a significant increase in the number of killer whale attacks on sea otters during the 1990s (Hatfield et al. 1998); 2) the number of observed attacks fits expectations from computer models of killer whale energetics; 3) the scarcity of beach cast otter carcasses that would be expected if disease or starvation were occurring; 4) markedly lower mortality rates for sea otters in a sheltered lagoon (where killer whales cannot go) than for those in an adjacent exposed bay; and 5) documentation of elevated mortality rate as the cause of decline, rather than reduced fertility or redistribution (Laidre et al. 2006).

The hypothesis that killer whales may be the principal cause of the sea otter decline suggests that there may have been significant changes in predator-prey relationships in the Bering Sea ecosystem (Estes et al. 1998; Springer et al. 2003). For the past several decades, harbor seals (*Phoca vitulina*) and Steller sea lions *(Eumetopias jubatus)*, the preferred prey species of transient, marine mammal eating killer whales, have been in decline throughout the western North Pacific. In 1990, Steller sea lions were listed as threatened under the ESA (55 FR 49204). Estes et al. (1998) hypothesized that killer whales may have responded to declines in their preferred prey species, harbor seals and Steller sea lions, by broadening their prey base to include sea otters. Springer et al. (2003) suggest that modern industrial whaling led to declines in great whale populations in the North Pacific, which in turn resulted in killer whales "fishing down" the marine food web; first harbor seals, then fur seals (*Callorhinus ursinus*), sea lions, and finally sea otters in succession as preferred prey were depleted.

Subsistence Harvest

Subsistence harvest has reportedly removed fewer than 1,400 sea otters from the southwest Alaska DPS between 1989 and 2011 (average from 2006 - 2010 = 76 per year; range = 30 - 122 per year; USFWS unpublished data; USFWS 2014b). The majority of the subsistence harvest in southwest Alaska occurs in the Kodiak archipelago. Given the estimated population growth rate of 10% per year estimated for the Kodiak archipelago by Bodkin et al. (1999), we would expect that these harvest levels by themselves would not cause a population decline. Some of the largest observed sea otter declines have occurred in areas where subsistence harvest is either nonexistent or extremely low. The best available scientific information does not indicate that subsistence harvest by Alaska Natives has had a major impact on the southwest Alaska DPS of the northern sea otter.

Interaction with Commercial Fisheries

Sea otters are sometimes taken incidentally in commercial set net, trawl, and finfish pot fisheries fishing operations (76 FR 73912). Entanglements of single animals have been reported from the Bering Sea, Bristol Bay, and PWS. In 1992, a total of eight sea otters were observed caught in the Pacific cod pot fishery in the Aleutian Islands (Perez 2006, 2007). In 2002, four incidents of entanglement with no mortality or serious injury were recorded in the Kodiak salmon set net fishery (Manly et al. 2003). Based on Kodiak fisheries data, coupled with self-reporting records from the Bering Sea and Aleutian Island ground fish trawl fishery, it is estimated that fewer than 10 sea otters per year might be killed or seriously injured as a result of entanglement with fishing gear (USFWS 2008b).

Development

Habitat destruction or modification is not known to be a major factor in the decline of the southwest Alaska DPS of the northern sea otter. Development of harbors and channels by dredging may affect sea otter habitat on a local scale by disturbing the sea floor and affecting benthic invertebrates that sea otters eat. As harbor and dredging projects typically impact an area of 50 hectares or less, the overall impact of these projects on sea otter habitat is considered to be negligible (USFWS 2008c). However, the cumulative effect of incremental, small losses of critical habitat may affect the population by removing or reducing the availability of PCEs. Between 2002 and 2014, section 7 consultation documented an estimated 20.24 hectares of habitat impacted (including both temporary and permanent impacts) and take by disturbance of 36 otters.

Research

Scientific research on sea otters occurs primarily as annual aerial and skiff surveys. When they occur, they last for very short durations of time. Other research includes capture and handling of individuals. During the 1990s, 198 otters were captured and released as part of health monitoring and radio telemetry studies at Adak and Amchitka. In the 2000s, 98 sea otters from the southwest Alaska DPS were live-captured and released as part of a multi-agency health monitoring study (USFWS 2005, 2008b). Accidental capture-related deaths have been rare, with research activities carefully monitored by the Division of Management Authority (DMA).

Disease

Parasitic infection was identified as a cause of increased mortality of sea otters at Amchitka Island in 1951 (Rausch 1953). These highly pathogenic infestations were apparently the result of sea otters foraging on fish, combined with a weakened body condition brought about by nutritional stress. More recently, sea otters have been impacted by parasitic infections resulting from the consumption of fish waste. Necropsies of carcasses recovered in Orca Inlet, Prince William Sound, revealed that some otters in these areas had developed parasitic infections and fish bone impactions that contributed to their deaths (Ballachey et al. 2002). Valvular endocarditis and septicemia have been isolated as a major, proximate cause of sea otter deaths in Alaska (Goldstein et al. 2009). The majority of these deaths are ultimately related to exposure to and infection from *Streptococcus* bacteria.

Oil Spills

The effects of oil on sea otters include short-term acute oiling of fur, resulting in death from hypothermia, smothering, drowning, or ingestion of toxics during preening. While these acute effects are not disputed, a growing body of evidence suggests that oil also affects sea otters over the long term, with interactions between natural environmental stressors and the compromised health of animals exposed to oil lingering well beyond the acute mortality phase (Peterson et al. 2003). The myriad studies that have been undertaken since EVOS provide the most comprehensive data by which to evaluate the effects to wild populations of sea otters to long-term, low-level exposure to hydrocarbons (Bodkin et al. 2002; Stephensen et al. 2001), but documenting chronic effects of EVOS on sea otters has been difficult due to lack of appropriate controls combined with the natural variability among affected resources. Without experimental controls, correlation analysis is the best available inferential tool in assessing the impacts of unpredictable environmental perturbations.

Sublethal exposure compromises health, reproduction, and survival across generations (Bodkin et al. 2002). Sea otters consuming prey in habitats contaminated by residual oil have a high likelihood of encountering subsurface oil while excavating prey from sediments (Bodkin et al. 2002). Unlike vertebrates, invertebrates do not metabolize hydrocarbons; thus they accumulate hydrocarbon burdens in their tissues (Short and Harris 1996). Sea otters are, therefore, potentially exposed to residual oil through two pathways: physical contact with oil while digging for prey, and ingestion of contaminated prey.

Research has confirmed the persistent exposure of sea otters to residual oil in western PWS. Several authors reported higher levels of a biomarker (P450 1A), which indicates exposure to aromatic hydrocarbons in sea otters sampled from oiled areas of PWS compared to animals sampled from un-oiled areas (Ballachey et al. 2000a; Ballachey et al. 2000b; Bodkin et al. 2002). Chronic, persistent exposure to oil appears to cause reduced productivity and reduced survival of young (Mazet et al. 2001; Ballachey et al. 2003). A comparison of body lengths of sea otters that attained adulthood prior to the spill, relative to post-spill measurements, suggests that food resources were approximately equivalent before and after. These results imply that factors other than body condition are affecting pup survival in western Prince William Sound (Ballachey et al. 2003).

Trans-generational effects may arise from direct exposure to a mutagen such as petroleum hydrocarbons, and therefore may be realized long after the contaminant exposure has ceased (Bickham and Smolen 1994). Sea otters are long-lived, with relatively low annual reproductive rates and high annual adult survival; factors that result in reduced reproduction, increased mortality, or increased emigration will eventually lead to depressed population growth rates (Riedman and Estes 1990). Finally, exposure to pollutants such as crude oil may affect sea otters at a variety of levels of organization, beginning with somatic or germinal cell mutations and leading to a cascade of alterations that go beyond the individual or community to threaten the long-term survival of the population (Bickham et al. 2000; Clements 2000).

Short-Tailed Albatross

Species Description

The short-tailed albatross is a large pelagic bird with long narrow wings adapted for soaring just above the water surface. It is classified within the family Diomedeidae, in the order of tube-nosed marine birds (Procellariiformes). Until recently, it had been assigned to the genus *Diomedea*. Following the results of genetic studies by Nunn et al. (1996), the family Diomedeidae was arranged in four genera. The genus *Phoebastria* (North Pacific albatrosses) now includes the short-tailed albatross, the Laysan albatross (*P. immutabilis*), the black-footed albatross (*P. nigripes*), and the waved albatross (*P. irrorata*) (AOU 1998).

Status and Distribution

The short-tailed albatross was federally listed as endangered throughout its range, including the United States, on July 31, 2000 (65 FR 147:46643). At the time of listing, designation of critical habitat was determined to be not prudent (65 FR 147:46651). Historically, the short-tailed albatross was probably the most abundant albatross in the North Pacific, with 14 known breeding colonies (Olson and Hearty 2003). However, from the late 1800's, millions were hunted for feathers, oil, and fertilizer (USFWS 2008), and by 1949 the species was thought to be extinct. The species began to recover during the 1950's and currently occurs throughout the North Pacific Ocean.

Current Population Status

Short-tailed albatross breed on remote islands in the North Pacific Ocean (Figure A-21). Torishima, a Japanese island that is an active volcano, is estimated to contain 80 - 85% of the existing breeding population in two main breeding colonies: Hatsunezaki and Tsubamezaki. The 2013 - 2014 population was 609 breeding pairs (or 1,218 breeding adults) (USFWS 2014). Assuming that 25% of breeding-age adults do not return to breed each year (H. Hasegawa, Toho University, pers. comm. *in* USFWS 2014), this would represent an adult population of 1,624 at Torishima at the start of the 2013 - 2014 nesting season.

The breeding colony in the Senkaku (or Diaoyutai) Islands is in disputed ownership among China, Japan, and Taiwan, and is politically difficult to access. As a result, this breeding population has not been surveyed since 2002. The estimates of the Senkaku population data are extrapolated from the 2002 data under the assumption that factors affecting population growth have remained similar to those observed on Torishima. Under this assumption, the total adult breeding population is estimated to be 220 in 2013 - 2014. Assuming that 25% of the adults do not return to breed each year, we estimate the population of breeding-age adults that potentially nest on the Senkaku Islands to be about 293 at the start of the 2013 - 2014 nesting season. Population estimates are calculated using a deterministic population model (P. Sievert, unpublished data, 2014).

In 2008, 10 chicks were translocated to a former colony site on Mukojima, a non-volcanic island, south of Torishima in the hope of re-establishing a colony on this island. All chicks in this group survived to fledging. From 2009 through 2012, an additional 15 chicks per year have been moved to Mukojima and reared to fledging. All but one of the 70 chicks fledged successfully. The relocation effort may be attracting additional breeding adults to this island; an egg was laid by a pair in 2012 and again in 2013.

In the Northwestern Hawaiian Islands, one pair was breeding at Midway Atoll (having fledged a chick in 2011, 2012, and 2014) and another suspected female-female pair has been attempting to breed at Kure Atoll since 2010. The hatching in 2011 marked the first confirmed hatching of a short-tailed albatross outside of the islands surrounding Japan in recorded history. Prior to that, observations of infertile short-tailed albatross eggs and reports from the 1930’s suggested that short-tailed albatross may have nested on Midway Atoll in the past.

As of 2013 - 2014, there were also two breeding sites with one pair each in the Ogasawara (Bonin) Islands and on Nakodo-jima near Mukojima. The total population estimate for breeding age short-tailed albatrosses as of the 2013 - 2014 nesting season is 1,928 individuals. Assuming that adults comprise 50% of the total population of short-tailed albatross (based on the age structure of the Torishima population), we estimate the total population at the end of the 2013 - 2014 breeding season to include 472 fledglings, and 55 chicks for a total population of 4,354 individuals. The population growth rate is determined by annual increases in eggs laid (by breeding pairs) at Torishima. The 3-year running average population growth rate since 2000 is estimated to be 7.5% and ranges from 5.2 - 9.4% (USFWS 2014a).

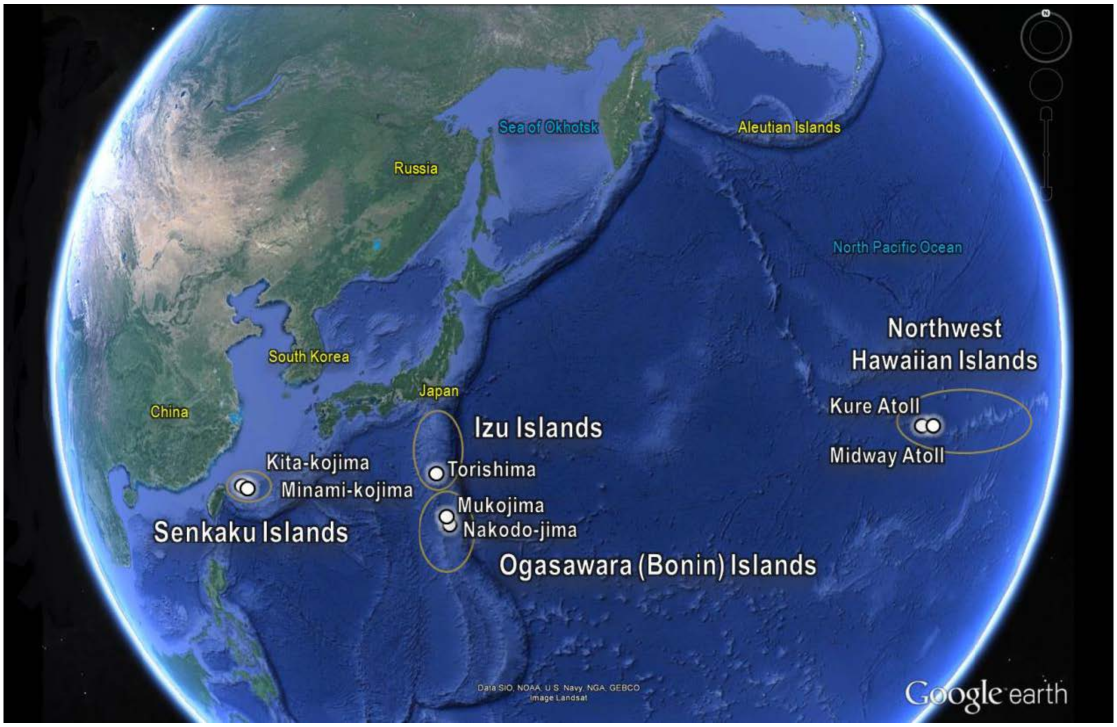

Figure A-21. Short-tailed albatross breeding locations in the North Pacific. Specific islands and their island groups are indicated. [Top]

Distribution

Juveniles and younger sub-adult birds (up to two years old) have a wider range than adults and can be found in the Sea of Okhotsk, a broader region of the Bering Sea, and the west coast of North America (O'Connor 2013; Figure A-22). Sub-adult birds also travel greater daily distances (mean = 191 km/day [119 mi/day] in first year of flight, 181 km/day [112 mi/day] in second year of flight; O'Connor 2013) than adults (133 km/day [83 mi/day]; Suryan et al. 2007). Post-fledging juvenile birds ranged widely throughout the North Pacific rim, and some individuals also spent time in the oceanic waters between Hawaii and Alaska (Deguchi et al. 2014). Although the highest concentrations of short-tailed albatross are found in the Aleutian Islands and Bering Sea (primarily outer shelf) regions of Alaska, subadults appear to be distributed along the west coast of the U.S. more than has been previously reported (Guy et al. 2013).

Life History

The short-tailed albatross is a colonial, annual breeding species; each breeding cycle lasts about eight months. Birds may breed at five years of age, but first year of breeding is more commonly at age six (H. Hasegawa, Toho University, pers. comm. *in* USFWS 2014). Short-tailed albatross are monogamous and highly philopatric to nesting areas (they return to the same breeding site year after year). However, young birds may occasionally disperse from their natal colonies to attempt to breed elsewhere, as evidenced by the appearance of adult birds on Midway Atoll that were banded as chicks on Torishima (Richardson 1994).

Birds arrive on Torishima in October, but as many as 25% of breeding age adults may not return to the colony in a given year (H. Hasegawa, Toho University, pers. comm. *in* USFWS 2014). A single egg is laid in late October to late November, and is not replaced if destroyed (Austin 1949). Bi-parental incubation lasts 64 - 65 days. Parents alternate foraging trips that may last 2 - 3 weeks while taking turns at incubating. When one bird is foraging, the other stays on the nest without eating or drinking for up to 24 days (Fumio Sato, Yamashina Institute, pers. comm. *in* USFWS 2014).

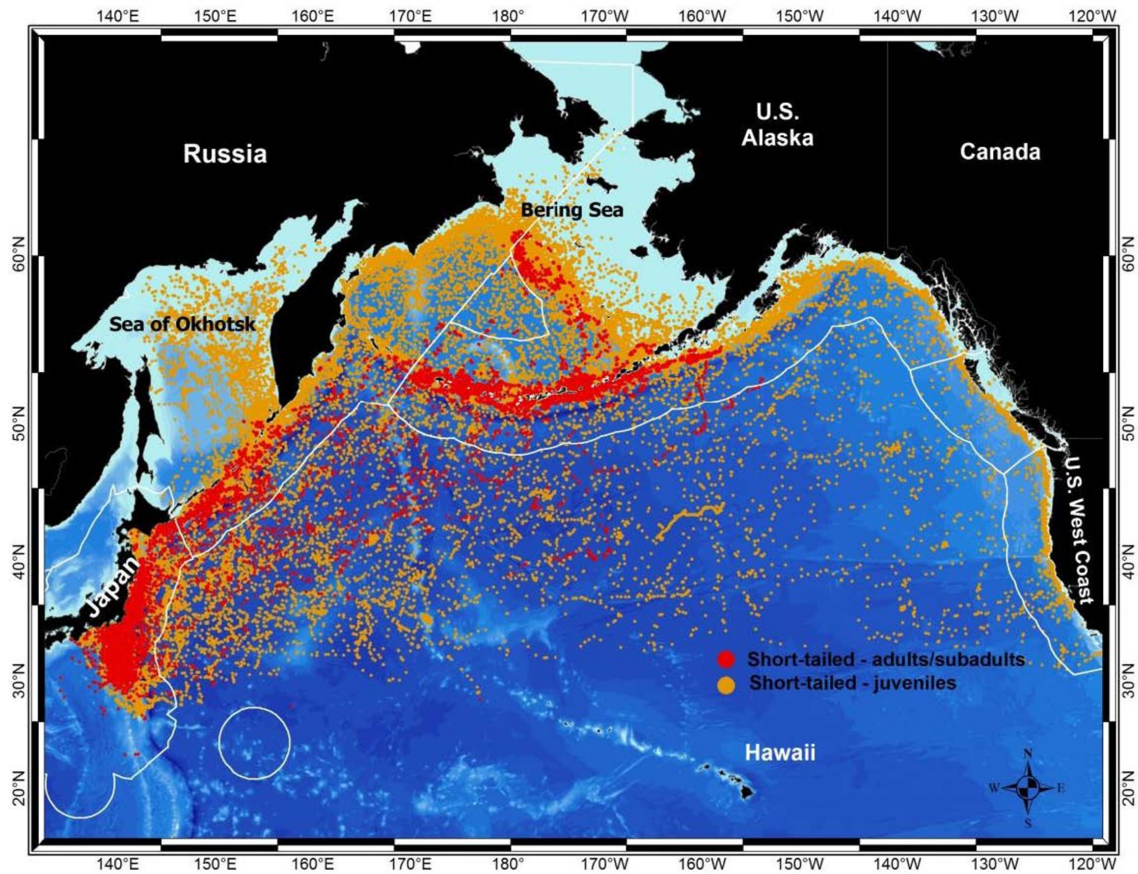

Figure A-22. Locations of 99 short-tailed albatrosses tracked between 2002 - 2012, showing adult and juvenile distributions in the North Pacific (Suryan et al. 2006, 2007, 2008, Suryan and Fischer 2010, Deguchi et al. 2014). White lines represent the exclusive economic zones of countries within the range of short-tailed albatrosses. [Top]

Hatching occurs from late December through January (Hasegawa and DeGange 1982). For the first few days after hatching the chick is fed on stomach oil that is very rich in calories and Vitamin A. This oil also provides a source of water once metabolized, which is important when chicks may be left for several days in high temperatures on dry islands. Soon after hatching, the chicks are fed more solid food, such as squid and flying fish eggs. During the first few weeks after hatching, one adult broods the chick and the other forages at sea. Later, when the chick can regulate its body temperature, both parents leave their chick, while they forage simultaneously. During the brood-rearing period, most foraging bouts are along the eastern coastal waters of Honshu Island, Japan (Suryan et al. 2008).

Chicks begin to fledge in late May into June (Austin 1949). By late May or early June, the chicks are almost fully grown, and the adults begin abandoning the colony site (Hasegawa and DeGange 1982, Suryan et al. 2008). The chicks fledge soon after the adults leave the colony. By mid-July, the breeding colony is empty (Austin 1949). Non-breeders and failed breeders disperse earlier from the breeding colony, during late winter through spring (Hasegawa and DeGange 1982). In summer (the nonbreeding season), short-tailed albatross disperse widely throughout the temperate and subarctic North Pacific Ocean (Sanger 1972; Suryan et al. 2007).

Foraging Ecology and Diet

The diet of short-tailed albatross is not well-known, but observations of food brought to nestlings and of regurgitated material (Austin 1949), as well as at-sea observations during feeding indicate that the diet includes squid, shrimp, fish (including bonitos [*Sarda sp.*], flying fishes [Exocoetidae] and sardines [Clupeidae]), flying fish eggs, and other crustaceans (Tickell 1975; Hasegawa and DeGange 1982; Tickell 2000). This species has also been reported to scavenge discarded marine mammals and blubber from whaling vessels, and they readily scavenge fisheries offal (Hasegawa and Degange 1982). Short-tailed albatross forage diurnally and possibly nocturnally (Hasegawa and Degange 1982), either singly or in groups (occasionally in the 100's) (Piatt et al. 2006) predominantly taking prey by surface-seizing (Piatt et al. 2006; Prince and Morgan 1987; Duke University 2008).

In an analysis of historic and current distribution of North Pacific albatrosses, Kuletz et al. (2014) speculated that the increase in albatrosses (including short-tailed albatross) and changes in their distribution over the last decade was due to possible increases in squid biomass in the Bering Sea/Aleutian Islands region. Overall the much higher abundance of albatrosses in the Aleutians compared to the Bering Sea mirrored the relative density of squid, which is estimated to be approximately seven times higher in the Aleutians (Ormseth 2012).

Threats

Habitat Alteration and Loss

Habitat destruction from volcanic eruption continues to pose a significant threat to short-tailed albatross at the primary breeding colony on Torishima (USFWS 2014). The main colony site, Tsubamezaki, is on a sparsely vegetated steep slope of loose volcanic soil that is subject to severe erosion, particularly during monsoon rains. A landslide at Tsubamezaki buried up to 10 chicks in February 2010 (Yamashina Institute for Ornithology, unpublished data). Future eruptions or landslides could result in a significant loss to the primary nesting area and the population as a whole.

Global Changes

Climate change impacts to short-tailed albatrosses could include changes to nesting habitat or changes to prey abundance or distribution. Fortunately, the nesting habitats on Torishima, the Ogasawara Islands, and the Senkaku Islands are high enough above sea level (above 20 m [70 ft]) to avoid inundation by projected sea level rise. Models for the Northwestern Hawaiian Islands indicate nesting habitat used by short-tailed albatrosses on low-lying Midway and Kure

Atolls is likely to be lost by the end of the century due to sea level rise and increased storm frequency and intensity (Storlazzi et al. 2013).

Sea-ice retreat in the Arctic (see "Habitat or Ecosystem Conditions") may potentially open new foraging habitat or provide a new migration corridor between the Pacific and Atlantic Oceans. A juvenile short-tailed albatross was recently sighted in the Arctic (Chukchi Sea) and evidence from other species (e.g., northern gannet [*Morus bassanus*], ancient murrelet [*Synthliboramphus antiquus*]) indicates some bird species might use ice free portions of the Arctic as a migration or population dispersion route (Gall et al. 2013). The alteration of ice, prey, and seabird distribution is expected to continue, but how these changes will affect short-tailed albatrosses is unknown.

Commercial Fishing

Since 2009, five short-tailed albatross mortalities associated with commercial fisheries have been reported, three in the Alaskan cod fishery one in the Pacific Coast groundfish fishery, and one during bycatch mitigation research in Japan (Table A-12).

Table A-12. Known short-tailed albatross mortalities associated with North Pacific and west coast fishing activities since 1983. Data from USFWS unpublished data and Kiyoaki Ozaki, Yamashina institute, pers. comm. in USFWS 2014).

Date	Fishery	Observer program	Bird age	Location	Source
7/15/1983	Net	No	4 mos	Bering Sea	USFWS (2008)
10/1/1987	Halibut	No	6 mos	Gulf of Alaska	USFWS (2008)
8/28/1995	IFQ sablefish	Yes	1 yr	Aleutian Islands	USFWS (2008)
10/8/1995	IFQ sablefish	Yes	3 yrs	Bering Sea	USFWS (2008)
9/27/1996	Hook-and-line	Yes	5 yrs	Bering Sea	USFWS (2008)
4/23/1998	Russian salmon drift net	n/a	Hatch-yr	Bering Sea, Russia	USFWS (2008)
9/21/1998	Pacific cod hook-and-line	Yes	8 yrs	Bering Sea	USFWS (2008)
9/28/1998	Pacific cod hook-and-line	Yes	Sub-adult	Bering Sea	USFWS (2008)
7/11/2002	Russian, unknown	n/a	3 mos	Sea of Okhotsk, Russia	Yamashina Institute of Ornithology (YIO 2011)
8/29/2003	Russian demersal longline	n/a	3 yrs	Bering Sea, Russia	YIO (2011)
8/31/2006	Russian, unknown	n/a	1 yr	Kuril Islands, Russia	YIO (2011)
8/27/2010	Cod freezer longline	Yes	7-yr old	Bering Sea/Aleutian Islands	NOAA (2010)
9/14/2010	Cod freezer longline	Yes	3-yr old	Bering Sea/Aleutian Islands	NOAA (2010)
4/11/2011	Sablefish demersal longline	Yes	1-yr old	Pacific Ocean/Oregon	USFWS (2012)
10/25/2011	Cod freezer longline	Yes	1-yr old	Bering Sea	NOAA (2011)
5/24/2013	Longline, seabird bycatch mitigation research	No	1-yr old	Pacific Ocean, Japan	YIO (2014)

[Top]

Domestic and international efforts have been ongoing to minimize fisheries impacts on short-tailed albatross. Threats have been reduced in some areas through the establishment or improvement of regulations to minimize seabird bycatch, including within the U.S. Pacific Coast groundfish fishery and in the longline tuna fishery in Japan (USFWS 2012a, Fisheries Agency of Japan 2009). Even with regulatory measures to minimize impacts on short-tailed albatross (including required use of long-line deterrent devices [streamers or tori lines] and implementation of observer programs), bycatch and other injury and mortality associated with fisheries in the North Pacific remain a concern, and the magnitude of the ongoing impacts is uncertain.

Commercial fishing in Russia

Russian longline cod fisheries implemented experimental use of streamers in 2004 - 2008 (Artukhin et al. 2013). The frequency of reported seabird attacks was 5 - 9 times lower on boats with paired streamers, and total catch of fish was 4 - 12% higher. The study recommended wide application of streamer line in the Far Eastern Seas of Russia. Although consistent funding has been a problem, the World Wildlife Fund has continued to work with Russian partners to educate the Russian commercial fishing communities about the benefits of using streamer lines and promote their use to reduce seabird bycatch and improve fishing success (World Wildlife Fund 2014).

Commercial Fishing in Japan

Japan developed a National Plan of Action for seabird conservation and management (Fisheries Agency of Japan 2004, 2009). In areas where short-tailed albatrosses occur (north of 23°N latitude), vessels must employ two of the following measures, one of which must be from the first four listed, and streamer lines are obligatory within 32 km (20 mi) of Torishima in October through May: side setting with a bird curtain and weighted branch lines, night setting with minimum deck lighting, streamer (tori) lines, weighted branch lines, blue-dyed bait, deep setting line shooter, and/or management of offal discharge. Japan has also implemented an observer program on their longline and purse seine fisheries to observe bycatch of non-target species, including seabirds (Uosaki et al. 2013, 2014). The only observed seabirds incidentally caught north of the 23˚N latitude were a black-footed albatross in 2012 and an unidentified petrel in 2013 (Uosaki et al. 2013, 2014). However, only a small percentage of deployed hooks are observed.

Japanese fishermen pioneered the use of streamer (tori) lines to deter seabirds, and researchers have continued to assess their use. Researchers have continued to examine methods to improve the effectiveness of streamer lines, Yokota et al. (2011), Sato et al. (2012) assessed types and lengths of streamers for their effectiveness and found that lighter lines with shorter streamers are as effective as those with long streamers, although the shorter lines are thought to be safer and less likely to tangle. Sato et al. (2013) further examined the use of paired versus single streamer lines and determined that paired lines were more effective than single lines in reducing bait attacks and seabird mortality. The continuing research by Japan has been an important contribution to minimizing longline fisheries bycatch of short-tailed albatrosses.

Driftnet Fishing in the North Pacific

United Nations General Assembly Resolutions 44/225, 45/197, and 46/215 (United Nations 1989, 1990, 1991) called for a global driftnet moratorium on the high seas by June 30, 1992, and the resolution has been re-adopted biennially. NMFS and the State Department work to implement the moratorium for the U.S. According to NMFS (2013), high seas driftnet fishing continues to occur in the North Pacific Ocean. The fishing effort targets species of squid and occurs toward the end of the fishing season. Both of these factors increase the threat to short-tailed albatrosses. While the numbers of sightings and apprehensions of vessels driftnetting in the North Pacific high seas appear to be decreasing, non-compliance with the moratorium continues to pose a risk of mortality to short-tailed albatrosses entangled in nets.

Canadian fishing Operations
Off Canada's west coast, deployment of seabird avoidance gear has been mandatory for all hook and line groundfish fisheries since 2002 - 2005. Most bycatch monitoring in these fisheries is done by on-board Electronic Monitoring Systems. Following each fishing trip, approximately 10% of the imagery is audited. Although there have been no reported takes of short-tailed albatross bycatch in the groundfish fisheries, in a recent examination of imagery collected between 2006 and 2012, 79 albatrosses were detected; a third of which were identified only as "albatross species". Based on the proportions of sets audited, an estimated 120 albatrosses were predicted to have been caught each year (range 0 - 269). Given the high proportion of albatrosses that are not identified to species and the fact that more than a third of all birds detected during the audits were listed as "unidentified bird", one might expect that one or two short-tailed albatrosses are killed each year in Canadian west coast groundfish longline fisheries (COSEWIC 2014).

Contaminants
Radiation
Approximately 80% of the radiation released from the Fukushima Daiichi Nuclear Plant, which was damaged by a March 11, 2011 earthquake and tsunami, was believed to have entered the Pacific Ocean (Tanabe and Subramanian 2011; Steinhauser et al. 2013, 2014). The area east of the plant is a primary feeding area for nesting short-tailed albatrosses. Although recent analysis has shown no detectable levels of radiation in short-tailed albatross, the impact of these continuing releases on short-tailed albatrosses or their food resources is unknown.

Organochlorines, pesticides and metals
Albatross and other birds may be exposed to organochlorine contaminants such as polychlorinated biphenyls (PCBs) and pesticides, and to toxic metals (e.g., mercury, lead) via atmospheric and oceanic transport. Vo et al. (2011) examined mercury and methylmercury in tissues of black-footed albatross. They compared the levels of mercury and methylmercury in museum specimens (n = 25) from a 120-year collection period (1880 - 2002). They found no temporal trend in mercury concentrations, but measured significantly higher concentrations of methylmercury through time. Finkelstein et al. (2007) found mercury concentrations in black-footed albatross were associated with decreased immune response. Similar effects would be expected for short-tailed albatross.

High concentrations of lead at Midway Atoll are a concern. Taylor et al. (2009) described neurological impacts of lead-based paints on Laysan albatross chicks. Since then, the Service has initiated removal and remediation of lead-based paint and contaminated soils on Sand Island (USFWS 2010). Although only one pair has successfully nested on Midway at Eastern Island, this remediation will reduce exposure to any offspring or future nesting birds on Sand Island. The degree to which any of these or other toxins impact short-tailed albatross remains uncertain, and further research is needed to examine the prevalence of these contaminants in short-tailed albatrosses and their impact on the population.

Plastics

Plastics have been found in most, if not all, species of albatross. Both black-footed and Laysan albatross are well known to ingest plastics in the course of foraging. Lavers and Bond (in review) have recently examined the role of plastic as a vector for trace metals in Laysan albatrosses. Lavers et al. (2014) studied sub-lethal effects of plastic ingestion in flesh-footed shearwaters (*Puffinus carneipes*) and found birds with high levels of ingested plastic exhibited reduced body condition and increased contaminant load ($p < 0.05$) (Lavers et al. 2014). Tanaka et al. (2013) analyzed polybrominated dephenyl ethers in the abdominal adipose of short-tailed shearwaters (*Puffinus tenuirostris*). Some of the birds were found to contain higher-brominated constituents (BDE209 and BDE 183), which were not present in their pelagic fish prey. These same birds were found to contain plastics in their stomach. Plastic ingestion is therefore not only a direct dietary risk but may contribute to chronic accumulation of contaminants that adhere to and are absorbed by plastics.

Polar Bear

Species Description

Polar bears are carnivorous, and a top predator of the Arctic marine ecosystem. The polar bear is usually considered a marine mammal since its primary habitat is the sea-ice (Amstrup 2003), and it is evolutionarily adapted to life on sea-ice. Polar bears are the largest of the living bear species (DeMaster and Stirling 1981; Stirling and Derocher 1990). They are characterized by large body size, a stocky form, and fur color that varies from white to yellow. They are sexually dimorphic; females weigh 181 - 317 kilograms (kg) (400 - 700 pounds (lbs)), and males up to 654 kg (1,440 lbs).

Status and Distribution

Due to threats to its sea-ice habitat, on May 15, 2008 the Service listed the polar bear as threatened (73 FR 28212) throughout its range under the ESA. In the U.S., the polar bear is also protected under the MMPA and the Convention on International Trade in Endangered Species of Wildlife Fauna and Flora (CITES) of 1973.

Polar bears are widely distributed throughout the Arctic where the sea is ice-covered for large portions of the year (Figure A-23). The number of polar bears is estimated to be 20,000 - 25,000 with 19 recognized management subpopulations or “stocks” (Obbard et al. 2010). The International Union for Conservation of Nature and Natural Resources, Species Survival Commission (IUCN/SSC) Polar Bear Specialist Group (PBSG) ranked nine stocks as data deficient, six as stable, three as declining, and one as increasing (IUCN/PBSG 2015). The status designation of “data deficient” for nine stocks indicates that the estimate of the worldwide polar bear population was made with known uncertainty. The population estimate for the Southern Beaufort stock is 907 whereas the population within the Chukchi Sea population is unknown (IUCN/PBSG 2015).

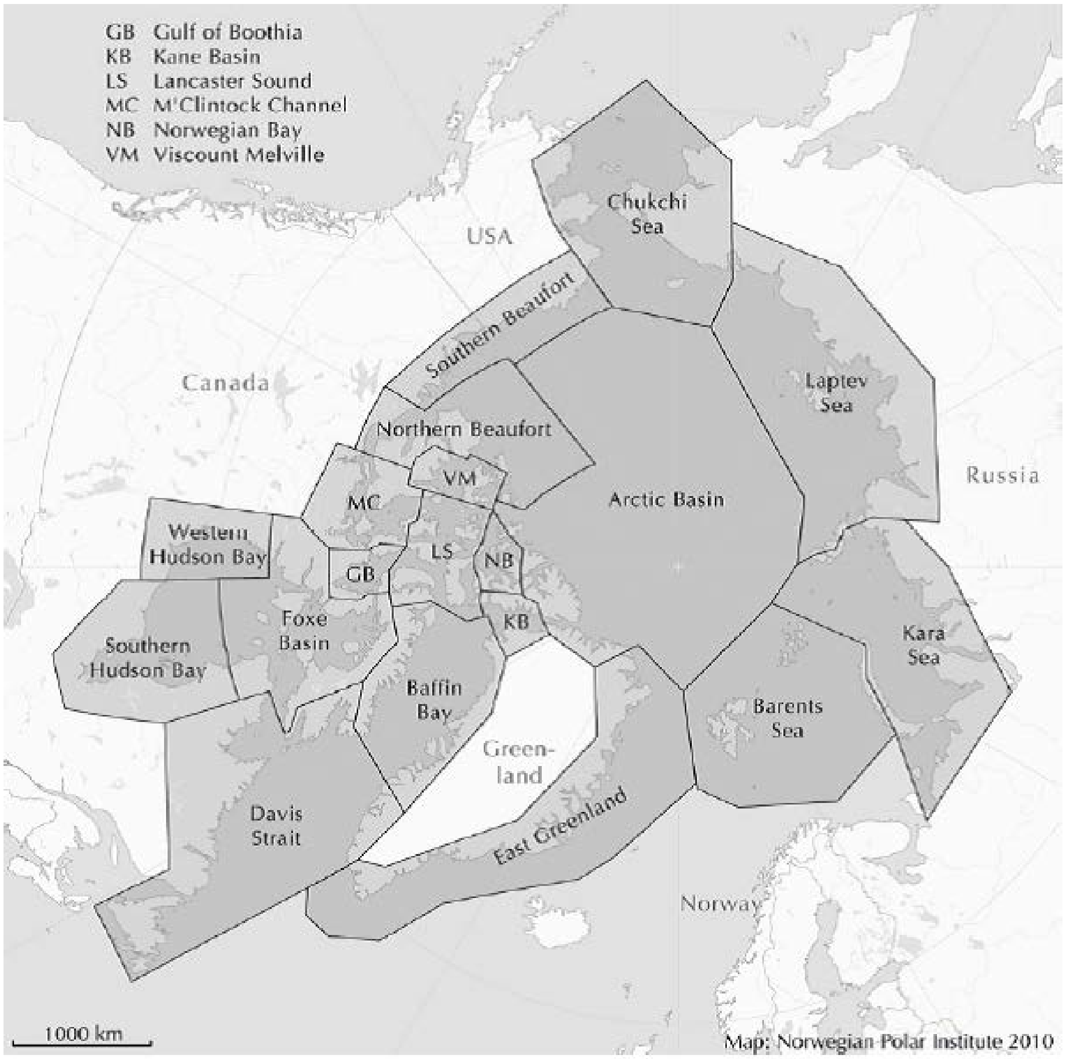

Figure A-23. Distribution of polar bear stocks throughout the circumpolar basin (from Obbard et al. 2010). [Top]

Life History

Breeding Biology

Polar bears are characterized by a late age of sexual maturity, small litter sizes, and extended parental investment in raising young, factors that combine to contribute to a very low reproductive rate (Schliebe et al. 2006). Females may give birth for the first time at age four to six depending on local conditions such as seal abundance (Schliebe et al. 2006), and litters per female varies from 0.25 to 0.45 per adult female (Schliebe et al. 2006). Likewise, litter size and production rate vary geographically with hunting pressure, environmental factors and other population perturbations. Two-cub litters are most common (Schliebe et al. 2006). Body weights of mothers and their cubs decreased markedly in the mid-1970s in the Beaufort Sea following a decline in ringed (*Phoca hispida*) and bearded (*Erignathus barbatus*) seal pup production (Stirling et al. 1977; Kingsley 1979; DeMaster et al. 1980; Amstrup et al. 1986). Declines in reproductive parameters varied by region and year with the severity of ice conditions and corresponding reduction in numbers and productivity of seals (Amstrup et al. 1986).

Most stocks use terrestrial habitat partially or exclusively for maternity denning; therefore, females must adjust their movements to access land at the appropriate time (Stirling 1988; Derocher et al. 2004). Most pregnant female polar bears excavate dens in the fall-early winter period (Harington 1968; Lentfer and Hensel 1980; Ramsay and Stirling 1990). The only known exceptions are in Western and Southern Hudson Bay where polar bears excavate earthen dens and later reposition into adjacent snow drifts (Jonkel et al. 1972, Richardson et al. 2005), and in the southern Beaufort Sea where a portion of the population dens in snow caves on sea-ice (Schliebe et al. 2006). Polar bears give birth in the dens during midwinter (Kostyan 1954; Harington 1968). Family groups emerge from dens in March and April when cubs are approximately three months old (Schliebe et al. 2006).

Foraging Ecology and Diet

Ringed seals (*Phoca hispida*) are polar bear's primary food source, and, to a lesser extent, bearded seals (*Erignathus barbatus)*, but bears they may occasionally consume other marine mammals such as walruses (*Odobenus rosmarus*), narwhal (*Monodon monoceros*), and belugas (*Delphinapterus leucas*) (Kiliaan and Stirling 1978; Smith 1980; Smith 1985; Lowry et al. 1987). On average, an adult polar bear needs approximately 2 kg (4.4 lbs) of seal fat per day to survive (Best 1985). Sufficient nutrition is critical and may be obtained and stored as fat when prey is abundant (Smith and Sjare 1990). Bowhead whale carcasses have been available as a food source on the North Slope since the early 1970s and may affect local polar bear distributions.

Record numbers of polar bears were observed in 2012 in the vicinity of the bowhead whale carcass "bonepile" on Barter Island; the USFWS observed a minimum, maximum, and average of 24, 80, and 52 bears, respectively (USFWS 2012). Barter Island (near Kaktovik) has had the highest recorded concentration of polar bears on shore (17.0 ± 6.0 polar bears/100 km) followed by Barrow (2.2 ± 1.8) and Cross Island (2.0 ± 1.8) (Schliebe et al. 2008). The high number of bears on/near Barter Island compared to other areas is thought to be due in part to the proximity to the ice edge and high ringed seal densities (Schliebe et al. 2008); the whale harvest at Kaktovik is lower than that at Barrow or Cross Island. The use of whale carcasses as a food source likely varies among individuals and years. Stable isotope analysis of polar bears in 2003 and 2004 suggested that bowhead whale carcasses comprised 11%-26% (95% CI) of the diets of sampled polar bears in 2003, and 0-14% (95% CI) in 2004 (Bentzen et al. 2007). Because polar bears depend on sea-ice to hunt seals, and temporal and spatial availability of sea-ice will likely decline, polar bear use of whale carcasses may increase.

Movement Patterns

Over most of their range, polar bears remain on the sea-ice year-round or spend only short periods on land. Sea-ice provides a platform for hunting and feeding, seeking mates and breeding, denning, resting, and long-distance movements. Areas near ice edges, leads, or polynyas where ocean depth is minimal are the most productive hunting grounds (Durner et al.

2004). However, some polar bear populations occur in seasonally ice-free environs and use land habitats for varying portions of the year. In the Chukchi Sea and Beaufort Sea areas of Alaska and northwestern Canada, for example, less than 10% of the polar bear locations obtained via radio telemetry were on land (Amstrup 2000; Amstrup, USGS, unpublished data); the majority of land locations were maternal dens during the winter. A similar pattern was found in East Greenland (Wiig et al. 2003). In the absence of ice during the summer season, some populations of polar bears in eastern Canada and Hudson Bay remain on land for extended periods of time until ice forms providing a platform for them to move to sea. Similarly, in the Barents Sea, a portion of the population spends greater amounts of time on land.

Although polar bears are generally limited to areas where the sea is ice-covered for much of the year, they are not evenly distributed throughout their range on sea-ice. They show a preference for certain sea-ice characteristics, concentrations, and specific sea-ice features (Stirling et al. 1993; Mauritzen et al. 2001; Durner et al. 2004). Sea-ice habitat quality varies temporally as well as geographically (Amstrup et al. 2000). Polar bears show a preference for sea-ice located over and near the continental shelf (Derocher et al. 2004; Durner et al. 2004), likely due to higher biological productivity in these areas (Dunton et al. 2005) and greater accessibility to prey in nearshore shear zones and polynyas (areas of open sea surrounded by ice) compared to deep-water regions in the central polar basin (Stirling 1997). Bears are most abundant near the shore in shallow-water areas, and also in other areas where currents and ocean upwelling increase marine productivity and serve to keep the ice cover from becoming too consolidated in winter (Amstrup and Demaster 1988; Amstrup et al. 2000).

Polar bear distribution in most areas varies seasonally with the seasonal extent of sea-ice cover and availability of prey. In Alaska in the winter, sea-ice may extend 400 km (248 mi) south of the Bering Strait, and polar bears will extend their range to the southernmost proximity of the ice (Ray 1971). Sea-ice disappears from the Bering Sea and is greatly reduced in the Chukchi Sea in the summer, and polar bears occupying these areas move as much as 1,000 km (621 mi) to stay with the pack ice (Garner et al. 1990; Garner et al. 1994). Significant northerly and southerly movements of polar bears appear to depend on seasonal melting and refreezing of ice (Amstrup 2000). In other areas, for example, when the sea-ice melts in Hudson Bay, James Bay, Davis Strait, Baffin Bay, and some portions of the Barents Sea, polar bears remain on land for up to four or five months while they wait for winter and new ice to form (Schweinsburg 1979; Prevett and Kolenosky 1982; Schweinsburg and Lee 1982; Ferguson et al. 1997).

In areas where sea-ice cover is seasonally dynamic, a large multi-year home range, of which only a portion may be used in any one season or year, is an important part of the polar bear life history strategy. In other regions, where ice is less dynamic, home ranges are smaller and less variable (Ferguson et al. 2001). Data from telemetry studies of adult female polar bears show that they do not wander aimlessly on the ice, nor are they carried passively with the ocean currents as previously thought (Pedersen 1945 cited in Amstrup 2003). Results show strong fidelity to activity areas that are used over multiple years (Ferguson et al. 1997). All areas within an activity area are not used each year.

Threats

Climate Change

Loss of sea-ice habitat due to climate change is identified as the primary threat to polar bears (Schliebe et al. 2006; 73 FR 28212; Obbard et al. 2010). Warming-induced habitat degradation and loss are negatively affecting some polar bear stocks, and unabated global warming will ultimately reduce the worldwide polar bear population (Obbard et al. 2010). Arctic summer sea-ice reached its lowest average extent in 2012 and has declined 13% per decade since 1979 (NSIDC 2012; Figure A-29). The loss rate of ice thickness is increasing (Haas et al. 2010), and trends in arctic sea-ice extent are declining (-12.2% and -13.5% per decade, respectively; Comiso 2012).

Declines in sea-ice are more pronounced in summer than winter (NSIDC 2011a, b). Positive feedback systems (i.e., sea-ice albedo) and naturally-occurring events such as warm water intrusion into the arctic and changing atmospheric wind patterns can cause fragmentation of sea-ice, reduction in the extent and area of sea-ice in all seasons, retraction of sea-ice away from productive continental shelf areas throughout the polar basin, reduction of the amount of heavier and more stable multi-year ice, and declining thickness and quality of shore-fast ice (Parkinson et al. 1999; Rothrock et al. 1999; Comiso 2003; Fowler et al. 2004; Lindsay and Zhang 2005, Holland et al. 2006; Comiso 2006; Stroeve et al. 2008). These climatic phenomena may affect seal abundances, the polar bear's main food source (Kingsley 1979; DeMaster et al. 1980; Amstrup et al. 1986; Stirling 2002). Patterns of increased temperatures, earlier spring thaw, later fall freeze-up, increased rain-on-snow events (which can cause dens to collapse), and potential reductions in snowfall are also occurring. As stated above, the polar bear depends on sea-ice for its survival, and loss of sea-ice due to climate change is its largest threat worldwide. However, threats to polar bears will likely occur at different rates and times across their range, and uncertainty regarding their prediction makes management difficult (Obbard et al. 2010).

Natural sources of mortality among polar bears are not well understood (Amstrup 2003). Polar bears are longlived (up to 30 years in captivity); have no natural predators, except other polar bears; and do not appear prone to death by diseases or parasites (Amstrup 2003). Accidents and injuries incurred in the dynamic and harsh sea-ice environment, injuries incurred while fighting other bears, starvation (usually during extreme youth or old age), freezing (also more common during extreme youth or old age), and drowning are all known natural causes of polar bear mortality (Amstrup 2003). Cannibalism by adult males on cubs and other adult bears is also known to occur; however, it is not thought that this is a common or significant cause of mortality. After natural causes and old age, the most significant source of polar bear mortality is from humans hunting polar bears (Amstrup 2003).

Subsistence Hunting

The largest human-caused loss of polar bears is from subsistence hunting of the species, but for most subpopulations where subsistence hunting of polar bears occurs, it is a regulated and/or monitored activity (Obbard et al. 2010). Polar bears historically have been, and continue to be, an important renewable resource for coastal communities throughout the Arctic (Amstrup and DeMaster 1988; Schliebe et al. 2006). Prior to the 1950s, most hunting was by indigenous people for subsistence purposes. Increased sport hunting in the 1950s and 1960s resulted in population declines (Prestrud and Sterling 1994). International concern about the status of polar bears resulted in biologists from the five polar bear range nations forming the PBSG within the IUCN. The PBSG was largely responsible for the development and ratification of the 1973 International Agreement on the Conservation of Polar Bears (1973 Polar Bear Agreement) (Prestrud and Sterling 1994). The 1973 Polar Bear Agreement and the actions of the member nations are credited with the recovery of polar bears following the previous period of overexploitation.

The various polar bear subpopulations face different levels of subsistence harvest pressure; some level of hunting is permitted in the U.S., Canada, Greenland, and recently, in the Russian Federation as well. Five populations (including four that are hunted) have no estimate of potential risk from overharvest, since adequate demographic information necessary to conduct a population viability analysis and risk assessment are not available. The Chukchi Sea, Baffin Bay, Kane Basin, and Western Hudson Bay populations may be overharvested (Aars et al. 2006). In other populations, including East Greenland and Davis Strait, substantial harvest occurs annually in the absence of scientifically derived population estimates (Aars et al. 2006). Considerable debate has occurred regarding the recent changes in population estimates based on indigenous or local knowledge and subsequent quota increases for some populations in Nunavut (Aars et al. 2006). Increased polar bear observations along the coast may be attributed to changes in bear distribution due to lack of suitable ice habitat rather than to increased population size (Stirling and Parkinson 2006). Additional data are needed to reconcile these differing interpretations.

Amstrup et al. (2007) used a Bayesian network model to forecast the range-wide status of polar bears during the 21st century, factoring in a number of stressors, including intentional take or harvest. The authors conducted a sensitivity analysis to determine the importance and influence of the stressors on the population forecast. Their analysis indicated that intentional take was the 4^{th}-ranked potential stressor, and could exacerbate the effects of habitat loss in the future. The relatively high ranking for this stressor indicates that effective management of hunting and evaluation of sustainable harvest levels will continue to be important to minimize effects for populations experiencing increased stress.

Other Threats

Other sources of polar bear mortality related to human activities, though few and very rare, include research activities and defense of life kills by non-Natives (Brower et al. 2002). Accumulation of persistent organic pollutants in polar bear tissue, tourism, human-bear conflict, and increased development in the Arctic are also sources of concern (Obbard et al. 2010). Because uncertainty exists regarding how human activities interact to ultimately affect the world-wide polar bear population, conservation and management of polar bears at the world-wide population level is challenging.

Walrus

Species Description

The Pacific walrus is a social and gregarious pinniped that mainly inhabits the shallow Continental Shelf waters of the Bering and Chukchi seas (Fay 1982; Garlich-Miller et al. 2011). Pacific walruses are ecologically distinct from other walrus populations, primarily because they undergo significant seasonal migrations between the Bering and Chukchi seas and principally rely on broken pack ice habitat to access offshore breeding and feeding areas (Fay 1982). Waters deeper than 100 m (328 ft.) and the extent of the pack ice are factors that limit distribution to the north (Fay 1982). Unlike other pinnipeds, walruses are not as adapted for a pelagic existence and must haul out on ice or land regularly to rest between feeding bouts (Ray et al. 2006; 76 FR 7634). Groups may range from <10 - >1,000 animals (Gilbert 1999; Ray et al. 2006).

Status and Distribution

Status and Trends

The Service was petitioned to list the Pacific walrus under the ESA in 2008. In 2011, the Service found that listing was warranted but precluded due to higher listing priorities, making them a candidate species. Pacific walruses are represented by a single stock of animals that inhabit the shallow continental shelf waters of the Bering and Chukchi seas (Sease and Chapman 1988). Though some heterogeneity in the populations has been documented (Jay and Fischbach 2008), Scribner et al. (1997) found no difference in mitochondrial or nuclear DNA among Pacific walruses sampled from different breeding areas. Pacific walruses are managed as a single population (USFWS 2010). The current estimate of population size is 129,000 (95% CI: 55,000 - 507,000; Speckman et al. 2010).

Based on harvest data from the 18th and 19th centuries, Fay (1982) speculated that the pre-exploitation population was at least 200,000 animals. Since then, the population size has likely fluctuated in response to varying levels of human exploitation. Large-scale commercial harvests are believed to have reduced the population to 50,000–100,000 animals in the mid-1950s (Fay et al. 1997: 539). The population size apparently increased rapidly during the 1960s and 1970s in response to harvest regulations that limited take of females (Fay et al. 1989). Population estimates from 1975 and 1990 obtained via aerial surveys ranged from 201,039 - 290,000 individuals. A 2006 survey in Bering Sea pack ice resulted in an estimate of 129,000 walruses (95% CI: 55,000 - 507,000; Speckman et al. 2010) in the survey area. However, uncertainty exists regarding the accuracy of this estimate because weather difficulties forced the early termination of this survey. Differences in survey methods among years preclude estimation of a rate of change in population estimates (76 FR 7634; Speckman et al. 2010).

The walrus population may have reached carrying capacity in the 1970s and 1980s, after which density-dependent mechanisms are thought to have caused a decrease in population size (Fay and Stoker 1982b; Fay et al. 1986; Sease 1986; Fay et al. 1989). Estimates of demographic parameters from the late 1970s and 1980s support the idea that population growth was slowing (Fay and Stoker 1982a; Fay et al. 1986; Fay et al. 1989). Garlich-Miller et al. (2006) found that the median age of first reproduction for female walruses decreased in the 1990s, which is consistent with a reduction in density-dependent pressures. The reduced productivity levels, together with the removal of harvest quotas in the United States beginning in 1979 resulted in another population decline. Taylor and Udevitz (2015) modeled mortality from non-harvest related factors (natural survival) between 1974–2006 and found that natural survival was high for juveniles (0.97) and adults (0.99) and annual density-dependent vital rates rose from 0.06 - 0.11 for reproduction, 0.31 - 0.59 for survival of neonatal calves, and 0.39 - 0.85 for survival of older calves, which represent patterns that may be expected concomitant with a population decline. Garlich-Miller et al. (2011a) predicted that changing sea-ice dynamics will result in further population declines in the future, but could not specify the magnitude or rate of decline.

Distribution and Movement Patterns

Pacific walruses are highly mobile, and their distribution varies in response to variations in seasonal and inter-annual sea-ice cover. During the January to March breeding season, walruses congregate in Bering Sea pack ice where open leads (fractures in sea-ice caused by wind drift or ocean currents), polynyas (enclosed areas of unfrozen water surrounded by ice), or thin ice allow access to water (Fay 1982; Fay et al. 1984). Breeding aggregations have been reported southwest of St. Lawrence Island, Alaska, south of Nunivak Island, Alaska, and south of the Chukotka Peninsula in the Gulf of Anadyr, Russia (Fay 1982; Mymrin et al. 1990). As the Bering Sea pack ice deteriorates in spring, most of the population migrates north through the Bering Strait to summer feeding areas over the continental shelf in the Chukchi Sea. However, several thousand animals, primarily adult males, remain in the Bering Sea during summer months, foraging from coastal haulouts in the Gulf of Anadyr, Russia, and Bristol Bay, Alaska.

Summer distribution in the Chukchi Sea varies annually depending upon the extent of sea-ice. When broken sea-ice is abundant, walruses are typically found in patchy aggregations over continental shelf waters. Summer concentrations have been reported in loose pack ice off the northwestern coast of Alaska, between Icy Cape and Point Barrow, near Wrangel Island, and along the coast of Chukotka, Russia (Fay 1982; Gilbert et al. 1992; Belikov et al. 1996). In years of low ice concentrations in the Chukchi Sea, some animals range east of Point Barrow into the Beaufort Sea; walruses have also been observed in the Eastern Siberian Sea in late summer (Fay 1982; Belikov et al. 1996).

The pack ice of the Chukchi Sea usually reaches its minimum extent in September. In years when the sea-ice retreats north beyond the continental shelf, walruses congregate in large numbers (up to several tens of thousands of animals in some locations) at terrestrial haulouts along the northern coast of the Chukotka Peninsula, Russia and northwestern Alaska (Fay 1982; Belikov et al. 1996; Kochnev 2004; Ovsyanikov et al. 2007; Kavry et al. 2008). In late September and October, walruses that summered in the Chukchi Sea typically move south in advance of the developing sea-ice (Figure A-25). Satellite telemetry data indicate male walruses that summered at coastal haulouts in the Bering Sea also move northward towards winter breeding areas in November (Jay and Hills 2005). The male walrus' northward movements appear to be driven primarily by the presence of females at that time of year (Freitas et al. 2009).

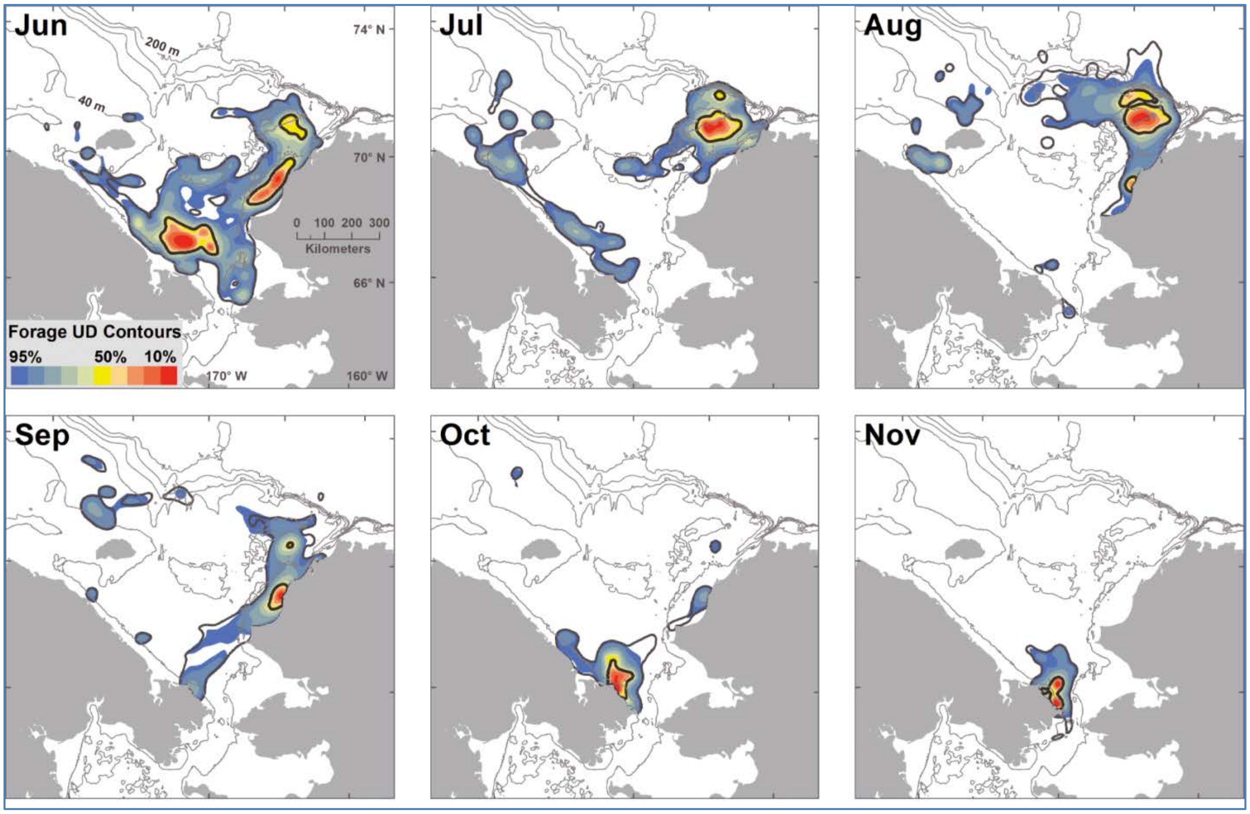

Figure A-24. Utilization distribution estimates (UDs) of walrus foraging (red to blue color ramp contours, 10 - 95% UDs) and occupancy (solid line contours, 50 and 95% UDs) in the Chukchi Sea, 2008 - 2011 (Jay et al. 2012).

[Top]

Life History

Pacific walruses are primarily benthic foragers. Stomachs of some walrus included over 60 benthic invertebrate genera (Fay et al. 1984; Bluhm and Gradinger 2008). Early interpretations of walrus stomach contents indicated walrus feed primarily on benthic bivalves; food items other than clams were suggested to be opportunistically consumed while clams were preferred (citations *in* Sheffield and Grebmeier 2009). However, non-mollusc taxa were likely misrepresented due to digestion and other biases such as sample size (Sheffield and Grebmeier 2009). Examination of fresh stomachs from 1975 - 1985 suggested no difference between the proportion of stomachs containing mostly bivalve and non-bivalve prey (Sheffield and Grebmeier 2009). Bivalves, gastropods (snails and slugs), and polychaete worms occurred most frequently in stomachs from the Bering and Chukchi seas. Although bivalves and gastropods occurred more frequently in stomachs from the Bering and Chukchi seas, respectively, it was most likely due to their differential variability at these locations (Sheffield and Grebmeier 2009). Male and female walruses consumed essentially the same prey when at the same location (Sheffield and Grebmeier 2009).

Although walruses are capable of diving to depths of more than 250 m (820 ft) (Born et al. 2005), they usually forage in waters 80 m (262 ft) deep or less (Fay and Burns 1988; Born et al. 2003; Kovacs and Lydersen 2008), presumably because of higher productivity of benthic foods in shallow waters (Fay and Burns 1988; Carey 1991; Jay et al. 2001; Grebmeier et al. 2006a; 2006b). Walruses make foraging trips that range from a few hours up to several days from land or ice haulouts (Jay et al. 2001; Born et al. 2003; Ray et al. 2006; Udevitz et al. 2009). Walruses tend to make more frequent but shorter trips, both in duration and distance, when using sea-ice as a foraging platform compared to terrestrial haulouts (Udevitz et al. 2009). Satellite telemetry data from walruses using Bering Sea-ice indicated that walruses spent 46 hours on average in the water between bouts of rest on the ice (Udevitz et al. 2009). Male walruses appear to have greater foraging endurance than females, with such excursions from land haulouts lasting up to 142 hours (Jay et al. 2001).

Threats

The two main stressors for Pacific walruses are loss of sea-ice resulting from climate change and subsistence hunting (76 FR 7634; Jay et al. 2011). We discuss these factors and other stressors that may be influencing walruses across their range.

Climate Change and Use of Coastal Haulouts in Summer

While the overall geographic range of Pacific walruses has not changed, over the past decade the number of walruses coming to shore along the coastline of the Chukchi Sea in both Alaska and Chukotka has increased from the hundreds to thousands to greater than 100,000 (Kavry et al. 2008; Garlich-Miller et al. 2011; Jay et al. 2011). Additionally, adult female and young walruses are arriving at these coastal haulouts as much as a month earlier and staying at the coastal haulouts a week or two longer. In fall 2007, 2009, 2010, and 2011 large walrus aggregations (3,000 - 20,000) were observed along the Alaska coast (Garlich-Miller et al. 2011). This increased use of coastal haulouts is a function of the loss of summer sea-ice over the continental shelf (Garlich-Miller et al. 2011). Summer sea-ice extent in the Chukchi Sea has decreased by about 12% per decade (NSIDC 2012); retreating off the shallow continental shelf and remaining only over deep Arctic Ocean waters where walruses cannot reach the benthos to feed. Declines in Chukchi Sea-ice extent, duration, and thickness are projected to continue in a linear fashion into the foreseeable future (Douglas 2010).

Increased use of coastal haulouts has several consequences. First, increased use of summer land haulouts by adult females and young could result in increased energy expenditures from foraging trips originating from shore and reduced access to preferred feeding grounds (Jay et al. 2011). Second, an increased dependence on coastal haulouts is likely to subject walruses to increased anthropogenic and natural disturbance; exposure to disturbance at coastal haulouts can lead to increased injury and mortality via trampling as walruses stampede into the water following disturbances (76 FR 7634). Such events have led to the trampling and death of hundreds of walruses in Alaska and thousands in Russia (calves are particularly vulnerable), presumably when herds were disturbed from anthropogenic and predator stimuli (citations *in* Jay et al. 2011: Kavry et al. 2008; Kochnev et al. 2008; Fischbach et al. 2009). An unusually high number of walruses hauled out and high levels of mortality occurred on the shores of Wrangel Island, Russia (citation *in* Jay et al. 2011: Ovsyanikov et al. 2008). Predators and human hunters may also indirectly cause calves to be crushed and die by causing stampedes (76 FR 7634). Third, as they become increasingly dependent on coastal haulouts, walruses will become more susceptible to predation by polar bears (especially on calves) and hunting by humans. Continued loss of sea-ice will likely cause walruses to become increasingly dependent on coastal haulouts in the summer and into the fall and early winter.

Subsistence Harvest

Pacific walruses have been an important subsistence resource for coastal Alaskan and Russian Natives for thousands of years (Ray 1975), and its harvest is likely to continue into the foreseeable future (76 FR 7634). The Pacific walrus population has experienced an estimated annual harvest of 3,200 - 16,100 animals from 1960 through 2000 (mean: 6,993; Angliss and Allen 2009). However, harvest estimates have declined, and recent harvest estimates are lower than historical levels, as demonstrated in a lower five-year mean from 2006 through 2010 (4,852 ± 346 SE; Table A-13; USFWS unpublished data) than the full data range. It is not known whether lower harvest levels reflect changes in walrus abundance or hunting effort. Factors affecting harvest levels include the cessation of Russian commercial walrus harvests after 1991, changes in political, economic, and social conditions of subsistence hunters in Alaska and Chukotka, and the effects of variable weather and ice conditions (Angliss and Allen 2009). No statewide harvest quotas exist in Alaska at this time.

The Service has adopted the average annual harvest over the past five years as a representative estimate of current harvest levels in Alaska and Chukotka (USFWS 2013c). Harvest mortality levels from 2006 - 2010 are estimated at 3,828 - 6,119 walruses per year (Table A-13) which includes adjusting for animals mortally wounded but not retrieved and required harvest reporting non-compliance rates. These harvest levels are approximately 4% of the minimum population estimate of 129,000 animals (Speckman et al. 2011). However, uncertainty regarding the population status and trend makes it difficult to quantify appropriate removal levels (Garlich-Miller et al. 2011). Jay et al. (2011) used Bayesian network modeling to determine that, along with the loss of sea-ice, harvest will likely cause a “worsening condition” (i.e., change the walrus population state from robust or persistent to vulnerable, rare, or extirpated) for the Pacific walrus population. Harvest is likely to continue at or near current levels, despite population declines in response to loss of summer sea-ice (76 FR 7634: 7657).

Table A-13. Mean estimated annual harvest (standard error) of Pacific walruses, 2006 - 2010. Russian harvest information was provided by Chukot TINRO and the Russian Agricultural Department. United States harvest information was collected by USFWS, and adjusted for unreported walruses using a mark-recapture method. Total harvest includes a struck and lost factor of 42% (Fay et al. 1994).

Year	Total harvest	United States harvest	Russian harvest
2006	4,022(157)	1,286(91)	1,047
2007	6,119(127)	2,376(74)	1,173
2008	3,828(185)	1,442(107)	778
2009	5,547(654)	2,123(379)	1,110
2010	4,716(308)	1,682(178)	1,053
Five year mean	4,852(346)	1,782(200)	1,032(67)

[Top]

Walrus Research

The DMA permits walrus research under the MMPA. Currently, the DMA permits researchers to: capture walruses for the purpose of taking tissue samples and attaching satellite telemetry tags; remotely collect tissue samples and attach satellite telemetry to walrus using small harpoon and a crossbow; and survey Pacific walrus population from aircraft and vessels. Typically, DMA allows between one and six deaths annually for each permit (currently, there are three active permits). Permits contain measures to minimize effects of research activities (e.g., to avoid causing stampedes at haulouts).

Disease

Walruses are susceptible to a variety of viral, bacterial, and parasitic infections. Sonsthagen et al. (2014) found low genetic diversity among genes associated with immune response, suggesting walruses may have limited resilience to novel pathogens. Increased use of terrestrial haulouts may escalate the risk of disease transmission (Garlich-Miller et al. 2011). For example, beginning in 2011, about 6% of 300 live walruses presented with unusual ulcerative lesions of the skin of unknown etiology (Garlich-Miller et al. 2011). Most (11/17; 65%) were sub-adults (2 - 6 years old), the other six animals were adults (Garlich-Miller et al. 2011). In general, the animals with skin lesions appeared to be otherwise robust, active and healthy (Garlich-Miller et al. 2011). The number of animals that may have died from this condition is unknown, but at the Point Lay haulout in September 2011, 14 of 19 (74%) fresh or moderately decomposed carcasses exhibited these lesions. This outbreak also affected ice seals, which are managed by the NOAA. The Service and NOAA deemed this infection as an Unusual Mortality Event (UME) in a joint press release dated December 20, 2011 (NOAA Fisheries 2011). Far fewer seals with symptoms of the syndrome were observed in 2012 and no walruses with lesions were seen, but haulouts did not form in the United States or Russia in 2012. Despite these UMEs, the importance of disease as a significant species-level threat to Pacific walruses remains uncertain.

Pollution, Contaminants and Other Activities

Human activity in walrus habitat could impact walruses. For example, noise from aircraft may disturb walruses at haulouts, possibly causing stampedes. Underwater noise, such as open-water seismic exploration (e.g., with air gun arrays), may potentially affect marine mammal hearing and/or communication. Oil and gas activities are a source of human disturbance in walrus habitat. Models of oil and gas exercises (Jay et al. 2011; MacCracken et al. 2013) did not identify activities such as ship and air traffic as stressors strongly influencing modeled outputs, possibly due to the low levels of these activities at that time. Oil and gas activities, spills, commercial fisheries interactions, and shipping do not currently appear to threaten the Pacific walruses population as a whole, and they are not likely to pose a significant risk to the listed species in the foreseeable future (76 FR 7634: 7671), but see the Environmental Baseline and Effects of the Action sections for further discussion of the occurrence of these factors in the Action Area and the role their impacts on individuals.

Spectacled Eider

Species Description

The spectacled eider is a large sea duck, 52–56 cm long (20–22 in). Sea ducks spend at least part of their lives at sea or on large waterbodies, and are a subgroup of the subfamily Anatinae, family Anatidae. The spectacled eider is one of three species in the genus Somateria. All Somateria species' ranges include the United States. In the winter and spring, adult male spectacled eiders are in breeding plumage with a black chest, white back, and pale green head (see Cover Photo). Females, juveniles, and males during the non-breeding season are mottled brown. Spectacled eiders are diving ducks that spend most of the year in marine waters where they primarily feed on bottom dwelling molluscs and crustaceans.

Status and Distribution

Spectacled eiders were listed as threatened throughout their range in based on indications of steep declines in the two Alaska-breeding populations (58 CFR 27474). There are three primary spectacled eider populations, corresponding to breeding grounds on Alaska's North Slope, Y-K Delta, and northern Russia. The Y-K Delta population declined 96% between the early 1970s and 1992 (Stehn et al. 1993). Data from the Prudhoe Bay oil fields (Warnock and Troy 1992) and information from Native elders at Wainwright, Alaska (R. Suydam, pers. comm. *in* USFWS 1996) suggested concurrent localized declines on the North Slope, although data for the entire North Slope breeding population were not available. Historically, spectacled eiders nested in Alaska discontinuously from the Nushagak Peninsula north to Barrow, and east nearly to Canada's Yukon Territory (Phillips 1922 - 1926; Bent 1925; Bailey 1948; Dau and Kistchinski 1977; Derksen et al. 1981; Garner and Reynolds 1986; Johnson and Herter 1989).

The most recent rangewide estimate of abundance of spectacled eiders was 369,122 (364,190–374,054 90% CI), obtained by aerial surveys of the known wintering area in the Bering Sea in late winter 2010 (Larned et al. 2012a). Comparison of point estimates between 1997 and 2010 indicate an average of 353,051 spectacled eiders (344,147 - 361,956; 90% CI) in the global population over that 14-year period (Larned et al. 2012b). The population growth rate is approximately stable over the long term (0.99, 90% CI: 0.98 - 1.01) and over the last 10 years (1.00, 90% CI: 0.97 - 1.03) (Larned et al. 2012a).

Life History

Breeding

In Alaska, spectacled eiders breed primarily on the North Slope (ACP) and the Y-K Delta. On the ACP, spectacled eiders breed north of a line connecting the mouth of the Utukok River to a point on the Shaviovik River about 24 km (15 mi) inland from its mouth, with breeding density varying across the ACP (Figure A-25). Although spectacled eiders historically occurred throughout the coastal zone of the Y-K Delta, they currently breed primarily in the central coast zone within about 15 km (9 mi) of the coast from Kigigak Island north to Kokechik Bay (USFWS 1996). However, sightings on the Y-K Delta have also occurred both north and south of this area during the breeding season (R. Platte, USFWS, unpublished data).

Spectacled eiders arrive on the ACP breeding grounds in late May to early June. Numbers of breeding pairs peak in mid-June and decline four to five days later when males begin to depart from the breeding grounds (Smith et al. 1994; Anderson and Cooper 1994; Bart and Earnst

2005). Mean clutch size reported from studies on the Colville River Delta was 4.3 (Bart and Earnst 2005). Spectacled eider clutch size near Barrow has averaged 3.2–4.1, with clutches of up to eight eggs reported (Quakenbush et al. 1995; Safine 2011). Incubation lasts 20–25 days (Kondratev and Zadorina 1992; Harwood and Moran 1993; Moran 1995), and hatching occurs from mid- to late July (Warnock and Troy 1992).

Nest initiation on Kigigak Island on the Y-K Delta occurs from mid-May to mid-June (Lake 2007). Incubation lasts approximately 24 days (Dau 1974). Mean spectacled eider clutch size is higher on the Y-K Delta compared to the ACP. Mean annual clutch size ranged from 3.8–5.4 in coastal areas of the Y-K Delta (1985–2011; Fischer at al. 2011), and 4.0–5.5 on Kigigak Island (1992–2011; Gabrielson and Graff 2011), with clutches of up to eight eggs reported (Lake 2007). On the breeding grounds, spectacled eiders feed on mollusks, insect larvae (craneflies, caddisflies, and midges), small freshwater crustaceans, and plants and seeds (Kondratev and Zadorina 1992) in shallow freshwater or brackish ponds, or on flooded tundra. Ducklings fledge approximately 50 days after hatch, when females with broods move from freshwater to marine habitat prior to fall migration.

Nest success appears to be variable depending on year and location. Bowman et al. (2002) reported high variation in nest success (20–95%) among spectacled eiders on the Y-K Delta. Recruitment rate (the percentage of young eiders that hatch, fledge, and survive to sexual maturity) of spectacled eiders is poorly known because there is limited data on juvenile survival (USFWS 1999). In a coastal region of the Y-K Delta, duckling survival to 30 days averaged 34%, with 74% of mortality occurring in the first 10 days, while survival of adult females during the first 30 days post hatch was 93% (Flint and Grand 1997).

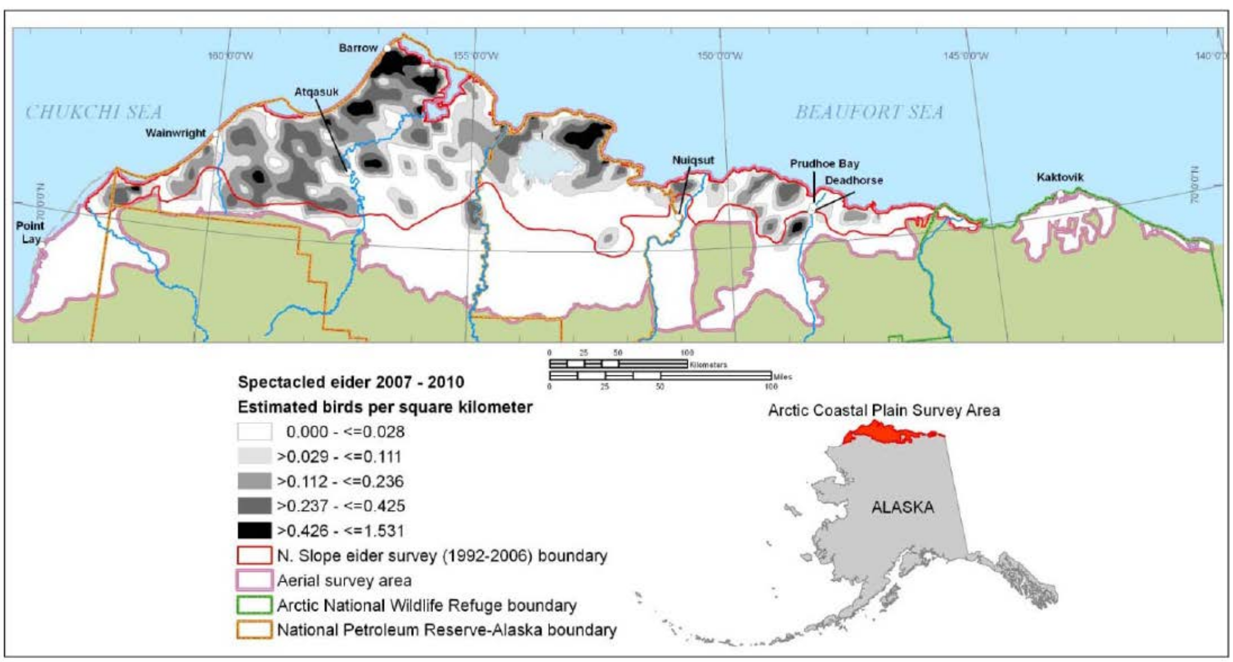

Figure A-25. Density distribution of spectacled eiders observed on aerial transects sampling 57,336 km^2 of wetland tundra on the North Slope of Alaska during early to mid-June, 2007 - 2010. From Larned 2011. [Top]

Fall migration

After breeding, spectacled eiders migrate to several discrete molting areas, with birds from the different populations and genders apparently favoring different molting areas (Petersen et al. 1999). After molting, spectacled eiders migrate to openings in the pack ice of the central Bering Sea south/southwest of St. Lawrence Island (Petersen et al. 1999; Figure A-26), where they remain until March or April (Lovvorn et al. 2003).

As with many other sea ducks, spectacled eiders spend the 8–10 month non-breeding season at sea. Satellite telemetry and aerial surveys led to the identification of spectacled eider migrating, molting, and wintering areas. These studies are summarized in Petersen et al. (1995 and 1999) and Larned et al. (1995). Results of more recent satellite telemetry research (2008–2011) are consistent with earlier studies (Matt Sexson, USGS, unpublished data). Phenology, spring migration and breeding, including arrival, nest initiation, hatch, and fledging, is 3–4 weeks earlier in western Alaska (Y-K Delta) than northern Alaska (ACP); however, phenology of fall migration is similar between areas. Individuals depart breeding areas in July–September, depending on breeding status and success, and molt in September–October.

Males generally depart breeding areas on the ACP when females begin incubation in late June (Anderson and Cooper 1994; Bart and Earnst 2005). Use of the Beaufort Sea by departing males is variable. Some appear to move directly to the Chukchi Sea over land, while the majority move rapidly (average travel of 1.75 days), over nearshore waters from breeding grounds to the Chukchi Sea (TERA 2002). Of 14 males implanted with satellite transmitters, only four spent an extended period of time (11–30 days) in the Beaufort Sea (TERA 2002). Males appeared to prefer areas near large river deltas such as the Colville River where open water is more prevalent in early summer when much of the Beaufort Sea is still frozen. Most adult males marked with satellite transmitters in northern and western Alaska in a recent satellite telemetry study migrated to northern Russia to molt (USGS, unpublished data). Results from this study also suggest that male eiders likely follow coast lines but also migrate straight across the northern Bering and Chukchi seas *en route* to northern Russia (Matt Sexson, USGS, unpublished data).

Females generally depart the breeding grounds later, when more of the Beaufort Sea is ice-free, allowing more extensive use of the area. Females spent an average of two weeks in the Beaufort Sea (range 6 - 30 days) with the western Beaufort Sea the most heavily used (TERA 2002). Females also appeared to migrate through the Beaufort Sea an average of 10 km further offshore than males (Petersen et al. 1999). The greater use of the Beaufort Sea and offshore areas by females was attributed to the greater availability of open water when females depart the area (Petersen et al. 1999, TERA 2002). Recent telemetry data indicate that molt migration of failed/non-breeding females from the Colville River Delta through the Beaufort Sea is relatively rapid (two weeks), compared to 2–3 months spent in the Chukchi Sea (Matt Sexson, USGS, unpublished data).

Molting and Wintering

Spectacled eiders use specific molting areas from July to late October/early November. Larned et al. (1995) and Petersen et al. (1999) found spectacled eiders' show strong preference for specific molting locations, and concluded that spectacled eiders molt in four discrete areas (Table A-14). Females generally used molting areas nearest their breeding grounds. All marked females from the Y-K Delta molted in nearby Norton Sound, while females from the North Slope molted in Ledyard Bay, along the Russian coast, and near St. Lawrence Island. Males did not show strong molting site fidelity; males from all three breeding areas molted in Ledyard Bay, Mechigmenskiy Bay, and the Indigirka/Kolyma River Delta. Males reached molting areas first, beginning in late June, and remained through mid-October. Non-breeding females, and those that nested but failed, arrived at molting areas in late July, while successfully-breeding females and young of the year reached molting areas in late August through late September and remained through October. Fledged juveniles marked on the Colville River Delta usually staged in the Beaufort Sea near the delta for 2–3 weeks before migrating to the Chukchi Sea.

Table A-14. Important staging and molting areas for female and male spectacled eiders from each breeding population.

Population and Sex	Known Major Staging/Molting Areas
Arctic Russia Males	Northwest of Medvezhni (Bear) Island group Mechigmenskiy Bay Ledyard Bay
Arctic Russia Females	Unknown
North Slope Males	Ledyard Bay Northwest of Medvezhni (Bear) Island group Mechigmenskiy Bay
North Slope Females	Ledyard Bay Mechigmenskiy Bay West of St. Lawrence Island
Y-K Delta Males	Mechigmenskiy Bay Northeastern Norton Sound
Y-K Delta Females	Northeastern Norton Sound

[Top]

Avian molt is energetically demanding, especially for species such as spectacled eiders that complete molt in a few weeks. Molting birds require adequate food resources, and apparently the benthic community of Ledyard Bay (Feder et al. 1989, 1994a, 1994b) provides this for spectacled eiders. Large concentrations of spectacled eiders molt in Ledyard Bay using this food resource; aerial surveys on four days in different years counted 200 - 33,192 molting spectacled eiders in Ledyard Bay (Petersen et al. 1999; Larned et al. 1995).

Spectacled eiders generally depart molting areas in late October/early November (Matt Sexson, USGS, unpublished data), migrating offshore in the Chukchi and Bering seas to a single wintering area in pack-ice lead complexes south/southwest of St. Lawrence Island (Figure A-26). In this relatively shallow area, > 300,000 spectacled eiders (Petersen et al. 1999) rest and feed, diving up to 70 m (230 ft) to eat bivalves, other mollusks, and crustaceans (Cottam 1939; Petersen et al. 1998; Lovvorn et al. 2003; Petersen and Douglas 2004).

Spring migration

Recent information indicates spectacled eiders likely make extensive use of the eastern Chukchi spring lead system between departure from the wintering area in March and April and arrival on the North Slope in mid-May or early June. Limited spring observations in the eastern Chukchi Sea have documented dozens to several hundred common eiders (*Somateria mollissima)* and spectacled eiders in spring leads and several miles offshore in relatively small openings in rotting sea-ice (W. Larned, USFWS, unpublished data). Woodby and Divoky (1982) documented large numbers of king (*Somateria spectabilis*) and common eiders using the eastern Chukchi lead system, advancing in pulses during days of favorable following winds, and concluded that an open lead is probably requisite for spring eider passage in this region. Preliminary results from an ongoing satellite telemetry study conducted by the USGS Alaska Science Center (Figure A-26) suggest that spectacled eiders also use the lead system during spring migration.

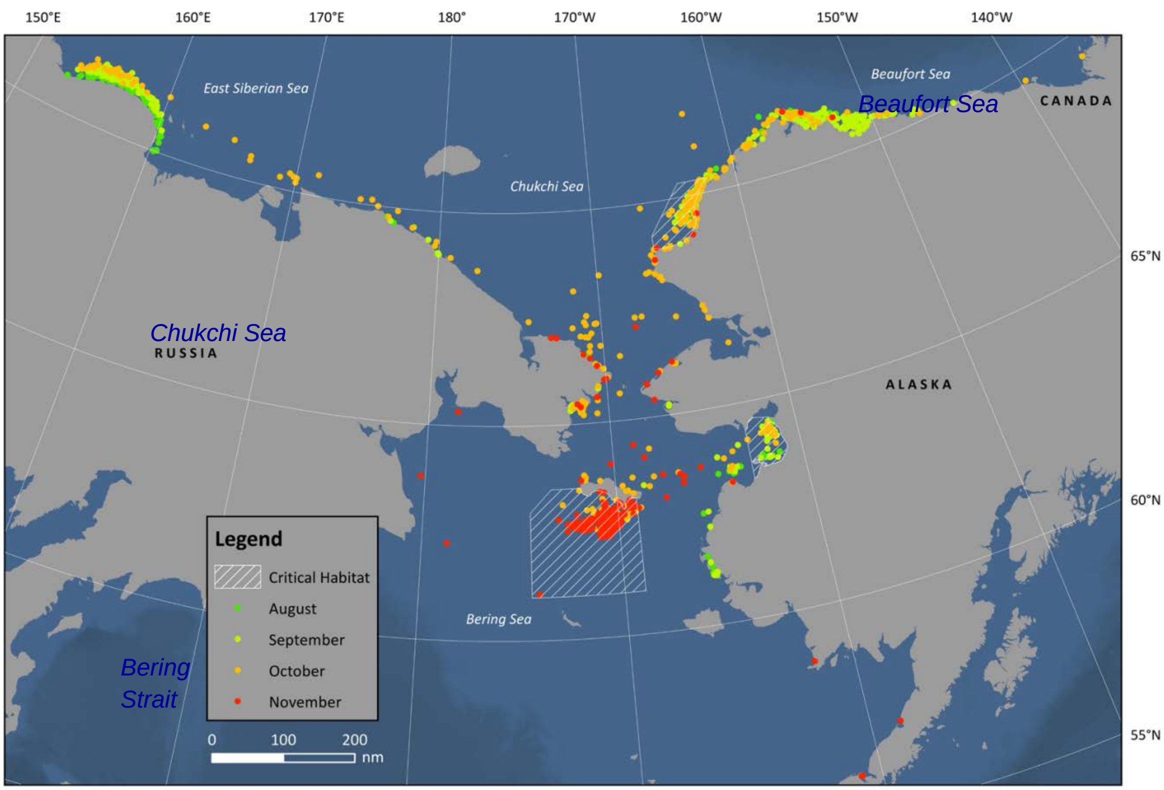

Figure A-26. Spectacled eider satellite telemetry locations 2008 - 2011 (M. Sexson, USGS Alaska Science Center, unpub. data). [Top]

Adequate foraging opportunities and nutrition during spring migration are critical to spectacled eider productivity. Like most sea ducks, female spectacled eiders do not feed substantially on the breeding grounds, but produce and incubate their eggs while living primarily off body reserves (Korschgen 1977; Drent and Daan 1980; Parker and Holm 1990). Clutch size, a measure of reproductive potential, was positively correlated with body condition and reserves obtained prior to arrival at breeding areas (Coulson 1984; Raveling 1979; Parker and Holm 1990). Body reserves must be maintained from winter or acquired during the 4 - 8 weeks

(Lovvorn et al. 2003) of spring staging, and Petersen and Flint (2002) suggest common eider productivity on the western Beaufort Sea coast is influenced by conditions encountered in May to early June during spring migration through the Chukchi Sea (including Ledyard Bay). Common eider female body mass has been found to increase 20% during the 4 - 6 weeks prior to egg laying (Gorman and Milne 1971; Milne 1976; Korschgen 1977; Parker and Holm 1990). For spectacled eiders, average female body weight in late March in the Bering Sea was 1,550 ± 35 g (n = 12), and slightly (but not significantly) more upon arrival at breeding sites (1,623 ± 46 g, n = 11; Lovvorn et al. 2003), indicating that spectacled eiders maintain or enhance their physiological condition during spring staging.

Threats

Predation

Primary predators of spectacled eiders and their eggs include gulls (*Larus* spp.), jaegers (*Stercorarius* spp.), red foxes (*Vulpes vulpes*), and arctic foxes (*Vulpes lagopus*). In arctic Russia, apparent nest success was estimated to be < 2% in 1994 and 27% in 1995; low nest success was attributed to predation (Pearce et al. 1998). Apparent nest success in 1991 and 1993–1995 in the Kuparuk and Prudhoe Bay oil fields on the ACP was also low, varying from 25–40% (Warnock and Troy 1992; Anderson et al. 1998). On Kigigak Island in the Y-K Delta, nest survival probability ranged from 0.06–0.92 from 1992– 2007 (Lake 2007); nest success tended to be higher in years with low fox numbers or activity (i.e., no denning) or when foxes were eliminated from the island prior to the nesting season.

Contaminants/Lead

The deposit of lead shot in habitats used for foraging is a threat to spectacled eiders. An eider was found with ingested lead shot on the Y-K Delta in 1978 (C. Dau *in* Franson et al. 1995), and confirmed mortalities due to lead ingestion were recorded in 1992 - 1994 (Franson et al. 1995). Lead has been detected in blood samples and ingested lead was found on x-rays of spectacled eiders on the Y-K Delta (USFWS 1996). Birds dying of lead poisoning have been confirmed from two locations on the Y-K Delta (Franson et al. 1995), but it is not known how common or widespread this problem is on the Y-K Delta or elsewhere.

Available data indicate egg hatchability is high for spectacled eiders nesting on the ACP, in arctic Russia, and at inland sites on the Y-K Delta, but considerably lower in the coastal region of the Y-K Delta. Spectacled eider eggs that are addled or that do not hatch are very rare in the Prudhoe Bay area (Declan Troy, TERA, unpublished data 1997), and Esler et al. (1995) found very few addled eggs on the Indigirka River Delta in Arctic Russia. Additionally, from 1969 - 1973 at an inland site on the Yukon Delta National Wildlife Refuge, only 0.8% of spectacled eider eggs were addled or infertile (Dau 1974). In contrast, 24% of all nests monitored in a coastal region of the Y-K Delta during the early to mid-1990s contained inviable eggs and ~10% of eggs in successful nests did not hatch due to either embryonic mortality or infertility (Grand and Flint 1997). This relatively high occurrence of inviable eggs near the coast of the Y-K Delta may have been related to exposure to contaminants (Grand and Flint 1997). It is unknown whether hatchability of eggs in this region has improved with decreased use of lead shot in the region and gradual settling of existing lead pellets (Flint and Schamber 2010) in coastal Y-K Delta wetlands.

Steller's eider

Species Description

The Steller's eider is a sea duck with a circumpolar distribution and the sole member of the genus *Polysticta*. The Steller's eider is the smallest of the four eider species, weighing approximately 700–800 g (1.5–1.8 lbs). Adult male Steller's eiders in breeding plumage have a black back, white shoulders, and a chestnut brown breast and belly. The males have a white head with black eye patches; they also have a black chin patch and a small greenish patch on the back of the head. Females and juveniles are mottled dark brown.

Status and Distribution

The Alaska breeding population of the Steller's eider was listed as threatened on July 11, 1997 based on substantial contraction of the species' breeding range in Alaska, reduced numbers of Steller's eiders breeding in Alaska, and the resulting vulnerability of the remaining breeding population to extirpation (USFWS 1997). Periodic non-breeding of the entire population of Steller's eiders breeding near Barrow, Alaska, the species' primary breeding grounds, coupled with low nesting and fledging success, has resulted in very low productivity (Quakenbush et al. 2004) and may make the population particularly vulnerable to extirpation.

Steller's eiders are divided into Atlantic and Pacific populations; the Pacific population is further divided into the Russia-breeding population, which nests along the Russian eastern arctic coastal plain, and the Alaska-breeding population. In Alaska, Steller's eiders breed almost exclusively on the ACP. While they historically nested on the Y-K Delta, only a few nests have been found there in recent years. During the molt and over winter, they mix with the majority of the Russia-breeding population in southcentral Alaska (Figure A-27).

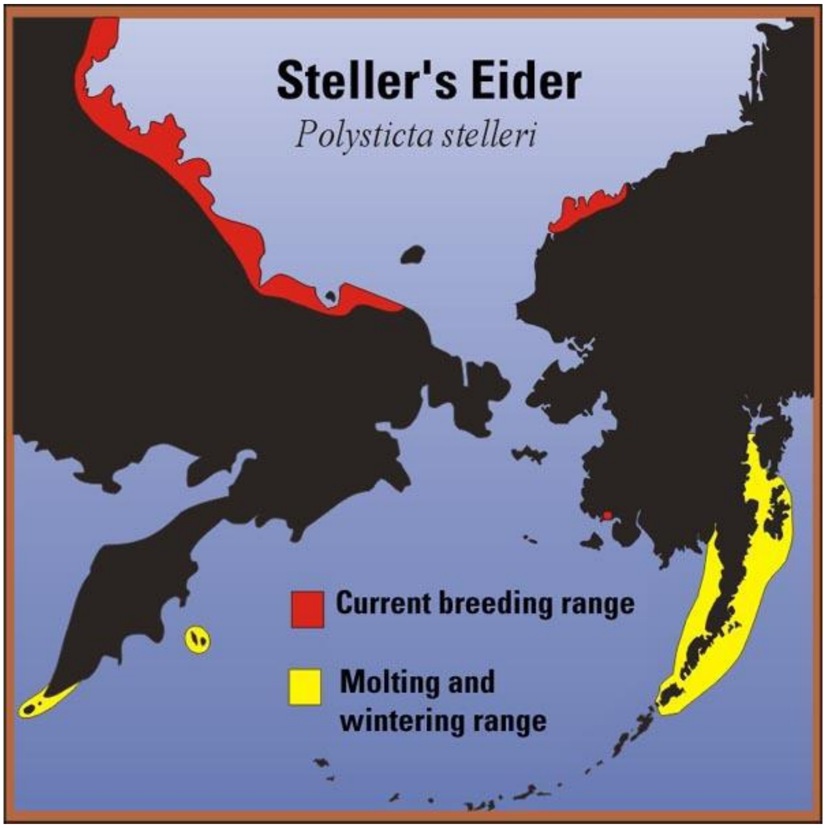

Figure A-27. Steller's eider distribution in the Bering, Beaufort, and Chukchi seas. [Top]

Range-wide Trends

The population of Pacific wintering Steller's eiders molting and wintering along the Alaska Peninsula has declined since the 1960s (Kertell 1991). The long-term trend from annual spring aerial surveys (1992 - 2011) indicates a 2.3% decline per year (R^2=0.34) (Larned 2012). Counts of Steller's eiders conducted during fall surveys for emperor geese indicate a 1.6% per year increase from 1979 - 2010. Banding data from 1975 - 1981 and 1991 - 1997 indicates a reduction in Pacific wintering Steller's eider survival over time (Flint et al. 2000). Population models for other waterfowl, applied to this species, indicate that reductions in annual survival would have a substantial negative effect on populations (Schmutz et al. 1997; Flint et al. 2000).

While current distribution on the North Slope breeding range has been reduced compared to the historical distribution (Quakenbush et al. 2002), the population trajectory for the North Slope population remains ambiguous (Stehn and Platte 2009). Data from the 1989 - 2006 ACP aerial surveys indicate that North American breeding Steller's eiders are in decline (λ=0.778, 0.686 - 0.882, 90% CI; Mallek at al. 2007), while the 1992 - 2008 North Slope Eider (NSE) survey data suggest that the population is increasing (λ=1.059, 0.909 - 1.235, 90% CI; Larned et al. 2008). Aerial survey data from 1999 - 2007 suggest a declining growth rate (λ=0.934, 0.686 - 1.272, 90% CI; Obrischkewitsch et al. 2008). Analysis of a subset of data from the NSE aerial survey

(1993 - 2008) estimates that growth is stable (λ=1.011, 0.857 - 1.193, 90% CI; Stehn and Platte 2009).

Aerial surveys that included the Y-K Delta, but did not include the ACP, indicated that the Y-K Delta population of eiders has declined by 90% since 1957 (Hodges et al. 1996). For the 1950s and early 1960s, the upper limit of the population, excluding the North Slope, had been estimated to be approximately 3,500 pairs (Kertell 1991). Kertell (1991) concluded that the Steller's eider had been extirpated from the Y-K Delta prior to 1990. The numbers of birds currently breeding on the Y-K Delta are not likely to be sufficient to sustain a breeding population (Kertell 1991; Quakenbush 2002). This population is most likely dependent on immigration from the Alaska-breeding or Russian breeding populations. If there is no permanent immigration or emigration between Russian breeding and Alaska-breeding Steller's eiders, if declining trends continue, and if the available estimates of vital rates are accurate and precise, the listed Steller's eiders have a high probability of extinction in the foreseeable future (Swem and Matz 2008).

Population Size

Population sizes are only imprecisely known. The Pacific wintering population is estimated to be about 74,369 birds (Larned 2012). The threatened Alaska-breeding population is thought to number approximately 500 individuals on the ACP (Stehn and Platte 2009), and as few as 10-50 on the Y-K Delta (USFWS, unpublished data).

Arctic Coastal Plain (ACP)/North Slope

Steller's eider population and trends have been obtained from the following three aerial surveys on the ACP: the USFWS ACP survey, 1989–2006 (Mallek et al. 2007) and 2007–2008 (new ACP survey design; Larned et al. 2008, 2009); the Service's North Slope eider survey 1992–2008 (Larned et al. 2009) and 2007–2008 (NSE strata of new ACP survey; Larned et al. 2008, 2009); and the Barrow Triangle (ABR, Inc.,) survey, 1999–2007 (Obrishkewitsch et al. 2008). In 2007, the ACP and NSE surveys were combined under a new ACP survey design.

The aerial survey efforts provide a range of estimates of the North Slope breeding population size. Estimates, including results from previous analyses of the ACP and NSE survey data, are summarized in Table A-15 and Table A-16 Caution must be used when interpreting the survey results. Neither the surveys conducted by Mallek et al. (2006) nor Larned et al. (2010) were originally designed to estimate Steller's eider populations. Surveys differed in spatial extent, seasonal timing, sampling intensity, and duration. Most observations of Steller's eider from both surveys occurred within the boundaries of the NSE survey (Figure A-28).

Following assessment of potential biases inherent in the two Service surveys, Stehn and Platte (2009) identified a subset of the NSE survey data (1993–2008) that they determined was "least confounded by changes in survey timing and observers." Based on this subset of the NSE survey, the average geographically-extrapolated population index total for Steller's eiders was 173 (90% CI: 88–258) with an estimated population growth rate of 1.011 (90% CI: 0.857–1.193). The average population size of Steller's eiders breeding in the ACP was estimated at 576 (292–859, 90% CI; Stehn and Platte 2009), assuming a detection probability of 30%. The 30%

detection probability and associated visibility correction factor of 3.33 was selected based on evaluation of estimates for similar species and habitats (Stehn and Platte 2009).

Table A-15. Aerial population estimates for Steller's eiders, from the North Slope.

Year	Population Estimate	Nesting Status Near Barrow	Year	Population Estimate	Nesting Status Near Barrow
1986	0[4]	Non-nesting	1998	281[4]/0[5]	Non-nesting[1]
1987	0[4]	Non-nesting	1999	1250[4]/785[5]	Nesting[1]
1988	0[4]	Non-nesting	2000	563[4]/0[5]	Nesting[2]
1989	2002[4]	Nesting	2001	176[4]/288[5]	Non-nesting[2]
1990	534[4]	Nesting	2002	0[4]/0[5]	Non-nesting[2]
1991	1118[4]	Nesting[1]	2003	0[4]/93[5]	Non-nesting[2]
1992	954[4] /0[5]	Non-nesting[1]	2004	0[4]/48[5]	Non-nesting[2]
1993	1313[4]/262[5]	Nesting[1]	2005	110[4]/99[5]	Nesting[2]
1994	2524[4]/47[5]	Non-nesting[1]	2006	96[3]/112[5]	Nesting[2]
1995	931[4]/281[5]	Nesting[1]	2007	96[6]	Nesting[2]
1996	2543[4]/0[5]	Nesting[1]	2008	576[7]	Nesting[2]
1997	1295[4]/189[5]	Nesting[1]			

[1] Quakenbush et al. 2001; [2] Nora Rojek, USFWS, pers. comm.; [3] Ritchie et al. 2006; [4] Mallek et al. 2005; [5] Larned et al. 2009; [6]Obritschkewitsch et al. 2008; [7]Stehn and Platte 2009 [Top]

Table A-16. Steller's eider males, nests, and pair densities recorded during ground-based and aerial surveys conducted near Barrow, Alaska 1999–2010 (modified from Safine 2011).

Year	Overall ground-based survey area			Standard Ground-based Survey Area[a]		Aerial survey of Barrow Triangle		Nests found near Barrow
	Area (km^2)	Males counted	Pair density (males/km^2)	Males counted	Pair density (males/km^2)	Males counted	Pair density (males/km^2)[b]	
1999	172	135	0.78	132	0.98	56	0.04	36
2000	136	58	0.43	58	0.43	55	0.04	23
2001	178	22	0.12	22	0.16	22	0.02	0
2002	192	1	<0.01	0	0	2	<0.01	0
2003	192	10	0.05	9	0.07	4	<0.01	0
2004	192	10	0.05	9	0.07	6	<0.01	0
2005	192	91	0.47	84	0.62	31	0.02	21
2006	191	61	0.32	54	0.4	24	0.02	16
2007	136	12	0.09	12	0.09	12	0.02	12
2008	166	114	0.69	105	0.78	24	0.02	28
2009	170	6	0.04	6	0.04	0	0	0
2010	176	18	0.1	17	0.13	4	0.01	2
2011	180	69	0.38	59	0.44	10	0.01	27

[a]Standard area (the area covered in all years) is ~134 km^2 (2008 – 2010) and ~135 km^2 in previous years.
[b]Actual area covered by aerial survey (50% coverage) was ~1408 km^2 in 1999 and ~1363 km^2 in 2000 – 2006 and 2008. Coverage was 25% in 2007 and 2010 (~682 km^2) and 27% in 2009 (~736 km^2). Pair density calculations are half the bird density calculations reported in ABR, Inc.'s annual reports (Obritschkewitsch and Ritchie 2011). [Top]

Currently, this analysis provides the best available estimate of the Alaska-breeding Steller's eider population size and growth rate from the ACP. Surveys of the northernmost portion of the ACP conducted annually by ABR, Inc., provide more intensive coverage of the nesting area (50%, 1999–2004; 25–50%, 2005–2010; Obritschkewitsch and Ritchie 2011). Based on ABR survey data, Stehn and Platte (2009) estimated that the average population index for Steller's eiders residing within the Barrow Triangle was 99.6 (90% CI: 55.5–143.7) with an estimated population growth rate of 0.934 (90% CI: 0.686–1.272). If we also assume the same 30% detection probability, the average population size of Steller's eiders breeding in the Barrow Triangle survey area would be 332 (90% CI: 185–479).

Population Structure

There are often genetic gradients or differences that correspond to the geographic distribution of the species (Lande and Barrowclough 1987). The Alaska-breeding population of Steller's eiders may contain unique geographic sub-populations arising from: 1) the distance between breeding populations on the Y-K Delta and the ACP [about 804 km (500 miles)], and 2) the anticipated site fidelity of nesting adult females (Anderson et al.1992). In contrast, the similarly distributed North Slope and Y-K Delta populations of spectacled eiders possess distinct mitochondrial DNA markers, implying limited maternal gene flow between these two areas for that species (Scribner et al. 2001). However, genetic analyses by Pearce et al. (2005) found little evidence for differentiation among and between nesting groups of Steller's eiders across their range using both nuclear and mitochondrial DNA. Pearce et al. (2005) also observed little evidence for genetic differentiation within the Pacific breeding distribution (Russia vs. Alaska) of Steller's eiders, suggesting that female gene flow is sufficiently high between the two locales, or that divergence of Russian and Alaskan breeding groups has occurred relatively recently.

Pearce and Talbot (2009) observed that the mean level and variance of genetic relatedness among all nests at Barrow in 1999 (n = 19; R_{XY} = -0.07, variance = 0.082) was nearly identical to the mean for 45 samples collected from Steller's eiders molting along the Alaska Peninsula (R_{XY} = -0.02, var = 0.075). The molting samples represent the broadest possible distribution of relatedness values since molting groups of Steller's eiders are thought to contain birds from multiple breeding areas (Dau et al. 2000). These findings corroborate conclusions by Pearce et al. (2005) of limited genetic differentiation among breeding areas. Greater differentiation would be expected if Barrow females were more closely related genetically in comparison to a larger group composed of multiple breeding areas, such as those molting and overwinter along the Alaska Peninsula.

Seasonal Distribution Patterns

Breeding Distribution

Steller's eiders breed on the western ACP in northern Alaska, from approximately Point Lay east to Prudhoe Bay, and in extremely low numbers on the Y-K Delta. On the ACP, anecdotal historical records indicate that the species occurred from Wainwright east, nearly to the Alaska-Canada border (Anderson 1913; Brooks 1915). There are very few nesting records from the eastern ACP, however, so it is unknown if the species commonly nested there or not. Currently, the species predominantly breeds on the western ACP, in the northern half of the National Petroleum Reserve-Alaska (Figure A-28). The majority of sightings in the last decade have occurred east of the mouth of the Utukok River, west of the Colville River, and within 90 km (56 mi) of the coast.

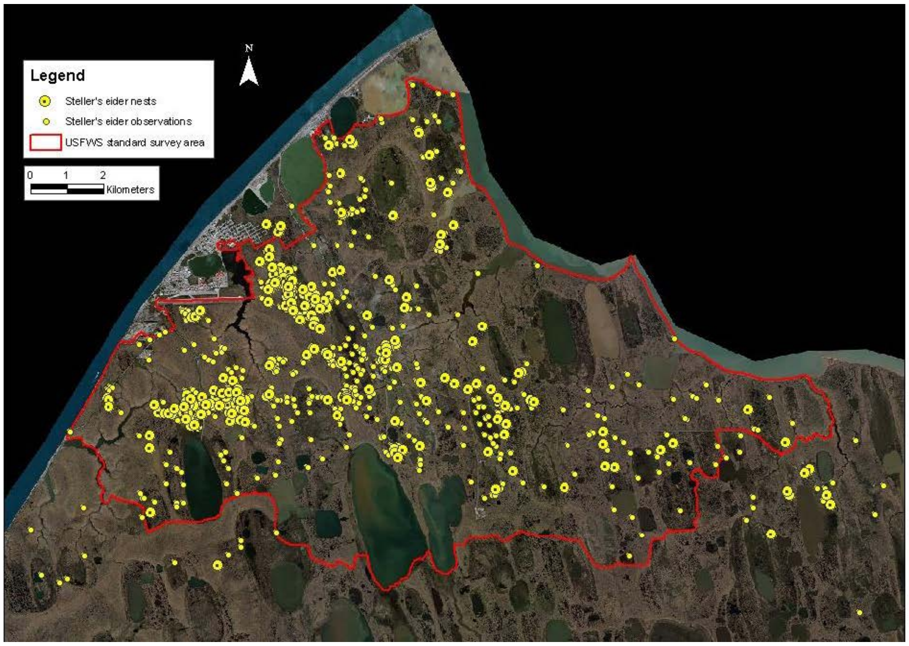

Figure A-28. Steller's eider nest locations (1991 - 2010) and breeding pair observations near Barrow (1999 - 2010). The red border represents the standard annual survey area. This survey is expanded beyond the standard survey in some years. [Top]

Steller's eiders were considered locally "common" in the central Y-K Delta by naturalists early in the 1900s (Murie 1924; Conover 1926; Gillham 1941; Brandt 1943), but nesting was reported in only a few locations. By the 1960s or 70s, the species had become extremely rare on the Y-K Delta; only six nests were found in the 1990s (Flint and Herzog 1999). Given the paucity of early-recorded observations, only subjective estimates can be made of the Steller's eider's historical abundance or distribution on the Y-K Delta. A few Steller's eiders were reportedly found nesting in other locations in western Alaska, including the Aleutian Islands in the 1870s and 1880s (Gabrielson and Lincoln 1959), Alaska Peninsula in the 1880s or 1890s (Murie and Scheffer 1959), Seward Peninsula in the 1870s (Portenko 1972), and on Saint Lawrence Island in the 1950s (Fay and Cade 1959).

Post-Breeding Distribution

Prior to migration in both nesting and non-nesting years, some Steller's eiders rest and forage in Elson Lagoon, North Salt Lagoon, Imikpuk Lake, and the Chukchi Sea in the vicinity of the northern most point of the Barrow spit. Males depart the nesting grounds soon after incubation begins, but females linger longer. From mid-July through September single hens, hens with broods and small groups of two to three birds have been observed in North Saltwater Lagoon, Elson Lagoon and near shore on the Chukchi Sea (Figure 14 in Environmental Baseline).

Molt Distribution

After breeding, Steller's eiders move to marine waters where they mix with birds from the Russian breeding population and undergo a three-week flightless molt. After the populations mix on the molting and wintering areas, there is no way to confirm whether an individual belongs to the Alaskan breeding population. We therefore assume that 0.8% of all Steller's eiders occurring on the molting and wintering grounds in Alaska are from the listed Alaska breeding population. This estimate is derived by taking the most recent North Slope breeding bird estimate (576; Stehn and Platte 2009), adding one for the Y-K Delta population (=577), and then dividing by the population estimate of Pacific-wintering Steller's eiders from 2010 (74,369; Larned 2012). Thus, 577 ÷ 74,369= (0.0078 x 100) = 0.8%.

The Pacific-wintering population molts in several main areas along the Alaska Peninsula: Izembek Lagoon (Dau 1991; Metzner 1993; Laubhan and Metzner 1999), Nelson Lagoon, Herendeen Bay, and Port Moller (Gill et al. 1981; Petersen 1981). Over 15,000 Steller's eiders have also been observed in Kuskokwim Bay (Larned and Tiplady 1996). Smaller numbers of molting Steller's eiders have been reported around islands in the Bering Sea, along the coast of Bristol Bay, and in smaller lagoons along the Alaska Peninsula (e.g., Dick and Dick 1971; Petersen and Sigman 1977; Wilk et al. 1986; Dau 1987; Petersen et al. 1991). Larned (2005) reported >2,000 eiders molting in lower Cook Inlet near the Douglas River Delta.

A few band recoveries indicate that the Alaska-breeding birds molt in Izembek Lagoon and Kuskokwim Shoals. The best available information is from the satellite telemetry studies described in Martin (2001) and Rosenberg et al. (2011). Martin (2001) marked 14 birds near Barrow, Alaska (within the range of the listed Alaska-breeding population) in 2000 and 2001. Although samples sizes were small, results suggested disproportionately high use of Kuskokwim Shoals by Alaska-breeding Steller's eiders during wing molt compared to the Pacific population as a whole, but Alaska-breeding birds were not found to preferentially use specific wintering areas. The second study marked Steller's eiders wintering near Kodiak Island, Alaska and followed birds through the subsequent spring (n = 24) and fall molt (n = 16) migrations from 2004–2006 (Rosenberg et al. 2011). Most of the birds marked near Kodiak migrated to eastern arctic Russia prior to the nesting period and none were relocated on land or in nearshore waters north of the Yukon River Delta in Alaska (Rosenberg et al. 2011).

Winter Distribution

After molt, many of the Pacific-wintering Steller's eiders congregate in select nearshore waters throughout the Alaska Peninsula and the Aleutian Islands, around Nunivak Island, the Kodiak Archipelago, and in lower Cook Inlet, although thousands may remain in lagoons used for molting (Bent 1987; Larned 2000a; Martin 2001; Larned and Zwiefelhofer 2002). Winter ice formation often temporarily forces birds out of shallow protected areas such as Izembek and Nelson Lagoons. Wintering Steller's eiders usually occur in shallow waters (< 10 meters deep), which are generally within 400 meters (m) of shore or at offshore shallows (USFWS 2002b). However, Martin et al. (*in prep*) reported substantial use of habitats >10 m deep during mid-winter. Use of these habitats by wintering Steller's eiders may be associated with night-time resting periods or with shifts in the availability of local food resources (Martin et al. *in prep*).

Spring Migration

In the spring, Steller's eiders form large flocks along the north side of the Alaska Peninsula and move east and north (Larned et al. 1993; Larned 1998; Larned 2000b). Larned (1998) concluded that Steller's eiders show strong site fidelity to "favored" habitats during migration, where they congregate in large numbers to feed before continuing their northward migration. Spring migration usually includes movement along the coast, although birds may take shortcuts across water bodies such as Bristol Bay (William Larned, USFWS, unpublished data). Several areas receive consistent use during spring migration, including Bechevin Bay, Morzhovoi Bay, Izembek Lagoon, Nelson Lagoon/Port Moller Complex, Cape Seniavin, Seal Islands, Port Heiden, Cinder River State Critical Habitat Area, Ugashik Bay, Egegik Bay, Kulukak Bay, Togiak Bay, Nanwak Bay, Kuskokwim Bay, Goodnews Bay, and the south side of Nunivak Island (Larned et al. 1993; Larned 1998; Larned 2000b). Like other eiders, Steller's eiders probably use spring leads for feeding and resting as they move northward, but there is little information on habitat use after departing spring staging areas.

Summer Distribution in Southern Alaska

A small number of Steller's eiders are known to remain along the Alaska Peninsula and Kachemak Bay during the summer; approximately 100 have been observed in Kachemak Bay, while a few may spend the summer at Izembek Lagoon (Chris Dau, USFWS, unpublished data).

Site Fidelity

In many species of waterfowl, female philopatry to breeding grounds is high (Anderson et al. 1992). Banding data from the Barrow area suggests some level of site fidelity for Steller's eiders breeding there (Quakenbush et al. 1995; P. Martin *in* USFWS 2011). Evidence of nest site philopatry has also been reported on the Y-K Delta. In 2003, 2004, and 2005, a single female Steller's eider nest was found in the same area each year. Nests were located as little as 124 m apart between years (Paul Flint, USGS, pers. comm.). Interestingly, natal philopatry has not been reported in Steller's eiders nesting in Russia (D. Solovieva, Zoological Institute, Russian Academy of Science, pers. comm.).

There is good evidence to suggest that individual eiders return to the same seasonal use areas each year, but individual fidelity to wintering areas is unknown. Eiders are known to overwinter in select nearshore waters year after year (Bent 1987; Larned and Zwiefelhofer 1995; Larned 2000a). Flocks of Steller's eiders also use the same molting areas each year (Larned 1998). About 95% of recaptured molting Steller's eiders were found at the same site at which they were banded (Flint et al. 2000). Telemetry data from Steller's eiders captured near Unalaska showed high within-season site fidelity on wintering areas (Reed and Flint 2007, P. Martin *in* USFWS 2011). Other species of waterfowl show high rates of individual fidelity to wintering areas as well (Robertson et al. 1999). This suggests that overwintering groups of Steller's eiders may belong to individual discrete subpopulations, although no information is available to confirm this.

Life History

Breeding Ecology

Steller's eiders are thought to develop pair bonds on the wintering grounds in early spring (Metzner 1993). They begin to arrive in small flocks of breeding pairs on the ACP in early June. Nesting on the ACP is concentrated in tundra wetlands near Barrow, AK (Figure A-28) and occurs at lower densities elsewhere on the ACP from Wainwright east to the Sagavanirktok River (Quakenbush et al. 2002). Nesting eiders often occupy shallow coastal wetlands in association with tundra (Quakenbush et al. 1995; Solovieva 1997) but have been observed well inland on the ACP. This species establishes nests near shallow ponds or lakes, usually close to water.

Long-term studies of Steller's eider breeding ecology near Barrow indicate periodic non-breeding by the entire local breeding population. Since 1991, Steller's eiders nests were detected in 12 of 20 study years (1991–2010; Safine 2011). Periodic non-breeding by Steller's eiders near Barrow may be associated with fluctuations in lemming populations and related breeding patterns in pomarine jaegers (*Stercorarius pomarinus*) and snowy owls (*Nyctea scandiaca*) (Quakenbush et al. 2004). In years with high lemming abundance, Quakenbush et al. (2004) reported that Steller's eider nesting success was a function of a nest's distance from pomarine jaeger and snowy owl nests. These avian predators nest only in years of high lemming abundance and defend their nests aggressively against arctic foxes (*Vulpes lagopus*). By nesting within jaeger and owl territories, Steller's eiders may benefit from protection against arctic foxes even at the expense of occasional partial nest depredation by the avian predators themselves (Quakenbush et al. 2002; Quakenbush et al. 2004). Steller's eiders may also benefit from the increased availability of alternative prey for both arctic foxes and avian predators in high lemming years (Quakenbush et al. 2004).

Mean clutch size at Barrow was 5.4 ± 1.6 SD (range = 1–8) over five nesting years in 1992–1999 (Quakenbush et al. 2004). Hatching occurs from mid-July through early August (Rojek 2006, 2007, 2008). Observations of known-age ducklings indicate that fledging occurs 32–37 days post hatch (Obritschkewitsch et al. 2001; Quakenbush et al. 2004; Rojek 2006; Rojek 2007). After hatching, hens move their broods to ponds within 0.3–3.5 km from the nests where they feed on aquatic insect larvae and crustaceans until fledging (Quakenbush et al. 2000; Rojek 2006, 2007).

Nest survival (the probability a nest will hatch at least one egg) is affected by predation levels. Predators include snowy owls, short-eared owls (*Asio flammeus*), peregrine falcons (*Falco peregrinus*), gyrfalcon (*Falco rusticolus*), pomarine jaegers, rough-legged hawks (*Buteo lagopus*), common ravens (*Corvus corax*), glaucous gulls (*Larus hyperboreus*), Arctic fox, red fox (*V. vulpes*), and bald eagles (*Haliaeetus leucocephalus*) (Quakenbush et al. 1995; Rojek 2008, Safine 2011). Nest depredation by a family group of polar bears was documented in 2011 (Safine 2011). Nest survival averaged 0.23 (±0.09, standard error [SE]) from 1991–2004 before fox control was implemented near Barrow and 0.49 (±0.10 SE) from 2005–2011 during years with fox control (USFWS, unpublished data; Rojek 2008).

Diet and Energetics

Steller's eiders spend most of the year in shallow, nearshore marine waters feeding on a variety of benthic (seafloor) invertebrates including gastropods, bivalves, crustaceans, echinoderms, and macrobenthic invertebrates (Petersen 1980; Petersen 1981; Quakenbush et al. 1995; Bustnes et al. 2000). Although considered a diving seaduck, Steller's eiders employ a variety of foraging strategies, including diving to depths up to 9 m (30 ft) or more, bill dipping, body tipping, and gleaning food items from the surface of water, plants, and mud. Metzner (1993) concluded that Steller's eiders were opportunistic generalists.

The Steller's eider is a relatively small-bodied sea duck, intermediate in size between the harlequin and long-tailed duck (Bellrose 1980). It overlaps harlequins and long-tails in its choice of foraging areas and prey items, and may, like these two species, exist near its energetic limits, especially during winter and the breeding season. Unlike other larger eiders, Steller's eiders must continue to feed during egg laying and incubation, to build and maintain energy reserves (D. Solovieva, Zoological Institute, Russian Academy of Science, pers. comm.).

Steller's eiders show a pattern of life-history traits indicating their life-history strategy is "K-selected." They can survive up to 21 years in the wild (C. Dau *in* USFWS 2011) and show a pattern of deferred reproduction, site fidelity, and low annual recruitment. Such "K-selected" species minimize the importance of annual reproduction, and maximize the importance of annual survival, relying instead on only a few successful years of reproduction (Wilson 1980). This strategy would only be expected to evolve in environments with predictable and stable resources (Stearns 1992). Robertson et al. (1999) concluded that long-lived species of waterfowl would be expected to show strong site tenacity in areas with stable resources, to allow animals to develop and use local knowledge about resource distribution to ensure high long-term survival. They suggest that site fidelity would be expected of long-lived species that are sensitive to adult mortality and depend, at least in part, upon habitat stability for survival. Under this life history strategy, species are vulnerable to perturbations within their habitat. As a K-selected species that is thought to spend at least part of the year surviving at the edge of its energetic limits, the Steller's eider is likely to be susceptible to habitat impacts resulting in loss of food resources.

Threats

Hunting

Although not cited as a cause in the decline of Steller's eiders, the take of this species by subsistence hunters near Barrow was cited as a factor in the decision to list the population of Steller's eiders (USFWS 1997). Hunting for Steller's eiders was closed in 1991. In 2003, spring/summer subsistence harvest of migratory birds in Alaska was opened by Alaska State regulations and Service policy, but harvest of Steller's eiders remained prohibited. Before this regulation took effect, it was estimated that approximately 97 Steller's eiders were shot each year (USFWS 2006). After 2003, it was predicted that approximately 59 Steller's eiders were killed each year (USFWS 2007). Shooting mortality during 2004 - 2008 was estimated to be 23 birds (USFWS, unpublished data, 2010).

Lead Poisoning

Lead poisoning of Steller's eiders has been documented on the ACP (Trust et al. 1997). Female Steller's eiders nesting at Barrow in 1999 had blood lead concentrations that reflected exposure to lead (>0.2 ppm lead), and six of the seven tested had blood lead concentrations that indicated poisoning (>0.6 ppm lead; Pattee and Pain 2003). Additional lead isotope tests confirmed the lead in the Steller's eider blood was of lead shot origin, not that of the background sediments (Angela Matz, USFWS, unpublished data). Because this species continues to feed near the nesting site before and during incubation, it may be subjected to an increased risk of exposure to lead shot compared to other tundra waterfowl species that largely forego feeding at this time.

Spectacled eiders do not seem to engage in feeding activities as much as Steller's eiders once breeding has commenced, but have higher rates of lead exposure than any other species sampled on the Y-K Delta (Flint et al. 1997). The proportion of spectacled eiders on the Y-K Delta's lower Kashunuk River drainage that contained lead shot in their gizzards was high (11.6%, n = 112) compared to other waterfowl in the lower 48 states from 1938 - 1954 (8.7%, n = 5,088) and from 1977 - 1979 (8.0%, n = 12,880). Blood analyses of spectacled eiders indicated elevated levels of lead in 13% of pre-nesting females, 25.3% of females during hatch, and 35.8% of females during brood rearing. Nine of 43 spectacled eider broods (20.9%) contained one or more ducklings exposed to lead by 30 days after hatch (Flint et al. 1997). Thus, if spectacled eiders have experienced population level effects on the Y-K Delta due to lead poisoning, then it is reasonable to conclude that Steller's eiders may have similar or greater lead-induced effects, since they continue to feed during the nesting period.

Predation

Changes in predation levels are thought to affect Steller's eider populations by reducing nesting success. There is some evidence that predator and scavenger populations may be increasing on the North Slope (Eberhardt et al. 1983; Day 1998). Reduced fox trapping, anthropogenic food sources in villages and oil fields, and nesting/denning sites on human-built structures may have allowed fox, gull, and raven numbers to increase (Day 1998). Poor breeding success at Barrow has been attributed to high predation rates (Obritschkewitsch et al. 2001). In years where arctic fox removal was conducted at Barrow prior to and during Steller's eider nesting, nest success appears to have increased significantly (Rojek 2008). Increased predation by arctic foxes following goose population crashes was cited as a possible contributing factor to the decline of the Steller's eider on the Y-K Delta as well (USFWS 1997).

Seafood Processor Waste

Discharge from seafood processors may affect the water column, sea floor, or shore directly or indirectly through burial and smothering, putrification and decay, eutrophication, nutrient loading and alteration of habitats, aquatic communities and food webs. Although wave action in shallow, nearshore habitat may keep particles suspended and prevent waste deposition, contaminants, parasites, viruses, and other pathogens may be present and/or concentrated in these wastes and may bioaccumulate in prey items consumed by eiders. Furthermore, fish waste directly or indirectly supplies food to scavenging seabirds (Furness et al. 1992), seaducks, and eagles that tend to congregate in the vicinity of processing facilities and outfalls (Reed and Flint 2007; Ellen Lance, USFWS, pers. observation). Therefore, fish-waste from seafood processing plants could potentially harm Steller's eiders indirectly by degrading foraging habitat, and directly by exposing individuals to contaminants, disease, and increased predation.

Collisions with Manmade Structures

Steller's eiders collide with wires, communication towers, and other on-land structures. Most collisions are likely to involve one or two birds, but "bird storms" have been documented to occur when fishing vessels use bright lights during inclement nighttime weather. The actual number of birds injured and killed through collisions is likely higher than reported: many injured and killed birds are believed to go unreported, or become scavenged before humans detect them. For example, carcass removal rates from scavengers on the Alaska Peninsula could be as high as 50% per 24 hours (Flint et al. 2010). Therefore, unless obstructions are checked every day, few carcasses would ever be documented. Searcher efficiency can also affect bird mortality estimates, for example following oil spills (Ford 2006).

Stochastic Events

Steller's eiders on the Y-K Delta and the ACP comprise a small population size. As discussed by Gilpin (1987), small populations have difficulty surviving the combined effects of demographic and environmental stochasticity. Demographic stochasticity refers to random events that affect the survival and reproduction of individuals (e.g., shifts in sex ratios, striking wires, being shot, oil/fuel spills; Goodman 1987). Environmental stochasticity is due to random, or at least unpredictable, changes in factors such as weather, food supply, and populations of predators (Shaffer 1987). If not already extirpated, Steller's eiders nesting on the Y-K Delta are at high risk of local extirpation due to the low number of birds that breed there. The world population of Steller's eiders is probably not at high risk of extinction due to environmental stochasticity alone, but local groups of wintering birds may be vulnerable to starvation due to stochastic events (e.g., unusually heavy ice-cover in their feeding habitats).

Allee Effect

The "Allee effect" refers to the destabilizing tendency associated with inverse density-dependence as it relates to population size and birth rate. One form of this occurs when the ability to find a mate is diminished (Begon and Mortimer 1986). For the Steller's eider, males are estimated to have higher mortality rates than females (Flint et al. 2000). The annual survival rate for Steller's eiders molting and wintering in Alaska is estimated to be 0.899 ± 0.032 for females and 0.765 ± 0.044 for males (Flint et al. 2000). The observed difference in annual survival between sexes may be manifested in a skewed sex ratio. Female Steller's eiders notably out-numbered male eiders in Akutan, False Pass, Unalaska, and Izembek (Lanctot and King 2000a; Lanctot and King 2000b). However, observations of a skewed sex ratio vary across the range of the species and show shifts through time (Dau et al. 2000; Flint et al. 2000; Lanctot and King 2000a; Lanctot and King 2000b). Skewed sex ratios may be resulting in reduced breeding populations, as adult females are effectively removed from the breeding population if they are unable to find a mate. It is not known to what degree (if any) that skewed sex ratios may be contributing to low breeding rates on the ACP.

Effects of Climate Change

Our analyses under the ESA include consideration of ongoing and projected changes in climate. The terms “climate” and “climate change” are defined by the Intergovernmental Panel on Climate Change (IPCC). “Climate” refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007a). The term “climate change” thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007).

Results of scientific analyses presented by the IPCC show that most of the observed increase in global average temperature since the mid-20th century cannot be explained by natural variability in climate, and is “very likely” (defined by the IPCC as 90% or higher probability) due to the observed increase in greenhouse gas (GHG) concentrations in the atmosphere as a result of human activities, particularly carbon dioxide (CO_2) emissions from use of fossil fuels (IPCC 2007). Various types of changes in climate can have direct or indirect effects on most species. These effects may be positive, neutral, or negative, and they may change over time, depending on the species and other relevant considerations, such as the effects of interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2007).

Evidence is emerging that human-induced global climate change is linked to the warming of air and ocean temperatures and shifts in global and regional weather patterns including reduced sea-ice cover. High latitude regions, including Alaska and the surrounding oceans, are thought to be especially sensitive to the effects of climate change (Smol et al. 2005; Schindler and Smol 2006). Reduced sea-ice cover in the Arctic is likely to result in increased storm surges and ocean acidification. Acidification may impact shellfish and other marine organisms that create their shells and other hard parts from calcium carbonate. Sea otters, walruses, and spectacled and Steller’s eiders all rely on these types of organisms for food. While climate change will likely affect individual organisms and communities, it is difficult to predict with specificity or reliability how these effects will manifest. Biological, climatological, and hydrologic components of the ecosystem are interlinked and operate on multiple spatial, temporal, and organizational scales with feedback between the components (Hinzman et al. 2005). Changes in the ocean climate are likely to continue on a scale similar to those presently occurring, but it is not clear whether climate change or ocean acidification will affect the long-term survival or recovery of listed species.

Loss of Sea-Ice

Regional-scale environmental shifts may be underway in the Chukchi and the Bering seas that may affect listed species. Ice thickness generally increases from the Siberian Arctic to the Canadian Archipelago, due mostly to convergence of drifting sea-ice (Walsh et al. 2005). Rothrock et al. (1999 *in* Walsh et al. 2005) found a decrease of about 40% (1.3 m) in the sea-ice draft (which is proportional to thickness) in the central Arctic Ocean by comparing sonar data obtained from submarines during two periods: 1958–1976 and 1993–1997. Satellite imagery has documented a downward trend in September sea-ice extent (historically when sea-ice extent is at its minimum (Figure A-29; NSIDC 2012). From 1979 through 2009, satellite data from 10

Arctic regions indicated that nine of 10 regions experienced trends towards earlier spring melt and later autumn freeze onset (Markus et al. 2009). For the entire Arctic, the melt season length had increased by about 20 days during this period (Markus et al. 2009). The Chukchi/Beaufort seas region, which is within the range of polar bears and walruses, has experienced a strong trend toward later autumn freeze-up date and longer ice-free seasons (Markus et al. 2009). Such changes in sea-ice extent and duration will likely affect polar bear and walrus population trends.

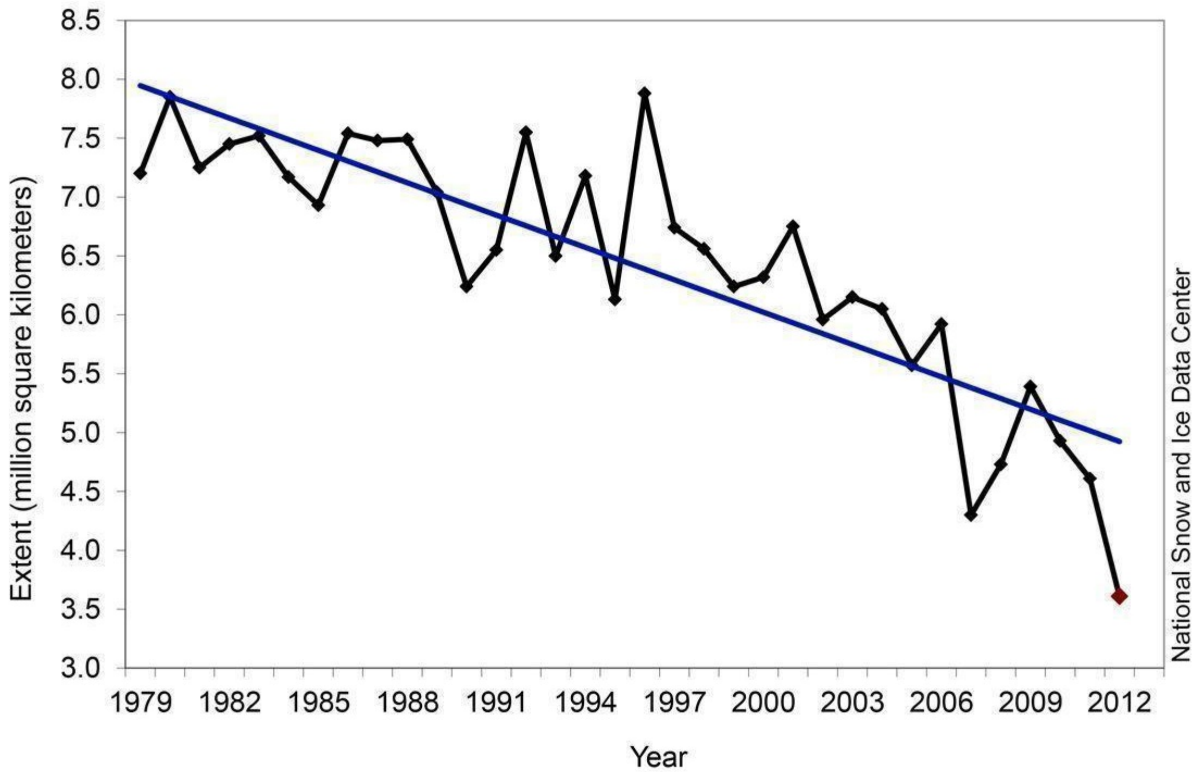

Figure A-29. Average September arctic sea-ice extent from 1979 through 2012 showing a 13.0% decline per decade (from NSIDC 2012).

[Top]

Storm Surges

Historically, sea-ice has protected shorelines from erosion; however, this protection has decreased as sea-ice decreases in extent and duration. With the reduction in summer sea-ice, the frequency and magnitude of coastal storm surges has increased. These can cause breaching of lakes and inundation of low-lying coastal wetland areas, killing salt-intolerant plants and altering soil and water chemistry, and hence, the fauna and flora of the area (Jorgenson 2001). These changes may alter the nesting habitat of eiders on the Y-K Delta. Coupled with thawing permafrost, the inundation of the shoreline due to lack of sea-ice has significantly increased coastal erosion rates (Mars and Houseknecht 2007), potentially reducing the quality or quantity of habitats such as bluffs with vegetation that catch snow in which polar bears den and beaches where walruses haul out during periods of low sea-ice along the Chukchi Sea.

Acidification of northern waters

Rising atmospheric CO_2 results in increased oceanic CO_2 uptake; this uptake of CO_2 by the oceans is the predominant factor driving ocean acidification (Dore et al. 2009; Doney et al. 2012). Sea-surface pH has dropped by an estimated 0.1 pH units since the preindustrial era, a 26% increase in acidity over the past 150 years, mostly in the past several decades. Sea-surface pH is projected to decline by an additional 0.2–0.3 pH unit over this century (Feely et al. 2009 *in* Doney et al. 2012). Ocean acidification can cause several chemical changes including elevated aqueous CO2 and reduced carbonate and calcium carbonate saturation (Doney et al. 2009). By lowering carbonate levels, ocean acidification is thought to increase the energetic cost of calcification (Fabry et al. 2008). Observations of mostly negative effects of higher CO_2 on calcification rates for several marine invertebrate species support this hypothesis (Kroeker et al. 2009 *in* Doney et al. 2012). Acidification, therefore, could negatively impact biogenic habitats (e.g., coral reefs, oyster beds) and other food webs (e.g., those of pteropods and other mollusks; Doney et al. 2012). For some taxa, including some mollusks, lower pH reduces the oxygen-binding capacity of respiratory proteins (e.g., hemocyanin), reducing aerobic activity (Doney et al. 2012). Thus, acidification and hypoxia may have synergistic effects (Doney et al. 2012). Immersion in more acidic waters can also disturb the internal acid-base balance of organisms, which in turn can affect several metabolic processes (Pörtner 2010 cited in Doney et al. 2012). Ocean acidification could impact the prey species eaten by otters, eiders, and walruses.

Reduced Availability of Benthic Prey

Benthic biodiversity, community composition, and biomass in the Arctic are affected by climate change (Bluhm and Grebmeier 2011, Grebmeier 2012). Traditionally, nutrients from the Pacific flow across the shallow, often ice-covered Chukchi Sea shelf, and this nutrient influx supports high primary production associated with the edge-ice. This primary production settles to the seafloor, becomes available to benthic organisms, and generates a rich macrobenthic community in a relatively short and efficient food chain (Grebmeier 1993; Grebmeier and Cooper 1995). This Arctic ecosystem supports large populations of benthic-feeding marine mammals and birds, including eiders and walruses. Recent changes in the timing of sea-ice formation and melt coupled with increasing seawater temperatures may have caused shifts in marine species composition; these changes may subsequently cause major changes in the arctic marine ecosystem that will likely affect benthic organisms (Grebmeier 2012).

In some Arctic regions, biotic communities are changing from longer-lived and slower-growing species to faster-growing species due to increasing water temperatures (Bluhm and Grebmeier 2011). Several benthic species have extended their range northward (Bluhm and Grebmeier 2011). Decline in primary production and decline in carbon supply to sediments (Grebmeier 2006; Grebeimer et al. 2012) are thought to be causing changes in community composition in the northern Bering Sea, including declines in clam populations (Grebmeier et al. 2006b; Bluhn and Grebmeier 2011; Doney et al. 2012,). Reduced ice cover may provide habitat for new top predators (i.e., fish; Bluhm et al. 2011) that may compete with for declining food resources in northern regions (Grebmeier et al. 2010, Grebmeier 2012). A shift from a benthic-dominated to pelagic-dominated food chain has also been predicted (Grebmeier 2012, Bluhm and Gradinger 2008). Such changes will likely affect prey availability for walruses and eiders, but predicting climate-mediated changes at the community level, can be difficult due the complexity of food webs (Doney et al. 2012). Thus, effects of climate change on food resources of listed species are concerning, but remain uncertain.

Contribution of the Action

Fuel consumption, especially oil, gas, and coal, is the primary source of GHG emissions worldwide. An estimated 83% of anthropogenic emissions from the primary GHG-producing countries are associated with use of these fuels (IEA 2013). The actions implemented under the Unified Plan will require varying amounts of fuel. Fuel will be used for transportation of personnel and equipment to and from spill sites. Diesel and gasoline will be used during a spill to power response vessels, aircraft, and equipment. The amount and type of fuel consumption, and the associated amounts of GHG produced will depend on the scale and location of the spill. A small spill response near an established response center will require much less fuel than a large effort in a remote area. The sum total of the effects of fuel consumption for spill response actions will be an increase in the release of GHGs. This is likely to be a tiny fraction of a global problem, and on its own, will not produce a measurable change in the impact of climate change on listed species and critical habitat.

[Top]

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APPENDIX B. Definitions

ACTION AREA: 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]

ACTION; THE PROPOSED ACTION: 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 CFR §402.02]. For this consultation, the action includes any actions taken to implement the Unified Plan or its Annexes.

ADVERSE EFFECT: an ADVERSE EVENT that is caused by an action or intervention or has a causal association to the action or intervention.

BENEFICIAL EFFECTS: contemporaneous positive effects with no adverse effects to listed species or designated critical habitat.

DISCOUNTABLE EFFECTS: are those that are extremely unlikely to occur. Based on best judgment, one would not 1) be able to meaningfully measure, detect, or evaluate insignificant effects; or 2) expect discountable effects to occur.

DISTURBANCE (ENVIRONMENTAL): any discrete event in time that disrupts ecosystem, community, or population structure and changes resources, substrate availability, or the physical, chemical, or biotic environment. Two general kinds of disturbance can be distinguished: disturbance events and environmental fluctuation.

DISTURBANCE (BEHAVIORAL): any event that has the potential to disrupt the normal behavior or physiological state of an animal. Disturbance most often causes a stress response and results in increased vigilance or displacement from preferred habitat.

ECOLOGICAL RISK ASSESSMENT: a systematic method for estimating the qualitative or quantitative probability of adverse consequences resulting from exposure to specific physical, chemical or biotic hazards (or from the absence of beneficial influences) on specific entities. Risk assessment uses clinical, epidemiological, toxicological, environmental, and any other data that is relevant. See also “Risk”.

EFFECTS OF THE ACTION: for the purposes of section 7(a)(2) consultation, NMFS and the U.S. Fish and Wildlife Service defined this term to mean “the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the ENVIRONMENTAL BASELINE.

EMERGENCY CONSULTATION: the process specified in the *Inter-agency Memorandum of Agreement Regarding Oil Spill Planning and Response Activities Under the Federal Water Pollution Control Act’s National Oil and Hazardous Substances Pollution Contingency Plan and the Endangered Species Act* (USCG et al. 2001) for conducting consultation pursuant to Section 7 of the ESA for spill response actions that may result in effects on listed species or critical habitat. The emergency consultation process includes both incident-specific informal consultation during the event, and formal consultation, if necessary, after the case is closed, if listed species or critical habitat have been adversely affected.

ENDANGERED SPECIES: any species which is in danger of extinction throughout all or a significant portion of its range. When only a portion of the taxonomic species is listed under the ESA, the endangered species refers to the portion of the species that is designated as endangered.

ENVIRONMENTAL BASELINE: for the purposes of section 7(a)(2) consultation, NMFS and the U.S. Fish and Wildlife Service defined this term to include the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with a consultation in process [50 CFR §402.02].

EXPOSURE: the fact or condition of being affected by something or experiencing something—the condition of being exposed to something.

EXTREMELY HAZARDOUS SUBSTANCE: any agent which may as the result of short-term exposures associated with spills cause death, injury or property damage due to its toxicity, reactivity, flammability, volatility, or corrosivity, including substances listed in the appendices to 40 CFR part 355. Agents common to Alaska include Acrylamide, Ammonia (Anhydrous), Chlorine, Formaldehyde, Hydrazine (Anhydrous), Hydrochloric Acid, Hydrogen Cyanide, Hydrogen Sulfide, Hydroquinone (Solid), Nitric Acid (>40% Solution), Phosphoric Acid, Dimethyl 4-(Methylthio), Phosphorus , Sodium Azide, Sodium Cyanide, Sulfur (Dioxide), Sulfuric Acid, Toluene, and others.

FREQUENCY: the number of times that something happens during a particular period. A count per unit time.

HAZARD: a source of danger.

HAZARDOUS MATERIAL: any substance that can pose a health or environmental risk.

INCIDENT-SPECIFIC CONSULTATION: the informal and formal consultation components of the EMERGENCY CONSULTATION process. This term is used in this BO to refer to the Service's involvement in spill response decision-making processes which may affect listed species and critical habitat prior to, and regardless of, whether take occurs. We use this term to avoid potential confusion arising from the use of the term "emergency consultation" which in some contexts outside of this BO, can be intended to refer only to the formal component of section 7 consultation.

INCIDENTAL TAKE: take that results from, but is not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant.

INDIRECT EFFECTS: are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur.

INSIGNIFICANT EFFECTS: relate to the size of the impact and should never reach the scale where a take will occur.

INTERDEPENDENT ACTIONS: are those that have no independent utility apart from the action under consideration" [50 CFR §402.02].

INTERRELATED ACTIONS: are those that are part of a larger action and depend on the larger action for their justification.

JEOPARDIZE THE CONTINUED EXISTENCE OF: means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species [50 CFR §402.02].

LIKELY: "probable". In most cases, no specific value can be attributed to the degree of probability, but an action that is likely will have a greater probability of occurring than not; >50% chance or higher.

LIKELIHOOD: the chance that something will happen; a synonym for "probability".

LISTED ENTITY, LISTED POPULATION: see listed species. These terms are commonly used when only a proportion of the taxonomic species is listed, as is the case with the southwest Alaska distinct population segment of the northern sea otter and the Alaska-breeding Steller's eiders.

LISTED SPECIES: means any species of fish, wildlife or plant which has been determined to be endangered or threatened under section 4 of the Act. Listed species are found in 50 CFR. 17.11-17.12. Listed species, for the purposes of this Biological Opinion, include threatened, endangered *and* candidate species, including the Steller's eider, spectacled eiders, the southwest Alaska distinct population segment of northern sea otters, polar bears, Pacific walruses, and the short-tailed albatross. When only a portion of the taxonomic species is listed under the ESA, the listed species refers to the portion of the species that is designated as a threatened, endangered or candidate species under the ESA.

MAY AFFECT: the appropriate conclusion when a proposed action may pose any effects on listed species.

MINIMUM VIABLE POPULATION SIZE: the smallest possible size at which a biological population can exist without facing extinction from natural disasters or demographic, environmental, or genetic stochasticity.

POPULATION: groups of individuals whose patterns of increase or decrease in abundance over time are determined by internal dynamics (births resulting from sexual interactions primarily between individuals in the group and deaths of individuals in the group) rather than external dynamics (immigration or emigration). Groups of individuals that meet this definition may also be spatially-separated from other groups of individuals that would also be defined as populations or genetically distinct from those other groups of individuals, but these characteristics are secondary to the internal dynamics of the group.

PRIMARY CONSTITUENT ELEMENT: specific physical and biological features of the environment within designated critical habitat necessary to support the conservation of listed species.

PROBABLE: "likely"; in most cases, no specific value can be attributed to the degree of probability, but an action that is likely will have a greater probability of occurring than not; >50% chance or higher.

PROBABILITY: the chance that something will happen; more specifically a number between 0 and 1 (where 0 indicates impossibility and 1 indicates certainty), often expressed as a percentage, e.g., there is a 50% probability that event will happen.

QUASI-EXTINCTION PROBABILITY: probability that population levels will decrease below a quasi-extinction threshold.

QUASI-EXTINCTION THRESHOLD: the number of individuals below which the population is likely to be immediately and critically imperiled. This threshold is typically the minimum number of animals in a population below which demographic stochasticity and genetic drift are likely to cause extinction.

RISK: the potential to lose something of value; in Ecological Risk Assessment, Risk is defined as an interaction between hazard and exposure, where there must concurrently be both a hazard and an exposure to it to result in risk. When quantified in Ecological Risk Assessment, risk is the product of the consequence and the probability of a hazardous event. Though we are often unable to quantify the risks discussed here due to lack of numerical probability data, risk is generally defined as the probability of a hazard resulting in an adverse event, times the severity of the event.

RESPONSE: an outcome associated with an activity; in this document, we use the term "response" to describe the positive or negative effects of the activities described in the unified plan; negative responses are synonymous with "hazards", but responses may also be positive.

SIGNIFICANT; SIGNIFICANCE: Our evaluation considers different "significance" to mean "clinically or biotically significant" rather than statistically significant. We distinguish our use of the terms as separate and independent from its use for analyses conducted under the National Environmental Policy Act (NEPA).

STRESSOR: the term has been defined variously as (a) any physical, chemical, or biological entity that can induce an adverse response (synonymous with agent); (b) any condition or situation that causes a system to mobilize its resources and increase its energy expenditure (Seyle 1956; Fitch and Johnson 1977); (c) a physical, chemical, or biotic phenomenon, circumstance, or condition that constitutes a real or perceived challenge or threat to an organism's homeostasis or homeostatic mechanisms. Because some physical, chemical, and biotic phenomena are stressors to some organisms in some circumstances, but not others, stressors are commonly referred to as "potential stressors."

THE PLAN; THE UNIFIED PLAN; THE PROGRAM; PROGRAM STRUCTURE: the actions and processes identified and implemented under the Alaska Federal/State Preparedness Plan for Response to Oil & Hazardous Substance Discharges/Releases (Unified Plan; ARRT 2010) and the proposed Dispersant Use Plan for Alaska (ARRT 2014).

TAKE: under the ESA: to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct involving a species listed.

- **HARM** is further defined by the Service as an act which actually kills or injures wildlife, and may include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering.
- **HARASS** is defined by the Service as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering.

TAKE under the MMPA: to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal.

- **HARASS:** The current definition of harassment in the MMPA separates harassment into two levels.
- **LEVEL A HARASSMENT:** any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild.
- **LEVEL B HARASSMENT:** any act of pursuit, torment, or annoyance which 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.

THE SERVICE; SERVICE: U.S. Fish and Wildlife Service

THE SERVICES: U.S. Fish and Wildlife Service and National Marine Fisheries Service, collectively

THREATENED SPECIES: any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. When only a portion of the taxonomic species is listed under the ESA, the threatened species refers to the portion of the species that is designated as threatened.

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APPENDIX C. Boat Operation Guidance to Avoid Disturbing Sea Otters

Because the southwest Alaska Distinct Population Segment (DPS) of the northern sea otter (Enhydra lutris kenyoni) is listed as threatened under the Endangered Species Act (ESA), and because the listed population and all other sea otter populations are protected under the Marine Mammal Protection Act (MMPA), the US Fish and Wildlife Service has developed guidance to boat operators to avoid the risk of disturbing or striking sea otters. Collectively, the ESA and MMPA make it illegal to take[51] sea otters.

Sea otter habitat is broadly defined as all near shore maritime waters within their range. Sea otters occupy waters up to 91 m deep (300 ft, 50 fathoms) and spend several hours a day foraging in waters usually less than 40 m deep (132 ft, 22 fathoms). Boats operating in sea otter habitat run the risk of disturbing sea otters, which is considered harassment, or of killing sea otters by striking them with the boat propeller or hull. To avoid the risk of such takings, please follow these guidelines:

- While operating boats in near shore areas, scan the water surface ahead of the boat vigilantly for otters. In choppy water conditions sea otters are difficult to spot. If you are boating with another person, place them in the bow to help search. You may encounter otters as individuals, a mother and a pup, or rafts of 10 or more.

- When you see an otter(s), alter your course and slow down to avoid disturbance and collision. Once you have spotted an otter(s), you should not assume that the otter(s) will dive and get out of the way. Even if they are alert, capable, and do dive, your action of knowingly staying your course would be considered harassment.

- Do not operate a vessel at ANY rate of speed heading directly at the otter(s). A good rule of thumb is that your buffer should be great enough that there is ample room for the otter(s) to swim away without startling them. It is your responsibility to minimize the stimulus and threat of a loud boat approaching quickly.

- The more otters you see, the wider the berth you need to give. Also, do not pass between otters, but rather go around the outside perimeter, plus add a buffer.

- It is illegal to pursue or chase sea otters. Do not single out or surround an otter(s).

Thank you for your efforts to help conserve Alaska's sea otters. If you have any questions, comments or concerns, please contact the US Fish and Wildlife Service's Marine Mammals Management Program or Ellen Lance (907-271-1467) at the Anchorage Fish and Wildlife Field Office's Endangered Species Program.

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[51] take under the ESA means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct; take under the MMPA means to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal.

[Top]

United States Department of the Interior
U.S. FISH AND WILDLIFE SERVICE
Anchorage Fish and Wildlife Field Office
4700 BLM Road, Anchorage, Alaska 99507

In Reply Refer To:
FWS/AFES/AFWFO

January 2, 2015

EMAILED TO:
Dispersant Working Group Members c/o
CAPT Dan Travers, USCG
Commander, Sector Columbia River/Air Station Astoria
Captain of the Port
2185 SE 12th Place
Warrenton, OR 97146

RE: Avoidance Areas

Dear Dispersant Working Group Members:

The enclosed analysis, resulting from the ongoing consultation under section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq., as amended), illustrates areas where endangered short-tailed albatrosses (*Phoebastria albatrus*) concentrate within Alaska's proposed preauthorization area (Annex F of Appendix I of the *Draft* Alaska Regional Response Team Dispersant Use Plan for Alaska, Revised 4-3-14; Dispersant Use Plan). We recommend these short-tailed albatross concentration areas be designated as avoidance areas and be excluded from preauthorization in accordance with Section 1.4 of the Dispersant Use Plan. It is our hope that the avoidance areas can be approved and incorporated into the Dispersant Use Plan as soon as possible to allow us to modify the proposed action our section 7 evaluations and avoid possible delays of our February 18, 2015 target completion deadline. We appreciate your consideration and look forward to your response. If you have any questions, please contact me at (907) 271-1467 or Kimberly Klein at (907) 271-2066.

Sincerely,

Ellen W. Lance
Ecological Services Branch Chief

Enclosure
cc: Marcia Combes, EPA; Mark Everett, USCG; Sadie Wright, NMFS

Short-Tailed Albatross Concentrations in Areas Pre-Authorized for Dispersant Use

The Environmental Protection Agency (EPA) created a distribution map of short-tailed albatross (STAL) observations and locations of hazardous material spills within Alaska's proposed dispersant-use preauthorization zone (the preauthorization zone; http://epa.maps.arcgis.com/apps/OnePane/basicviewer/index.html?appid=584c580bec0c4c9898e83123ebd4014e; Figure 1). STAL observation data was provided by the U.S. Fish and Wildlife Service (Service) and spill information from the Alaska Department of Environmental Conservation. The high percentage of STAL observations within the preauthorization zone prompted the Service to develop avoidance areas where STAL concentrate. If designated, these avoidance areas would be amended to the Dispersant Use Plan, excluded from preauthorization, and incorporated into the applicable Subarea Contingency Plans.

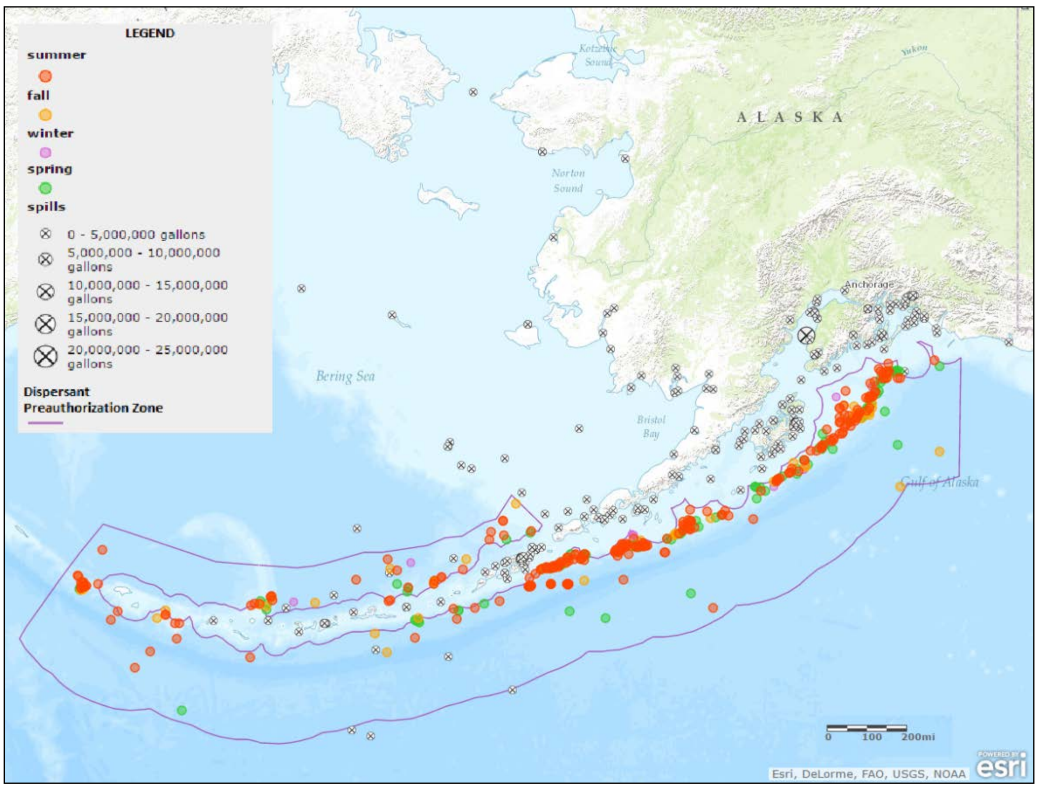


Figure 1. STAL distribution in proposed dispersant preauthorization zone relative to spill occurrences. Map compiled by EPA (2014).

Polygons containing concentrations of STAL within the preauthorization zone were created by: 1) compiling, all available STAL geographic data, ensuring they were not duplicative; 2) using ArcGIS to clip STAL data by the preauthorization zone to remove observations outside of the area of interest; 3) analyzing kernel density using ArcGIS software tools. Kernel density is calculated using a nearest-neighbor function to fit a smoothly tapered surface to each point. The top 5% of kernel density values were identified, and a buffer (4nm) around each polygon was assigned to smooth the polygon surfaces and merge small, isolated concentrations. These concentration areas comprise the highest densities of short-tailed albatross observed within the preauthorization zone (Figure 2).

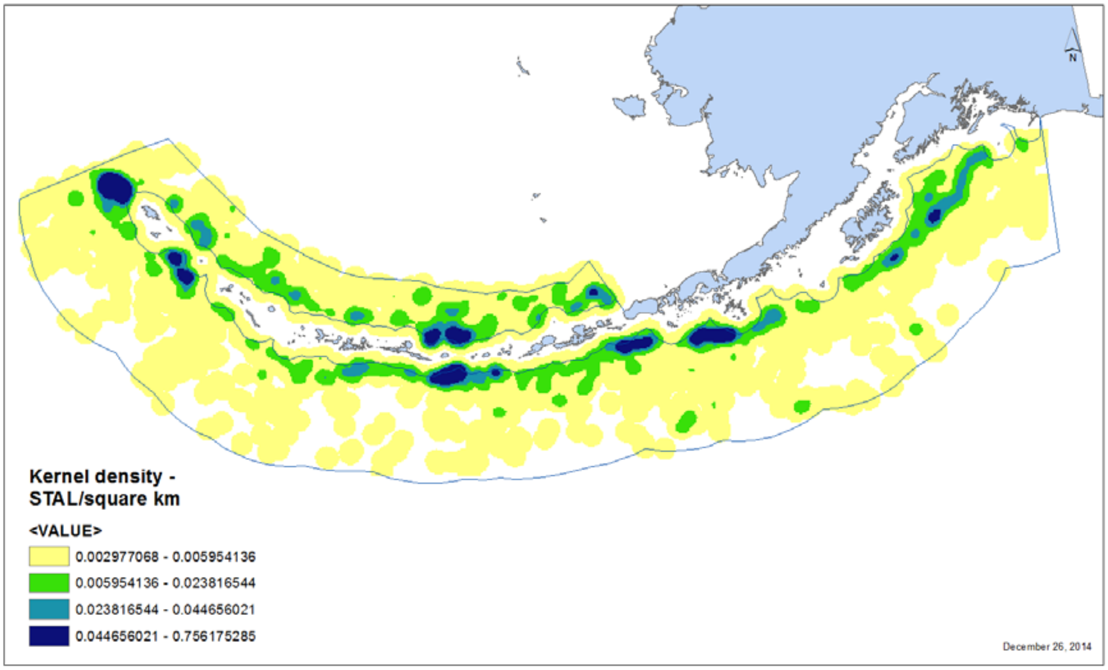


Figure 2. Kernel densities of STAL within the preauthorization zone.

A hotspot analysis was conducted to evaluate whether the top 5% of kernel density values represented a useful threshold for identifying high-density aggregations. To conduct this analysis, STAL observations were spatially joined with 5- and 10-km^2 polygon grids throughout the preauthorization zone. Statistically significant expected values for observations within polygons were identified using the Hotspot Analysis tool (Getis-Ord Gi* statistic) in the Spatial Statistics toolbox of ArcGIS 10. Delaunay triangulation was used to generate spatial weighting because it performs well with isolated polygons and polygons with an uneven spatial distribution of features (ESRI 2012), both of which are characteristics of the STAL dataset.

Statistically significant hotspots generally corresponded with the highest kernel density polygons (Figure 3). Four kernel density polygons did not correspond to hotspots. These were clusters containing a high density of observations, but not higher than expected by chance alone. Those four polygons are not included in our recommendation for avoidance areas. Three polygons in close proximity to one another (30km) were merged, and the border of another polygon smoothed to simplify use of the avoidance areas during an event. We recommend the polygons depicted in Figure 4 as avoidance areas within the preauthorization zone, to ensure protection of endangered STAL. The avoidance areas should be included in the Dispersant Use Plan and respective Subarea Contingency Plans. An ArcGIS shapefile of these areas is attached, and additional copies are available from the Service upon request.

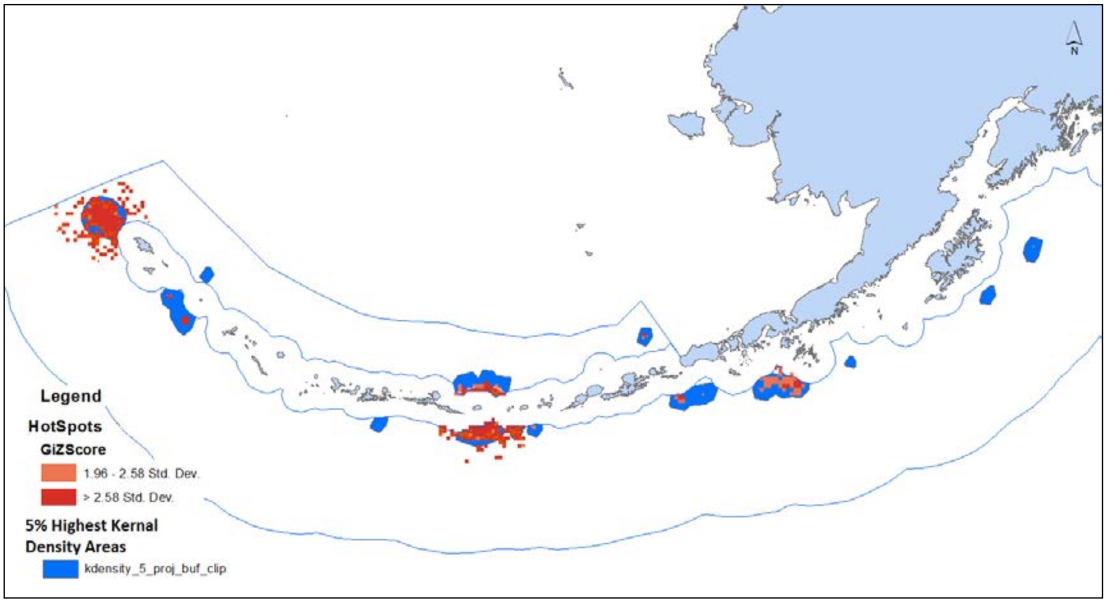


Figure 3. Significant hotspots superimposed on top 5% of kernel densities for STAL within the preauthorization zone.

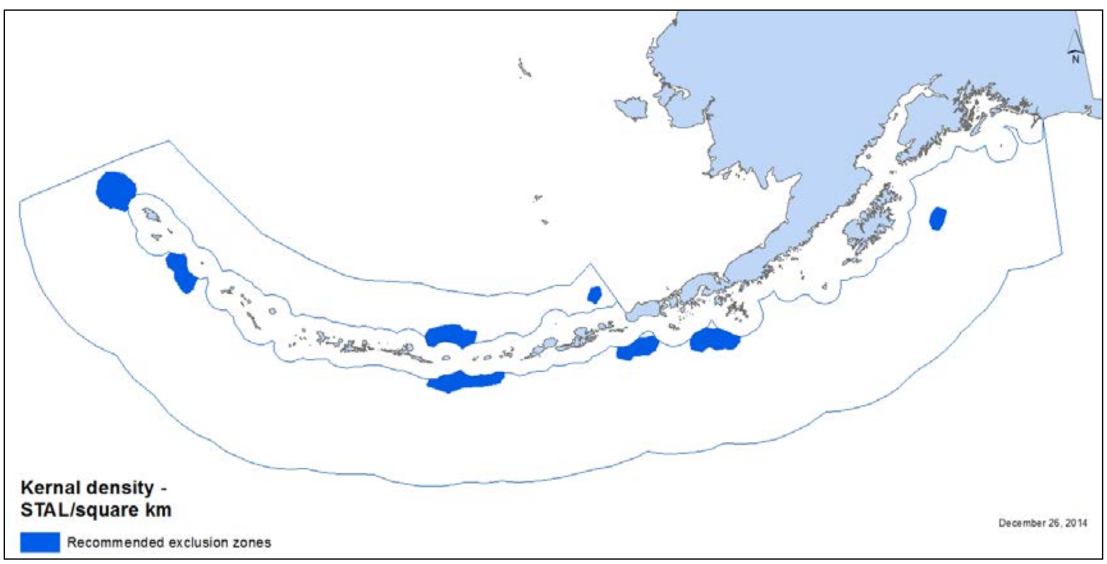


Figure 4. Final recommended avoidance areas based on high density STAL observations.

Literature Cited

ESRI. 2012. Modeling Spatial Relationships *in* ArcGIS 10 Resource Center. Available: http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html#/Modeling_spatial_relationships/ (December 2014).

Alaska Regional Response Team (ARRT)
c/o USEPA Region 10
ECL Emergency Response, AOO
222 W. 7th Ave. #19
Anchorage, AK 99513
http://alaskarrt.org/

February 17, 2015

Ellen W. Lance
Ecological Services Branch Chief
Fish and Wildlife Service
Anchorage Field Office
605 West 4th Avenue, G-61
Anchorage, Alaska 99501

Dear Ms. Lance:

On November 06, 2014, I received an inquiry via telephone conference regarding the *Biological Assessment of the Alaska Federal/State Preparedness Plan for Response to Oil & Hazardous Substance Discharges/Releases (Unified Plan)* from the U.S. Fish and Wildlife Service (USFWS). The stated reason for the inquiry was that USFWS desired an accommodation for the short-tailed albatross (STAL) critical habitat inside the proposed preauthorization area. As agreed during the telephone conference, I proposed creating avoidance areas for the STAL critical habitat as part of the Endangered Species Act (ESA) section 7 consultation process in accordance with Section 1.4 of the Draft ARRT Dispersant Use Plan for Alaska and also updating footnote 1 on page 7 of the Draft ARRT Dispersant Use Plan for Alaska to highlight this action. The Dispersant Working Group (DWG) met via telephone conference on November 13, 2014 and approved these proposed actions pending USFWS submitting the proposed STAL critical habitat avoidance areas.

On January 02, 2015, I received USFWS's proposed STAL critical habitat avoidance areas and on January 23, 2015, the DWG approved the proposed STAL critical habitat avoidance areas (see enclosure 1). As agreed during the telephone conference with USFWS on November 06, 2014, these avoidance areas are considered final as part of the ESA section 7 consultation process and will be included in the next update to each respective Subarea Contingency Plan. Additionally, footnote 1 on page 7 of the Draft ARRT Dispersant Use Plan for Alaska will be revised to read as follows:

> "Prior to the Alaska Regional Response Team approving this plan, Endangered Species Act section 7 consultation with the U.S. Fish and Wildlife Service and National Marine Fisheries Service was completed. As a result, there were several avoidance areas created in the preauthorization area in accordance with Section 1.4 of this Dispersant Use Plan to

account for the highest concentrations of the short-tailed albatross and North Pacific right whale critical habitat."

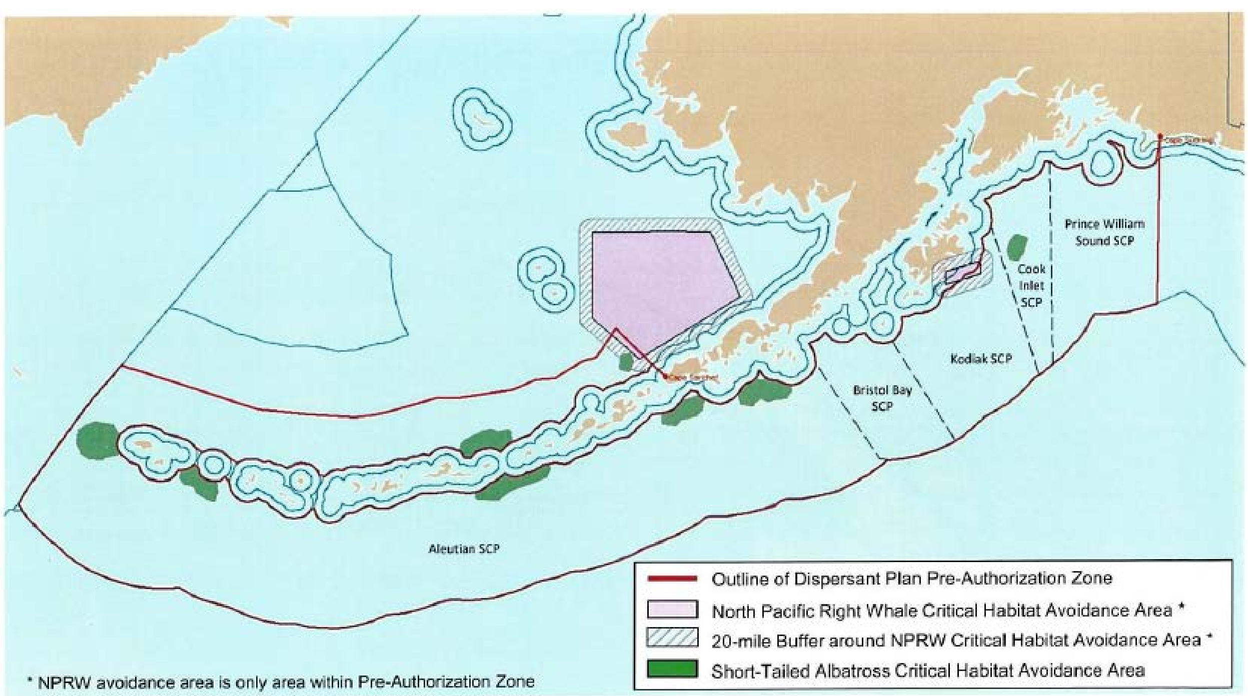
If you require additional information, please contact me at (503) 861-6200.

Sincerely,

Daniel J. Travers
Captain, U. S. Coast Guard
Commander, Sector Columbia River
ARRT Dispersant Working Group Chair

Encl: (1) Updated Preauthorization Area

cc: ARRT U.S. Coast Guard Co-Chair
ARRT U.S. Environmental Protection Agency Co-Chair
State of Alaska ADEC, Division of Spill Prevention and Response
ARRT U.S. Department of Interior Representative
ARRT U.S. Department of Commerce Representative
ARRT U.S. Environmental Protection Agency Liaison



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DISCUSSION PAPER
PREPARED AND SUBMITTED BY USCG AND EPA
TO THE SERVICES
CLARIFYING THE ACTION:
SPECIFICALLY - THE INCLUSION OF SOME
ATYPICAL DISPERSANT USES IN FORMAL CONSULTATION ON THE
ALASKA UNIFIED PLAN

Background

This paper responds to concerns expressed by the Services regarding a perceived discrepancy identified during review of the *Biological Assessment of the Alaska Federal/State Preparedness Plan for Response to Oil & Hazardous Substance Discharges/Releases (Unified Plan)*. Included in the biological assessment (BA), as coordinated with the Services, is the draft final proposed *ARRT Dispersant Use Plan for Alaska* which describes potential atypical use of chemical dispersants in combating oil spills. At issue is whether atypical use of dispersants is part of the consultation and, if so, whether the action agencies (EPA & USCG) included sufficient analysis to complete the consultation.

Summary

According to 50 CFR §402.14(c)(1) A written request to initiate formal consultation shall be submitted (by a Federal Agency) to the Director and shall include, among other things "a description of the action to be considered". The action agencies clearly laid out the description of the proposed action (Section 1.1.2 of the BA) specifically stating that:

> Subsea dispersant use is not a component of potential response actions identified in the Alaska Unified Plan because it was not conceived of as a response option until the Deepwater Horizon spill in the Gulf of Mexico in 2010. The draft oil dispersant authorization plan, (which will replace Appendix I in Annex F, once approved [approval anticipated for April 2014]; the draft language is included in Appendix A to this BA) indicates any request for subsea dispersant use will be considered using the process for case-by-case dispersant use authorization, with requirements for emergency ESA Section 7 consultation and effectiveness monitoring. As more information and conclusive science becomes available on the subsea application of dispersants, the potential impacts of this response method and any recommended mitigative measures will be further analyzed and evaluated and appropriately incorporated into the Alaska Unified Plan.

The contents of BAs prepared pursuant to the Endangered Species Act are largely at the discretion of the action agency although the regulations provide recommended contents (50 CFR §402.12(f)). As stated in the BA the action under consultation was implementation of the *Unified Plan*. The description of the action presented above states that, due to the lack of information on the effects of subsea application of dispersants (primarily because of its novelty) and the fact that this application method is not currently included in the *Unified Plan*, subsea application of dispersants was not part of the action. Because the subsea application of dispersants had not been conducted before 2010, the state of the science by the time the BA was in preparation was not developed to the degree that it could be utilized to analyze the effects of this potential response method on Arctic species.

Atypical Use Defined

Atypical use of dispersants[1] is defined in the proposed *ARRT Dispersant Use Plan for Alaska* to include: 1) full scale dispersant application on the water surface ongoing for, or expected to exceed or exceeding 96 hours following the dispersant application field test, and/or 2) the use of dispersants subsea (i.e., below the water surface).[2]

Prolonged Use Included in the Consultation

As expanded in the following paragraphs, prolonged surface use (i.e., exceeding 96 hours following the dispersant application field test[3]) is part of this consultation as this form of atypical use is:

1) available under current dispersant policy (Appendix I of Annex F of the *Alaska Federal/State Preparedness Plan for Response to Oil & Hazardous Substance Discharges/Releases (Unified Plan)*);

2) essentially the same response method as full scale dispersant application less than 96 hours, but with enhanced environmental monitoring;

3) significantly different from subsea application (which is not part of this consultation); and

4) a rare occurrence.

Current Dispersant Policy

The current dispersant policy found at Appendix I of Annex F of the *Unified Plan* places no time limits on the use of dispersants. It stipulates only that:
For areas where there is no preauthorization by EPA, ADEC, DOI, and DOC, Paragraph (b) of Section 300.910 of the National Contingency Plan provides that the FOSC, with the concurrence of the EPA representative to the RRT and, as appropriate, the concurrence of the RRT representative from the state(s) with jurisdiction over the navigable waters threatened by the release or discharge, and in consultation with the DOC and DOI natural resource trustees, when practicable, may authorize the use of dispersants that are listed on the NCP Product Schedule.

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[1] Some countermeasures, while not presently pre-authorized by the ARRT, are available to FOSCs provided they are approved by the ARRT – including Incident Specific activation of the ARRT which would include review by DOC & DOI – prior to application in accordance with National Contingency Plan (NCP) at 40 CFR §300.910(b).

[2] See footnote on page F-15 of the proposed *ARRT Dispersant Use Plan for Alaska (Draft Revision - April 3, 2014).*

[3] The ARRT standard of “expected to exceed or exceeding 96 hours following the dispersant application field test” contained in the proposed *ARRT Dispersant Use Plan for Alaska* is a more precise refinement of the National Response Team (NRT) standard of “expected to exceed 96 hours or that has already exceeded 96 hours from the time of the first application of any dispersant” found at Section 2.2.1 of the NRT’s *Environmental Monitoring for Atypical Dispersant Operations (May 30, 2013).*

This existing policy harmonizes with the stipulations and protocol for case-by-case dispersant use authorization found in the proposed *ARRT Dispersant Use Plan for Alaska* at Tab 1, Part 1B.

Same Tactic, Longer Duration, Enhanced Monitoring

The general premise behind prolonged use of surface dispersant is that: 1) continued use of dispersants remains the best option based on the overall response picture, and; 2) there is a continuous release of fresh oil amenable to surface dispersion, and/or; 3) the condition of the oil in an existing slick remains amenable to surface dispersion. The methods and tactics for prolonged surface application via vessels and/or aircraft are the same as for surface application periods less than 96 hours via vessels and/or aircraft. What differs between the two time frames is the prescribed monitoring protocols, which are more stringent for prolonged surface application.

The National Response Team's (NRT) *Special Monitoring of Applied Response Technologies (SMART) (rev. August 2006)* and *Environmental Monitoring for Atypical Dispersant Operations (May 30, 2013)* have both been incorporated *in toto* into the *ARRT Dispersant Use Plan for Alaska* at Tab 3, Part 1 and Tab 3, Part 2, respectively. *Environmental Monitoring for Atypical Dispersant Operations* assumes the SMART protocols have been put in place by the FOSC and offers additional guidance, specifically at Section 2.2, for prolonged surface application. Taken together, these documents provide a comprehensive approach to environmental monitoring. Moreover, Section 2.3 Conditions/Stipulations of the *ARRT Dispersant Use Plan for Alaska* requires that, "[d]ispersant application effectiveness and potential trade-offs associated with its use will be evaluated on a daily basis, informing the FOSC's decision to continue, postpone, modify, or cease dispersant application based on that day's monitoring information." This highly protective *daily* re-evaluation stipulation applies to prolonged surface application.

Atypical Modes Vary

While both subsea and prolonged surface application are considered atypical use, they are vastly different tactics and monitored in very different ways. Firstly, the unique and extreme conditions and chain of events that ushered in the first and *only* use of subsea dispersant application (i.e., an inaccessible high pressure reservoir – over a mile deep – with a severely damaged blowout preventer spewing an unprecedented volume of hydrocarbons) during the *Deepwater Horizon/Macondo* response are not present in Alaska[4]. Secondly, the technical means of application of dispersant are different. In subsea scenarios – based on the novel *Deepwater Horizon/Macondo* response – dispersant is injected directly into the oil's flow stream at the source, the wellhead, via a special apparatus on the blowout preventer and/or remotely operated vehicle (ROV) and the necessary mixing energy is derived from the intermix of the fluids rising up through the water column. In surface (or prolonged surface) application, dispersant is applied via a nozzle array from a vessel or aircraft and natural or artificial mixing energy must be adequate to ensure the intermix and proper dispersion down through the water column.

[4] According to the head of the Bureau of Safety and Environmental Enforcement's Oil Spill Preparedness Division, while the overall likelihood of a subsea wellbore incident is greater during exploration activities than during production operations, the shallow depth (~120'-150') and low reservoir pressures of the Chukchi offshore field make such an occurrence very unlikely, particularly in comparison to the high reservoir pressures present far offshore in the Gulf of Mexico. Moreover, industry has proposed and is therefore required to implement other, more direct source control measures (i.e., 'mudding' the hole, engaging the blowout preventer, wellhead capping stack, and/or 'cap and flow' systems). Industry has not proposed nor are they required to use subsea dispersant.

Thirdly, the NRT-mandated monitoring protocols (previously referred to and included in the BA) are very different.

Rarity of Use

Both forms of atypical use of dispersants are rare occurrences. However, it is conceivable that prolonged surface application could be employed on a large, continuous source spill either from a vessel or offshore drilling operation, so it is desirable to include in this consultation.
Dispersants are used on only a small percentage of oil spills. Of those, the vast majority are surface applications for less than 96 hours. Therefore, little data exists on the chronic exposure from prolonged use, particularly in cold water. What does exist was included or referenced in Appendix B of the BA.

Subsea Use Not Included in the Consultation

As mentioned above, subsea dispersant application as a countermeasure has only been used *once* and under unique and extreme tactical conditions. Moreover, the met-ocean and environmental conditions of that use – the Gulf of Mexico in summer time – are not comparable to the cold water conditions in Alaska. Subsea use has never been attempted in Alaska and there are no plans to use this tactic at any of the offshore drilling locations in the state and surrounding waters. Therefore, the action agencies do not consider it part of this consultation, even though it remains a potential tool in the FOSC's response toolbox per 40 CFR §300.910(b)..

The Bureau of Safety and Environmental Enforcement (BSEE) – a Federal agency which regulates offshore oil and gas development activities – does not require industry operators to possess a subsea dispersant use capability *per se*. BSEE, at 30 CFR §254.27, requires industry dispersant use plans to be consistent with the National Contingency Plan (NCP) Product Schedule and other provisions of the NCP and the appropriate Area Contingency Plan(s). The regulation also requires industry dispersant use plans to include:

1) An inventory and a location of the dispersants and other chemical or biological products which they might use on the oils handled, stored, or transported at the facility;

2) A summary of toxicity data for these products;

3) A description and a location of any application equipment required as well as an estimate of the time to commence application after approval is obtained;

4) A discussion of the application procedures;

5) A discussion of the conditions under which product use may be requested; and

6) An outline of the procedures they must follow in obtaining approval for product uses[5].

Given the novel use of subsea application during the *Deepwater Horizon/Macondo*, it's reasonable to assume that data on the acute and chronic environmental impacts are being generated for use in the Natural Resource Damage Assessment (NRDA). These NRDA findings remain cloaked in the legal process and follow-on settlement adjudication.

Data Availability

Under 50 CFR 402.14(6)(d) the "The Federal agency requesting formal consultation shall provide the Service with the best scientific and commercial data available or which can be obtained during the consultation for an adequate review of the effects that an action may have upon listed species or critical habitat." The action agencies compiled the information that was available at the time the BA was in preparation and presented what was known about the use of dispersants in an appendix (Appendix B) to the document. The purpose of this appendix was to describe the known or potential adverse impacts of chemical dispersants, alone or in a mixture with oil, both directly and indirectly on species listed under the Endangered Species Act (ESA) (or using surrogates) and through their prey.

As previously mentioned, atypical use of dispersants falls into two categories: prolonged and subsea. The National Response Team, which includes DOI and DOC, specified a 96 hour dispersant period in the *Environmental Monitoring for Atypical Dispersant Operations* document because 96 hours is a common exposure duration in toxicity studies on dispersants (and other chemicals). Because we didn't identify *a priori* a specific spill scenario to evaluate in the BA, we didn't define a spill response duration, either greater or less than 96 hours.

A rigorous literature search was conducted to compile acute and chronic, lethal and sublethal data to analyze the effects of dispersants and dispersed oil on listed species and their prey. The majority of the available data was for tests run at 48 and 96 hour exposure periods. A limited amount of data were available for 14 and 21 day exposures. Data for 96 hour exposure periods was compiled to develop the species sensitivity distribution curves for aquatic species, along with chronic toxicity data to evaluate sensitive endpoints. Chronic exposure durations include a notable portion of a species entire life cycle or early life stages, and are often characteristically longer that acute exposures; where available, we included these in an attachment to the BA (Attachment B-1). Finally, effects were also described more generally for some species, in terms of duration (short or long-term) and magnitude (low or high), which was necessary due to the uncertainties associated with the assessment.

The BA addressed both direct and indirect effects, and potential impacts to listed species, not specifically restricted to short term exposure, including effects on: 1) herring spawning in nearshore waters from potential exposure to dispersed oil; 2) avian reproduction from potential exposure of eggs to dispersants; and 3) prey base resulting in a potential reduction in food resources.

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[5] Appendix I in Annex F of the *Unified Plan* provides the basis for these procedures. The proposed *ARRT Dispersant Use Plan for Alaska*, which will update Appendix I in Annex F of the *Unified Plan*, will provide a comprehensive, fully-vetted, and more protective standard.

Effects Determinations Unchanged

The purpose of Appendix B of the BA was to describe the known or potential adverse impacts of chemical dispersants, alone or in a mixture with oil, both directly and indirectly on listed species. As a result of this analysis it was determined that the use of dispersants would result in a "likely to adversely affect" determination for numerous (13/25) species. While certainly useful, we don't anticipate that data derived for longer exposure periods (should it have been available) would have changed these determinations.

The Role of Emergency Consultation

Atypical use of dispersant, as contemplated under the proposed *ARRT Dispersant Use Plan for Alaska,* occurs only under the process for case-by-case dispersant use authorization described in Tab 1, Part 1B. This protocol clearly offers several opportunities for input by the Services, including ESA Section 7 emergency consultation described at Step 4.

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APPENDIX F. Effects of Natural Attenuation of Spills on Listed Species

The majority of spills in the Action Area involve petroleum products, generally referred to here as "oil", thus we focus our review on the effects of oil spills. The effects of spilled oil on listed species and critical habitat is an important consideration when evaluating to what degree spill response actions might exceed the effects of exposure to the oil. In some circumstances, the Unified Plan allows spilled oil to attenuate naturally when the adverse impacts resulting from response activities outweigh the benefits. Evaluation of the effects of oil spills as a component of spill response action is limited to this "Natural Attenuation" scenario. This Appendix is not intended to evaluate the effects of spills on listed species as an Action in the Unified Plan, but may be useful to help tease apart the individual and combined effects of spilled material and the actions to respond to the spills. Because the available information specific to listed species is limited, where appropriate, we include information on related taxa as proxies for listed species.

Birds – Spectacled Eider, Steller's Eider, and Short- tailed Albatross

Direct effects on seabirds exposed to spills include acute mass mortality and morbidity caused by fouling of feathers subsequent loss of waterproofing and insulation (discussed in more detail, below). This leads to hypothermia, weakness, behavioral deficits (inability to fly, forage, avoid predators, incubate, or care for young), and mortality. Birds can also exhibit debilitating sublethal effects or mortality from ingestion of toxic oil components (total petroleum hydrocarbons, or more specifically PAHs) via preening of fouled feathers or consumption of contaminated prey (discussed in more detail, below). Direct exposure to fumes or aspiration exposure can result in pneumonia (Albers 2003). Effects from acute exposure may be long-lasting; even after cleaning, rehabilitated birds exhibited weight loss and organ damage (necrosis of the liver, kidney, and duodenum) (Khan and Ryan 1991), and have lower productivity than unoiled birds (Giese et al. 2000). Further, birds that survive acute exposure may be re-exposed to toxic elements of crude oil and experience sublethal physiological impacts for many years following an oil spill (Peterson et al. 2003, Trust et al. 2000). Finally, developing embryos are particularly sensitive to oil exposure, and even small amounts of oil transferred from parent feathers or contaminated nest material may cause embryo death (discussed in more detail, below).

Effects of feather fouling

Exposure to crude oils can have a significant negative effect on the structure and function of the "waterproofed" feathers of waterbirds. Birds are dependent on an insulating layer of air within the plumage for effective thermoregulation. Aquatic bird feathers must be highly water repellent to prevent displacement of the air layer within the plumage. Feathers are not inherently waterproof; they are porous structures that water can pass through under certain circumstances. Feather waterproofing is conferred mostly by its lattice-like fine structure. The physical aspects of feathers that confer repellence include the radii of the barbs, the distance between their axes, and the contact angle of the air/water interface (Rajke 1970). A high contact angle causes water droplets to 'pearl' off a duck's back (Rajke 1970). Birds must preen elaborately and frequently to preserve ideal feather structure. Oil from the uropygial gland is spread during preening; it contains fatty, hydrophobic waxes and esters, and serves as a lubricant to keep feathers smooth and flexible (Rajke 1970).

Water surface tension plays an important role in feather wettability for water birds, because the pressure exerted by the weight of a floating bird must be sufficiently counteracted to keep water from penetrating its feathers (Stephenson and Andrews 1997). Researchers have calculated (Rejke 1970), and empirically shown (Stephenson and Andrews 1997), that feathers may be only marginally resistant to water penetration because only a small pressure gradient across the feather vane, above that caused by the bird's weight, would cause water to pass through. Since surface tension is the force resisting passage of water through the feather pores, only a small change of water surface tension may be required to enable feather wetting. In one experiment, it was shown that ducks and geese would become instantly wetted if they alighted on water where the surface tension had decreased to approximately 50 - 55% of its normal value (Stephenson & Andrews 1997). Water surface tension is decreased during spills of oils, surface-active organic pollutants including organic solvents, and detergents, thus compounding the negative effects of feather structure disruption.

Mallard ducks (*Anas platyrhynchos*) exposed to Prudhoe Bay crude oil were observed shivering, suggesting that the insulating properties of their plumage had been affected. Matting and clumping of feather barbules, which disrupted natural feather layering, were observed, and metabolic rates were increased (Lambert et al. 1982). Stephenson (1997) reviewed the effects of oil and other surface-active organic compounds on aquatic birds, using lesser scaup (*Aythya affinis*) as a model species. He also concluded that once wetted, unless the birds could reach land, preening was unlikely to restore the feathers' insulating ability. Stephenson further noted that wet, weakened birds on shore would be at greater risk of predation relative to healthy birds that rarely come ashore or that may be more capable of escape.

At the microscopic scale, O'Hara and Morandin (2010) studied the physical effects of sheens associated with marine oil and gas development on the feather miscrostructure of common murres (*Uria aalge*) and dovekies (*Alle alle*). They concluded that thin oil or drilling fluid sheens affected feather structure, causing feather barbules to clump together more than in controls. Stephenson (1997) reviewed the mechanisms and effects of external oiling on waterbirds, including studies that demonstrated lower body temperatures and increased metabolic rate (an energetic cost) from external oiling. In water, metabolic rates increased more than on air, expected given the greater heat loss associated with water. Smaller birds have a greater surface:volume ratio may be more vulnerable than large birds.

Molting water birds are particularly vulnerable to loss of plumage insulation, waterlogging and hypothermia (Stephenson 1997). Shortly before molt there is a loss of structural integrity due to feather wear, and the total mass of feathers is reduced as worn feathers are lost. One experiment found that the "wettability safety factor," expressed as the difference between the pressure required to force water through the feather and the pressure exerted by the weight of the bird, is reduced by about half during molt (Stephenson 1997). Molting birds are thus more vulnerable to wetting, while at the same time their energy demands may be elevated due to the cost of feather synthesis.

Effects of ingested oil

Birds (and mammals) are able to metabolize and excrete Polycyclic aromatic hydrocarbon (PAHs), but the energetic cost of doing so (by increasing detoxifying enzymes such as CYP1A1) can be substantial and lead to reduced fitness; if detoxifying systems are overwhelmed, individuals can become ill, have lowered reproduction, or die. PAHs effects on birds have been studied with dosing research and samples collected from the field during oil spills. Effects included lower egg production, lower hatching rates, increased clutch or brood abandonment (likely from mortality or morbidity of one or both parents), reduced growth, increased organ weights, and a variety of biochemical responses (Albers 2006). Hemolytic anemia and other blood abnormalities are common with oiling, as PAH metabolites attack red blood cells (Troisi et al. 2007). Yamato (1996) noted decreased mature erythrocytes, hemoglobin, and hematocrit values, and hemosiderosis (from iron released from red blood cells) in white-winged scoters (*Melanitta fusca*) oiled with Bunker C from a capsized ship, and attributed the exposure to ingestion from preening. Cassins auklets (*Ptychoramphus aleuticus*) exhibited liver damage (hepatocellular dissociation and hemosiderosis), kidney damage (renal tubular necrosis), and hemolytic anemia after experimental exposure to weathered crude oil on their feathers; common murres recovered from an accidental oil spill exhibited the same effects (Fry and Lowenstine 1985).

Pigeon guillemots (*Cepphus columba)* following the EVOS had acute effects of continued exposure to unweathered oil including elevated hepatic cytochrome P4501A (CYP1A), and other detoxifying enzyme activities (Golet 2002). Adult body mass, body condition, and nestling survival of pigeon guillemots were related to oil exposure, perhaps because of reduced availability of a preferred forage fish (Golet 2002). Peterson et al. (2003) summarized other effects of continued exposure to EVOS oil long after the spill event, including higher winter mortality, CYP1A induction, weight loss, and decreased densities of adult female harlequin ducks (*Histrionicus histrionicus*). Black oystercatchers (*Haematopus bachmani*) had reduced productivity on oiled shores compared to unoiled, including reduced incidence of breeding, smaller eggs, and chick mortality. Both species feed on tidal benthic invertebrates, as do listed spectacled and Steller's eiders; black oystercatchers were shown to consume oiled mussels with subsequent negative effects on chick growth, with negative implications for chick survival (Peterson et al. 2003).

Some metabolites of PAHs are far more toxic than the parent compound. For example, the carcinogenicity of PAHs such as benzo(a)pyrene is mediated by reactive metabolites, such as epoxides and dihydrodiols, that bind to cellular proteins and DNA (Albers 2003). The addition of alkyl groups to the base PAH structure also often induces or enhances carcinogenicity of PAHs (Albers 2003). Reactive metabolites of PAHs cause biochemical disruptions and cell damage that can lead to mutations, developmental malformations, tumors and cancer (Varanasi 1989). Thus, PAH metabolism is not always indicative of detoxification.

Effects on embryos (eggs)

Developing avian embryos are particularly sensitive to oil (PAH) toxicity; this has been studied with laboratory-based egg injection, egg immersion, and egg shell application of a variety of oils and PAH mixtures; and with some experimental and observational field research following oil spills (White et al. 1979). Oil ingested by laying females may cause reduced hatchability, eggshell thickness, or altered yolk structure (Grau et al. 1977, Ainley 1981, Clark 1984, Leighton 1993), but external oiling of eggs also has negative effects. Oil can be transferred to eggs from water (Albers 1980) via parent plumage, feet, or contaminated nest material (Albers 2006, 2003). Effects likely come from PAH toxicity, rather than smothering (Hoffman 1978, 1979). Effects include embryo death, developmental abnormalities (such as retarded growth and teratogenic effects; Hoffman 1978, 1979), and cellular and biochemical responses (Albers 2006), even with no behavioral changes on the part of incubating parents (Albers 1980). Even very small quantities of fresh crude oil (e.g., 1 - 20 ul) can cause mortality (Albers 2003). Although toxicity varies with degree of weathering and developmental stages, Finch et al. (2011) concluded that bird eggs exposed to Gulf of Mexico weathered crude may have had reduced hatching success.

Population- and community-level mortality rates for bird species affected by oil spills are difficult to estimate for various reasons, but a number of large oil spills were estimated to affect tens to hundreds of thousands of birds (1989 EVOS, 1991 *Sea Empress*, 1996 Arabian Gulf; Albers 2003). However, before and after comparisons are often lacking and effects may be confounded by other environmental conditions. When differences in population sizes can be detected, the effects of natural variability make it difficult to attribute the differences to the exposure to spilled substances. We found no research specific to albatrosses or eiders, but some information was available for other species of marine birds. Table F-17 shows taxa for which significant population declines were detected due to the effects of spills. No significant differences were detected for other taxa, some of which were examined in the same studies (Murphy et al. 1997; Piatt et al. 1990).

Table F-17. Estimates of acute bird mortality rates from oil spills.

Taxa	Population Decline (%)	Citation
European shag (*Phalacrocorax aristotelis*)	11	Martinez-Abrian et al. 2006
Grebes, cormorants and sea ducks	44-84	Piatt et al. 1990 (EVOS)
Common murres	50	Piatt et al. 1990 (EVOS)
Marine birds	54	Mcknight et al. 2006 (DHS)
Pigeon guillemots	57	Murphy et al. 1997
Pelagic cormorants (*Phalacrocorax pelagicus)*	32	Murphy et al. 1997
Black oystercatchers	27.5	Murphy et al. 1997

[Top]

When adequate data are available, they show that population and community level effects can be long-lasting: twelve avian taxa (black-legged kittiwakes [*Rissa tridactyla*], buffleheads [*Bucephala albeola*], “goldeneyes,” [*Bucephala spp.*] “grebes,” glaucous-winged gulls [*Larus glaucescens*], harlequin ducks, “mergansers,” [*Mergus*] mew gulls [*Larus canus*], marbled murrelets [*Brachyramphus marmoratus*], common murres, northwestern crows [*Corvus caurinus*], and pigeon guillemots) exhibited no population trends consistent with recovery in 2005, 16 years after the EVOS (McKnight et al. 2006).

Sea Otter

Sea otters are critically dependent upon their fur for thermoregulation, and oiling severely reduces fur thermoregulatory performance. Thermal conductance (an index of insulative quality) of marine mammal fur was significantly decreased after oiling, with sea otter pup fur being the most affected (Kooyman et al. 1976). A live otter would experience thermal stress, including decreased body temperature and significantly increased metabolic rate, as well as increased energy expenditure through additional grooming attempts (Kooyman et al. 1976; Costa and Kooyman, 1980, 1982; Englehardt 1983). Sea otters may also ingest oil, through grooming of oiled fur and through ingestion of contaminated prey. Sea otters have exhibited hemorrhagic gastrointestinal lesions (Baker et al. 1981), lung, liver, and kidney damage, DNA damage, and altered blood chemistry (Lipscomb 1996; Bickham 1998) after oil ingestion.

Spills may cause direct and indirect effects on critical habitat elements for sea otters, particularly kelp forests. For example, the rocky shoreline recovery after the EVOS took a decade or more (Peterson 2003). The initial loss of the rockweed *Fucus gardneri* triggered a community cascade, including blooms of ephemeral green algae caused by loss of *Fucus* on rocks, followed by loss of grazing and predatory gastropods. Fucus recovery was constrained; without canopy cover, *Fucus* recruits were subject to dessication. Even after apparent recovery of *Fucus*, previously oiled shores exhibited more rockweed mortality caused by the senescence of the single-aged stand (Peterson 2003). These studies and others such as those after the Torrey Canyon oil spill in the United Kingdom (Peterson 2003) point out the importance of indirect interactions to the continuity of rocky intertidal communities and the lengthy recovery time after severe oiling. All of these effects may result in population-level impacts to sea otters, as demonstrated by the very large EVOS (Albers 2003), with a reduction in otter survival rates still evident nine years post-spill (Monson 2000).

Polar Bears

Polar bears may also experience decreased fur performance with oiling. Thermal conductance of marine mammal fur including polar bear fur was significantly increased after oiling, which means loss of insulating capacity (Kooyman et al. 1976). Polar bears are most likely to come in contact with spilled material either directly at preferred feeding areas or through ingesting contaminated prey (Neff 1990). Polar bears groom themselves regularly as a means to maintain the insulating properties of their fur, so oil ingestion would likely be by this means (Neff 1990).

Most direct information comes from two experimental studies (Øritisland et al. 1981; St. Aubin 1990) in which polar bears were involuntarily forced into pools of water with oil. These authors suggest that polar bears are particularly vulnerable to oil spills due to inability to thermoregulate and to poisoning from ingestion of oil from grooming and/or eating contaminated prey (St. Aubin 1990; Øritisland et al. 1981). In the St. Aubin (1990) study, the animals immediately attempted to clean the oil from their paws and forelegs by licking, and continued grooming trying to clean their fur for five days. After 26 days one bear died of liver and kidney failure and the other bear was euthanized at day 29. Gastrointestinal fungus-containing ulcers, degenerated kidney tubules, low-grade liver lesions, and depressed lymphoid activity were found during necropsy (St. Aubin 1990). Other effects included hair loss, gastrointestinal damage, anemia, anorexia, and stress (Øritsland et al. 1981; St. Aubin 1990; Derocher and Stirling 1991). Effects were both acute and chronic, with some occurring five to six weeks after a single exposure to oil (Øritisland et al. 1981). Additionally, polar bears are curious and are likely to investigate oil spills and scavenge oil-contaminated wildlife, especially inexperienced subadults or if behaviorally compromised.

Although oil avoidance behavior by healthy polar bears is unknown, bears that are hungry are likely to scavenge contaminated seals, as they have shown no aversion to ingesting oil (St. Aubin 1990; Derocher and Stirling 1991). Petroleum hydrocarbons irritate or destroy epithelial cells lining the stomach and intestine, thereby affecting motility, digestion, and absorption, potentially contributing to weight loss or poor growth in young bears.

Population-level effects of exposure to oil on polar bears would depend upon the severity, location, and timing of the spill. Pipeline leaks could expose a small number of bears, including vulnerable females with young. Spills during the fall or spring (ice-up or breakup) would expose prime bear feeding areas over the continental shelf. Amstrup et al. (2000a) concluded that the release of oil trapped under the ice from an underwater spill during the winter could be catastrophic during spring break-up. During the autumn freeze-up and spring break-up periods it is expected that any spilled oil in the marine environment would concentrate and accumulate in open leads and polynyas, areas of high activity for both polar bears and seals (Neff 1990), resulting in oiling of both polar bears and seals that are their prey (Neff 1990; Amstrup et al. 2000a; Amstrup et al. 2006). The impact of a large spill, particularly during the broken ice period, could be significant to polar bear populations (71 CFR 43926), especially if the spill spread to seasonal concentration areas (e.g., near Kaktovik). A large oil spill could also indirectly affect polar bears through reductions in prey (ringed seal) as did the EVOS with harbor seals (Frost et al. 1994a; Frost et al. 1994b; Lowry et al. 1994; Spraker et al. 1994). Because of the greater maternal investment a weaned subadult represents, reduced survival rates of subadult polar bears greater impact on population growth rate than reduced litter production rates (Taylor et al. 1987).

Pacific Walrus

Because walruses rely primarily on a layer of blubber under the integument for insulation, direct coating would not affect their thermoregulation as it would sea otters and polar bears (St. Aubin 1990). However, direct exposure to oil could cause corneal ulcers and abrasions, conjunctivitis, and swollen nictitating membranes, as observed in captives ringed seals (Geraci and Smith 1976), harbor seals following the Exxon Valdez oil spill, and seals in the Antarctic after an oil spill (St. Aubin 1988); they could also exhibit increased gastrointestinal motility, vocalizations, and sleep less (Geraci and Smith 1976; Engelhardt 1985; Engelhardt 1987). Oral ingestion of oil can destroy epithelial cells in the digestive tract, affecting motility, digestion, and absorption, leading to illness, death, or reproductive failure (St. Aubin 1990). Walruses depend on scent to recognize pups; sea lion mothers did not recognize their oil-coated pups, though oiled grey seal pups appeared to nurse normally (St. Aubin 1990).

Marine mammals can be exposed to volatile and aerosolized petroleum components through inhalation, as they normally breathe immediately above the air-water interface. This was attributed as one cause of harbor seal mortality following the EVOS (Frost et al. 1994a,b; Lowry et al. 1994; Spraker et al. 1994). Dolphins sampled over a year after the DHS from heavily oiled regions of the Gulf of Mexico evidenced lung disease, with “significant alveolar interstitial syndrome, lung masses, and pulmonary consolidation” (Schwacke et al. 2013), consistent with laboratory studies and clinical reports of humans and animals exposed via ingestion, inhalation, or aspiration of petroleum hydrocarbons. The dolphins also had reduced adrenal gland function consistent with petroleum exposure (Schwacke et al. 2013). Parasitized lungs are common in walruses and other pinnipeds, and can exacerbate the effects of even mild PAH exposure (St. Aubin 1990).

Indirect Effects on Invertebrate Prey of Listed Species

Food resources are a critical biological feature of the of listed species’ environment. Food quality and availability is a key determinant of the ability of habitat to support survival and recovery of the species, and thus the conservation value of designated critical habitat. Effects of spills plus response actions on food resources constitute indirect impacts as well as impacts to habitat. Actions that reduce the availability, quantity, or quality of food resources also reduce the utility of the habitat. For spectacled eiders, Steller’s eiders, short-tailed albatross, sea otters, and Pacific walrus (who all depend upon invertebrate and fish prey) indirect effects under the Natural Attenuation spill response action include reduced prey abundance or quality (e.g., smaller prey items), consumption of invertebrate prey that accumulate PAHs over time (bivalves), or ecosystem shifts due to spill impacts on other species (e.g., trophic cascades from loss of macroalgae as described in Peterson et al. 2003). As a result of the EVOS, oil persisted in toxic forms for more than a decade, resulting in long-term impacts to species closely associated with shallow sediments (Peterson et al. 2003).

There are volumes describing the effects of oil exposure on invertebrates and fish (Albers 2003). For invertebrate prey of listed species, we are most concerned with mortality and recolonization rates, which affect abundance; and growth rates following exposure, which could affect size and therefore quality of invertebrate prey. For fish prey of listed species, we are concerned about mortality (abundance), and effects of oil exposure on young, which could result in population declines. We are concerned about oil on the water surface, in the water column (pelagic compartment), and on the bottom (benthic compartment), because life histories of most prey items include residence time in one or more of these.

Oil effects on marine invertebrates include debilitation, mortality, reduced reproduction, lowered respiration, abnormal or slow development and delayed larval emergence, lesions, population declines, and community changes; these are caused by physical smothering, narcosis and other forms of PAH toxicity, and perhaps water chemistry changes including decreased dissolved oxygen or changes in pH (reviewed in Albers 2003). Narcosis, caused by disruption of ion channels in membranes, is a distinct effect on fish and invertebrates including squid (Hendry et al. 1985) (prey of short-tailed albatross). Eggs and larvae are often more sensitive to PAH toxicity compared to young and adults, including to phototoxicity. Although less work has been done on freshwater invertebrates, effects of petroleum or PAH exposure included reduced survival, altered physiology and behavior, inhibited reproduction, soft-tissue abnormalities, and population and community changes (Albers 2003).

Ultra-violet (UV) light enhances oil toxicity, observed in translucent organisms exposed to the UV component of sunlight following tissue accumulation of certain larger-ringed PAHs (photosensitization), or when dissolved PAHs are photo-chemically transformed to compounds of higher toxicity and subsequently absorbed by the organism (photo-modification) (Duersterloh 2002). Photosensitization has been identified as the main mechanism causing photo-enhanced toxicity in various fish and invertebrates (Pelletier et al. 1997, Barron et al. 2003, Incardona et al. 2012), but several authors described photo-modification as a mechanism for increased toxicity of PAHs to plants (Huang et al. 1995, Marwood 1999). When organisms are exposed to phototoxic PAHs and UV, subsequent toxicity can be hundreds or even thousands-fold greater than exposure to the PAH in the absence of UV (Pelletier et al. 1997). Translucent biota inhabiting the upper water column, and the intertidal and shallow subtidal epibenthos, are exposed to UV in sunlight and may encounter PAH dissolved from chronic or catastrophic oil pollution sources (Duesterloh et al. 2002). Species with pelagic larvae are also at particular risk (Pelletier 2003). In one experiment, pyrene LC50s and EC50s for mysids (*Mysidopsis bahia*), bivalve embryos (*Mulinia lateralis*), and bivalve juvenile survival under fluorescent and ultraviolet light differed by a factor of 27.6, 51900, and 5620, respectively (Pelletier 2003). Similarly, the EC50 for embryonic and larval bivalves exposed to Prudhoe Bay crude oil, expressed was total PAHs, was 29-fold lower under UV light relative to fluorescent light (Pelletier 2003). Thus, laboratory toxicity values can underestimate toxicity under field conditions.

Toxic effects of PAHs to fish can have consequences via the food chain for short-tailed albatross and seal-eating polar bears (seals eat fish). Effects depend upon life stage and the specific PAH composition. Smaller 1- and 2-ringed PAHs produce a general narcotic toxicity, which is the type of toxicity best captured by short-term acute lethality studies (including those characterized in the BA's Species Sensitivity Distributions and HC5s). In embryonic fish, 3- to 4-ring compounds produce cardiac dysfunction characterized by pericardial and yolk-sac edema, dorsal curvature of the trunk and tail, significant growth reduction, and often death at later developmental stages (Incardona et al. 2004). In contrast, 4-ring PAHs exhibit Ah receptor-mediated toxicity (such as that produced by dioxins and polychlorinated biphenyls) including CYP1A enzyme induction, reduced circulation in the head and trunk with pericardial edema, failure of erythropoiesis, and apoptotic cell death in the neural tube (Incardona et al. 2004). The 4-, 5-and 6-ring PAHs are the most carcinogenic PAHs, particularly following activation to reactive metabolites that bind to cellular proteins and DNA (Albers 2003).

Multiple studies have shown that herring embryos are exquisitely sensitive to cardiotoxicity caused by 3- and 4-ring PAHs. Concentrations of 0.3 - 1 part per billion of these chemicals, referred to as "cardiotoxicity associated with polycyclic aromatic compounds" or PAH, are sufficient to cause cardiotoxicity and resultant death in herring embryos (Incardona et al. 2012, Carls 1999, Mcintosh et al. 2010), substantially lower than LC50 values generated in laboratory tests (summarized in WindWard 2014). In one experiment, embryos with sub-lethal pericardial edema failed to feed as larvae and did not survive metamorphosis (Hicken et al. 2011). Others have documented negative impacts to growth and marine survival of pink salmon that were exposed to crude oil as embryos, demonstrating the importance of long-term impacts and delayed effects on ecosystems (Heintz et al. 2000).

There may be other components of crude oils, in addition to PAHs, that are also phototoxic. When herring embryos were exposed to sunlight and weathered bunker oil on the day of fertilization, embryos developed "normally" and were viable for seven days, and then there was an abrupt loss of epithelial integrity and mortality by day eight post-fertilization, at the hatching stage (Incardona et al. 2012). Tissue levels of known phototoxic PAHs were too low to explain the observed degree of toxicity, indicating the presence of other unidentified or unmeasured phototoxic compounds derived from bunker oil. Crude oils are complex mixtures of over 500 chemicals; crude oils and products like residual oil are poorly characterized, both with respect to their chemical composition and their biological activities.

In Alaska, calanoid copepods (order Calanoida) occupy an important niche in marine food webs because they ingest a substantial proportion of annual primary production in the temperate and subarctic waters of the North Atlantic and North Pacific Oceans (Parsons and Lalli 1988). Thus, they account for the majority of the secondary production on a biomass basis in these waters. As secondary production, they are prey for most of the higher trophic level species, either directly or indirectly. Forage or juvenile fishes are often zooplanktivorous and are themselves prey for piscivorous fishes and marine mammals. The calanoid copepods are all translucent, and the advanced life stages of many are exposed to UV light while grazing on phytoplankton blooms near the sea surface during daylight (Hays 1995). Many of these copepods are lipid-rich in their later life stages and may bioaccumulate substantial burdens of PAHs through equilibrium partitioning (Duesterloh et al. 2002). Calanoid copepods thus include ecological key-role species that may be especially vulnerable to photo-enhanced toxicity of PAHs derived from crude oil, and their ingestion may be an important exposure pathway for organisms at higher trophic levels. Calanoid copepods exposed to small amounts of Alaska North Slope crude oil (approximately 2 parts per billion total PAH) exhibited passive PAH uptake into lipid-rich tissues, and those concurrently exposed to UV from sunlight exhibited dramatic photo-enhanced toxicity (Duesterloh et al. 2002). The authors postulated that the ecological implications of calanoid copepod toxicity could be particularly severe in nearshore areas where vertical migration of copepods is limited; phototoxicity in this situation could cause a mass mortality of the local plankton population.

Indirect effects of exposure to oil vary by species, but listed eiders, sea otters, and Pacific walruses all consume benthic invertebrates. Some invertebrates including bivalves and some crustaceans do not have a well-developed mixed function oxidase system and do not readily metabolize PAHs (Albers 2003). Organisms are exposed at the sediment-water interface, or by ingestion of sediment particles by filter feeders or sediment-dwelling deposit feeders (Varanasi and Malins 1977, Engelhardt 1987, Akkanen et al. 2012). Thus, if oil reaches the benthos, listed species can be exposed long-term to the toxic compounds in oil, with recovery taking many years, particularly in colder regions (Elmgren et al. 1983).

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