DRAFT

Conservation plan for reducing the impact of the Oregon ocean commercial Dungeness crab fishery on ESA-listed species off Oregon

Prepared for the

National Marine Fisheries Service

by the

Oregon Department of Fish and Wildlife
Marine Resources Program

2040 SE Marine Science Drive
Newport, OR 97365

http://www.dfw.state.or.us/MRP/

August 2021

Table of Contents

List of Figures

List of Tables

Acronyms

BIA: Biologically Important Area
CAM: Central America [DPS]
CCE: California Current Ecosystem
CCIEA: California Current Integrated Ecosystem Assessment
CDFW: California Department of Fish and Wildlife
CEP: Cooperative enforcement plan
CP: Conservation plan
DPS: Distinct population segment
EEZ: Exclusive economic zone
EGP: Experimental gear permit
EM: Electronic [vessel] monitoring
ENP: Eastern North Pacific [DPS or stock]
ENSO: El Niño Southern Oscillation
ESA: Endangered Species Act
ESCA: Endangered Species Conservation Act
FDA: Food and Drug Administration
HAB: Harmful algal bloom
HCI: Habitat Compression Index
HI: Hawaii [DPS]
ITP: Incidental Take Permit
IUCN: International Union for Conservation of Nature
IWC: International Whaling Commission
LRP: Limit reference point
MMPA: Marine Mammal Protection Act
MOU: Memorandum of understanding
MRP: [ODFW] Marine Resources Program
MSA: Magnuson-Stevens Fishery Conservation and Management Act
M/SI: Mortality and serious injury
MX: Mexico [DPS]
NEPA: National Environmental Policy Act
NID: Negligible impact determination
NIT_s: Single Negligible Impact Threshold
NIT_t: Total Negligible Impact Threshold
NMFS: National Marine Fisheries Service
NOAA: National Oceanic and Atmospheric Administration

NSI: Non-serious injury
OAR: Oregon Administrative Rule
ODA: Oregon Department of Agriculture
ODCAC: Oregon Dungeness Crab Advisory Committee
ODCC: Oregon Dungeness Crab Commission
ODFW: Oregon Department of Fish and Wildlife
OFWC: Oregon Fish and Wildlife Commission
ORS: Oregon Revised Statute
OSP: Oregon State Police
OWEWG: Oregon Whale Entanglement Working Group
PCFG: Pacific Coast Feeding Group
PBR: Potential biological removal
PDO: Pacific Decadal Oscillation
PRD: [NMFS WCR] Protected Resources Division
PSMFC: Pacific States Marine Fisheries Commission
RAC: Rules advisory committee
SAR: Stock assessment report
SI: Serious injury
SPLASH: Structure of Populations, Levels of Abundance and Status of Humpbacks [project]
SST: Sea surface temperature
USFWS: U.S. Fish and Wildlife Service
WCR: [NMFS] West Coast Region
WDFW: Washington Department of Fish and Wildlife
WNP: Western North Pacific [DPS]

Definitions

Biotoxin management zone: One or more harvest areas that due to test results the Oregon Department of Agriculture, in order to protect public health from domoic acid or other biotoxin concerns, has so designated in accordance with Oregon Administrative Rule (OAR) 603-025-0410 (OAR 635-005-0466).

Changed circumstances: Changes in circumstances affecting a species or geographic area covered by a conservation plan (CP) that can reasonably be anticipated by plan developers and the National Marine Fisheries Service (NMFS) and that can be planned for (50 CFR 222.102).

Conservation measures: Actions to benefit or promote the recovery of listed species that are included by the federal agency as an integral part of the proposed action. These actions will be taken by the federal agency or applicant, and serve to minimize or compensate for, project effects on the species under review. These may include actions taken prior to the initiation of consultation, or actions which the federal agency or applicant have committed to complete in a biological assessment or similar document (USFWS and NMFS, 1998).

Critical habitat: The specific areas within the geographical area occupied by [threatened or endangered] species, at the time it is listed, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and specific areas outside the geographical area occupied by the species at the time it is listed, upon a determination by the Secretary that such areas are essential for the conservation of the species (16 USC § 1532(5)(A)).

Cumulative effects: (Endangered Species Act; ESA) Those effects of future state or private activities, not involving federal activities, that are reasonably certain to occur within the action area of the federal action subject to consultation (50 CFR 402.02).

Cumulative impact: (National Environmental Policy Act; NEPA) The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) of person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).

El Niño Southern Oscillation (ENSO): A coupled climate phenomenon involving cyclic fluctuations in temperature between the ocean and atmosphere in the east-central equatorial Pacific (approximately between the International Date Line and 120° W). Opposite phases of ENSO (classified as El Niño and La Niña) are defined by sea surface temperature (SST) anomalies in the tropical Pacific.

Endangered species: Any species which is in danger of extinction throughout all or a significant portion of its range (16 USC § 1532(6)).

Evisceration: The common processor's action of removing and discarding the entire intestinal tract, hepatopancreas, and all associated abdominal organs of a crab (OAR 603-025-0410).

Exclusive economic zone (EEZ): The zone extending to 200 nautical miles (from the nation's coastal baseline) over which the U.S. and other coastal nations have jurisdiction. Under the MSA, the inner boundary of the U.S. EEZ is coterminous with the seaward boundary of the adjacent coastal state's territorial sea (3 nautical miles offshore) (PL 109-479).

Generation length: The average age of parents of the current cohort (i.e., newborn individuals in the population) which reflects the turnover rate of breeding individuals in a population (Taylor *et al.*, 2007).

Harm: An act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR § 222.102).

Harvest area: Section of waters of this state or the Pacific Ocean off Oregon delineated for crab traceability purposes (OAR 603-025-0410).

Incidental take: Takings that results from, but are not the purpose of, carrying out an otherwise lawful activity (50 CFR § 402.02).

Nearshore: The area from the outer boundary of Oregon's Territorial Sea at 3 nautical miles to the supratidal zone affected by wave spray and overwash at extreme high tides, and up into the portions of estuaries where species depend on the saltwater that comes in from the ocean (ODFW, 2016).

Negligible impact: An impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival (50 CFR § 216.103; used to implement MMPA 101(a)(5)(A) and 101(a)(5)(D); no definition exists for MMPA 101(a)(5)(E)).

Pacific Decadal Oscillation (PDO): A recurring pattern of widespread climate variability in the Pacific Basin and North America. Extreme phases of the PDO (classified as warm or cool) are defined by SST anomalies in the North Pacific.

Plan area: The specific geographic area where covered activities described in the CP, including mitigation, may occur (USFWS and NMFS, 2016).

Potential Biological Removal (PBR): The maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach of maintain its optimum sustainable population. The potential biological removal level is the product of the following factors: (A) The minimum population estimate of the stock, (B) One-half the maximum theoretical of estimated net productivity rate of the stock at a small population size, (C) A recovery factor of between 0.1 and 1.0 (16 USC § 1362(2)).

Spring transition: The transition from a winter downwelling state to a summer upwelling state along the west coast of the United States as a result of winds from the south shifting to a predominately equatorward direction.

Take: To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct (16 USC § 1532(19)).

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 (16 USC § 1532(20)).

Unforeseen circumstances: Changes in circumstances affecting a species or geographic area covered by a CP that could not reasonably have been anticipated by plan developers and NMFS at the time of the CP's negotiation and development, and that result in a substantial and adverse change in the status of the covered species (50 CFR 222.102).

Upwelling: The offshore movement of surface shelf waters and subsequent replacement by cold, nutrient-rich deeper water from off the shelf.

Executive Summary

The commercial Dungeness crab fishery is a critically important fishery in Oregon that provides significant economic, cultural, and social benefits to coastal communities in Oregon and the broader U.S. West Coast. Since 2014, an increase in the number of marine mammal entanglements in fixed fishing gear, driven largely by interactions between humpback whales and commercial Dungeness crab gear, has emerged as a management challenge across the entire West Coast fishery.

Whale populations in the United States are protected, assessed, and managed by the federal government under the Marine Mammal Protection Act (MMPA) for all species, and additionally under the United States Endangered Species Act (ESA) for threatened or endangered populations. Interactions between large whales and fishing gear have been documented as one of the largest contributors to human-caused serious injury and mortality of large whales on the West Coast, including fishing gear that has been definitively linked with the West Coast and Oregon commercial Dungeness crab fisheries.

Over the past six years, the Oregon Department of Fish and Wildlife (ODFW) has been actively working to address marine life entanglements in Oregon's fixed-gear fisheries with increased effort over the last three years. ODFW has worked closely with a number of partners to develop a proactive management strategy for Oregon. Many parts of this strategy have already been implemented through regulations adopted by the Oregon Fish and Wildlife Commission (OFWC). These regulations are primarily intended to strengthen accountability to improve the information obtained from any future entanglements and reduce the risk of future entanglements by minimizing co-occurrence between ESA-listed species and crab gear.

ODFW has developed this draft Conservation Plan (CP) in support of an incidental take permit (ITP) application under section 10(a)(1)(B) of the federal ESA. ODFW is seeking a 20-year take authorization for Oregon's ocean and Columbia River commercial Dungeness crab fishery covering humpback whales, blue whales, and leatherback sea turtles. Through this CP, ODFW will implement a comprehensive conservation program that minimizes take of covered species as required by the ESA and reduces mortality and serious injury of marine mammals to insignificant levels as required by the MMPA, while also sustaining the economic viability of the commercial Dungeness crab fishery.

In addition to outlining the terms and conditions of the requested ITP and providing background information on the covered species and the fishery, this CP describes the conservation program that is being implemented. Key elements of the conservation program include an assessment of anticipated take levels for covered species over the permit term, biological goals and objectives that will be achieved through implementation of targeted conservation measures, a robust monitoring program that will provide the necessary information to assess progress towards objectives, and an adaptive management strategy for refining the existing conservation measures throughout the permit term should monitoring indicate that changes are warranted. This CP also reviews alternative actions to the taking that were considered by ODFW and ultimately rejected.

Section 1 Introduction and Background

1.1 Overview and background

The commercial Dungeness crab fishery is an economically and culturally significant fishery in Oregon with landings recorded since the late 19th century (Waldron, 1958). In most years, the commercial Dungeness crab fishery is the most valuable single species commercial fishery in Oregon, accounting for over forty percent of Oregon's annual commercial landings by value (TRG, 2021). The crab fleet is diverse, ranging from small dories that fish for several hours in a day to large vessels that spend days or weeks at sea and can deliver over 100,000 pounds of crab in a single trip.

The commercial Dungeness crab fishery is conducted in both state (0 – 3 nm) and federal (3 – 200 nm) waters along the U.S. West Coast, with permanent management authority delegated to the states of Washington, Oregon, and California through specific provisions of the Magnuson-Stevens Fishery Conservation and Management Act (MSA; PL 94-265). Management has been largely stable over time, with each fishery operating under the same basic '3-S' management structure which limits harvest based on crab size, sex, and season. Since the mid-1990s, several additional actions have transformed the management of the West Coast fishery, including: development of a limited entry system which restricts the number of vessel permits; formation of a Tri-State Dungeness Crab Committee which provides a forum for resolving interstate issues; and, implementation of a pot limit system which limits the number of crab pots allocated to each permitted vessel.

Since 2014, there has been an elevated number of marine mammal entanglements in fixed fishing gear, which has emerged as a management challenge across the entire West Coast fishery. This increase has been driven largely by interactions between humpback whales, which are listed under the Endangered Species Act (ESA; 16 USC § 1531 et seq.), and commercial Dungeness crab gear (hereafter "crab gear"). Oregon Department of Fish and Wildlife (ODFW) has been actively working to address entanglements involving Oregon's fixed gear fisheries, with increased effort since 2017.

A Conservation Plan (CP; also called a Habitat Conservation Plan or HCP) is needed to ensure that ESA-listed species and an economically viable Dungeness crab fishery can co-exist and that the fishery remains in compliance with federal and state laws. The purpose of this CP is to detail ODFW's management strategy for minimizing and mitigating harmful impacts to federally listed whale and turtle species, which may occur incidental to the ocean and Columbia River commercial Dungeness crab fishery (hereafter "crab fishery") in Oregon. This includes an assessment of the impacts to these species and their habitat, in support of an Incidental Take Permit (ITP) application under the ESA.

1.2 Permit holder and duration

ODFW is the executive branch agency of state government responsible for managing Oregon's fish and wildlife and their habitats. ODFW is authorized in statute by the Oregon Legislature and in administrative rule by the Oregon Fish and Wildlife Commission (OFWC) to administer the regulation and management of Oregon's Dungeness crab fisheries. ODFW is requesting an Incidental Take Permit under section 10(a)(1)(B) of the Endangered Species Act for the crab fishery in Oregon for a 20-year period from date of issuance, with ability for permit renewal (see renewal procedure in *Section 6.2.3*). The requested ITP will authorize the incidental take of ESA-listed whale and sea turtle species in the crab fishery, allowing the fishery to continue operating concurrent with the implementation of a robust conservation program designed to protect threatened and endangered species from the impacts of interactions with crab gear.

ODFW proposes a 20-year renewable permit, based on the agency's demonstrated commitment to aligning management with conservation to support the co-existence of the crab fishery and ESA-listed species in Oregon. Commercial landings of Dungeness crab have been recorded since the late 19th century (Waldron, 1958). Since this time, ODFW and its predecessor agencies have exhibited a willingness and ability to adapt to changing conditions and address emerging issues. A complete description of the crab fishery management strategy and structure can be found in *Section 2* of this plan.

Additionally, given the relatively long generation time (i.e., 20+ years) of the covered species (defined in *Section 1.4*) and the time scales over which the environmental factors that affect their distribution and abundance may operate, the amount of time required to detect transgenerational impacts may be substantial (NMFS and USFWS, 1998; Taylor *et al*., 2007). This is compounded by the fact that entanglement events in Oregon are relatively rare and routine monitoring has not existed to date.

Finally, the proposed Conservation Plan includes a robust adaptive management strategy and a range of conservation measures that will be evaluated over time and responsive to new or changing information. ODFW is committed to ongoing monitoring and coordination with the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) to ensure that Oregon is a meaningful partner in meeting the conservation goals of ESA-listed whale and sea turtle species covered by this plan, while supporting the socioeconomically important Oregon crab fishery.

1.3 Plan and permit area

The geographic area considered in this plan and the requested ITP includes Oregon state waters and the Pacific Ocean in federal waters south of an east-west line extending westward at 46°15' N latitude (Oregon/Washington border) to 42°00' N latitude (Oregon/California border), to a seaward distance of 200 nautical miles (i.e., the U.S. Exclusive Economic Zone; EEZ) (Figure 1-1). The plan and permit area additionally include the Oregon waters of the Columbia River estuary west of the Megler-Astoria Bridge. The state maintains permanent authority to manage the crab fishery throughout this area (43 USC § 1311; PL 115-49).

The plan area and requested permit area encompasses the entire geographic range over which the crab fishery is active in Oregon, along with a buffer to account for potential future changes in fishery activity. Dungeness crab are distributed throughout a variety of coastal habitats, but are commonly fished to a depth of 100 fathoms (600 feet).

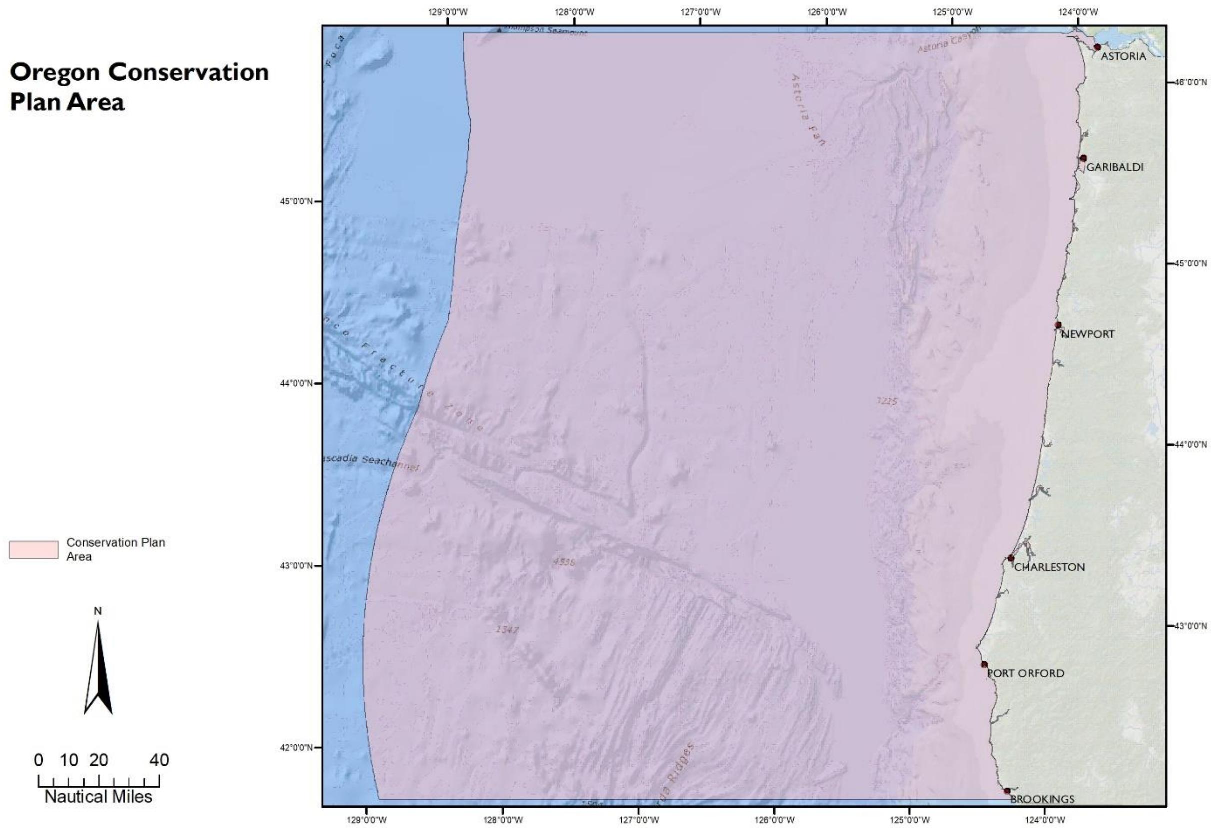

Figure 1-1. The conservation plan and permit area (light pink) extending seaward 200 nautical miles off the coast of Oregon.

1.4 Covered species

The following endangered or threatened species are referred to as "covered species" in the requested ITP.

Covered species	Federal listing status	State listing status
Humpback whale (*Megaptera novaeangliae*)	E (Central America DPS) T (Mexico DPS)	E
Blue whale (*Balaenoptera musculus*)	E	E
Leatherback sea turtle (*Dermochelys coriacea*)	E	E

ODFW considered the complete NMFS entanglement record of all ESA-listed (i.e., endangered or threatened with 4(d) rules) marine mammal and turtle species off the West Coast. ODFW is seeking coverage for each listed species or distinct population segment (DPS) that has been confirmed entangled in crab gear from any West Coast state (Washington, Oregon, or California); this criterion results in requested coverage for humpback whales (both the Central America and Mexico DPSs), blue whales, and leatherback sea turtles.

Humpback whales were first designated as endangered throughout their range under the federal ESA in 1970. In 2016, the globally endangered listing status was revised to include 14

DPSs (Bettridge *et al.*, 2015), which by definition are each considered discrete from other populations of the species and significant in relation to the entire species. Humpback whale DPSs are geographically designated based on wintering grounds, with three DPSs documented off the coast of the contiguous U.S. West Coast, including:

- The Mexico (MX) DPS which breeds along the Pacific coast from Mexico to the Revillagigedo Islands, transits the Baja California Peninsula, and feeds from California to the Aleutian Islands;
- The Central America (CAM) DPS which breeds along the Pacific coast of Central America and feeds off the West Coast of the United States and southern British Columbia; and
- The Hawaii (HI) DPS which breeds in the main Hawaiian Islands and feeds in most of the known feeding grounds in the North Pacific, particularly Southeast Alaska and northern British Columbia.

Of these, the CAM DPS is listed as endangered, the MX DPS is listed as threatened, and the HI DPS was found to not warrant listing under the ESA in 2016. Additionally, humpback whales are listed as endangered under the Oregon Endangered Species Act (Oregon Revised Statute; ORS § 496.171 through 496.192), which does not distinguish among DPSs.

For Marine Mammal Protection Act purposes (MMPA; 16 USC § 1361 et seq.), NMFS defines humpback whales that feed off the U.S. West Coast as one California/Oregon/Washington stock ("CA/OR/WA stock") which primarily includes whales from the endangered CAM DPS and the threatened MX DPS, with a small number of whales from the HI DPS. Due to the high proportion of whales originating from ESA-listed DPSs, the CA/OR/WA stock is currently considered "depleted" under the MMPA (NMFS, 2019a).

Similarly, blue whales have been listed as endangered throughout their range under the ESA since 1970 and are consequently considered a "depleted" stock under the MMPA. Blue whales found along the contiguous U.S. West Coast belong to the Eastern North Pacific (ENP) stock (as recognized under the MMPA) which extends from the northern Gulf of Alaska to the eastern tropical Pacific (NMFS, 2019b). Blue whales are also listed as endangered under the Oregon Endangered Species Act (ORS § 496.171 through 496.192).

Finally, leatherback sea turtles are a highly migratory species that has been listed as endangered under the ESA throughout their range since 1970 (NMFS and USFWS, 1998) and is also listed as endangered under the Oregon Endangered Species Act (ORS § 496.171 through 496.192). Leatherback sea turtles forage in the North Pacific Ocean, including in waters off the U.S. West Coast (Benson *et al.*, 2011).

Off Oregon, critical habitat was designated for ESA-listed humpback whale DPSs in 2021 and for ESA-listed leatherback sea turtles in 2012.

1.4.1 Non-covered species

The following species are discussed within the CP, but will not be "covered species" in the requested ITP.

Non-covered species	Federal listing status	State listing status
Gray whale (*Eschrichtius robustus*)[a]	E (Western North Pacific DPS)	E
Killer whale (*Orcinus orca*)	E (Southern Resident DPS)	
Fin whale (*Balaenoptera physalus physalus*)	E	E
Sperm whale (*Physeter macrocephalus*)	E	E
Sei whale (*Balaenoptera borealis*)	E	E
North Pacific right whale (*Eubalaena japonica*)	E	E
Minke whale (*Balaenoptera acutorostrata scammoni*)		
Loggerhead turtle (*Caretta caretta*)	E (North Pacific DPS)	T
Green turtle (*Chelonia mydas*)	T (East Pacific DPS)	E
Olive ridley turtle (*Lepidochelys olivacea*)	E (Mexico's Pacific coast breeding population) T (All other populations)	T
Hawksbill turtle (*Eretmochelys imbricata*)	E	

[a]The Eastern North Pacific gray whale DPS is not federally listed under the ESA, but will be discussed within the CP. This includes the Pacific Coast Feeding Group which is recognized as a distinct feeding aggregation, while the stock status of the PCFG is unresolved (see below).

ODFW is not seeking coverage for the following species: those that are not ESA-listed marine mammal or turtle species (even if they have been confirmed as entangled in crab gear), and those that have not previously been confirmed as entangled in crab gear along the U.S. West Coast (even if they are ESA-listed). However, the conservation program described in this plan is intended to avoid increasing interactions between crab gear and other (non-covered) whale and turtle species, and may reduce interactions between crab gear and species that have similar ecology to covered species. Additionally, these non-covered species may be discussed in the context of the West Coast entanglement record or through consideration of various management measures.

1.4.1.1 Gray whales

Gray whales are the second most commonly entangled whale species, after humpback whales, in West Coast fishing gear in recent years (2013 through 2020; NMFS WCR whale entanglement data, provided April 2021). Additional details on gray whale entanglements along the U.S. West Coast and in Oregon crab gear are included in *Sections 4.1.1* and *4.1.2*, respectively.

Under the MMPA, NMFS currently recognizes two North Pacific gray whale stocks: an Eastern North Pacific stock that primarily ranges from wintering grounds in Baja California, Mexico, to feeding areas in the Bering, Beaufort, and Chukchi Seas, and a Western North Pacific (WNP) stock that feeds during summer and fall off Sakhalin Island and in nearshore waters off southeastern Kamchatka, Russia. The migration routes and wintering grounds used by WNP gray whales are not well understood. Historical evidence suggests that areas in the South China Sea were used as wintering grounds, though present-day records of gray whales off the coast of Asia are infrequent. Some observations of whales identified in the WNP off Russia have been made in the ENP, including off the coast of North America (Alaska to Mexico) (Urbán *et al*., 2019).

Recent genetic research suggests that gray whale population structure may be in flux due to evolving migratory dynamics and, therefore, cannot be determined by a simple east-west divide (Brüniche-Olsen *et al*., 2018). Despite this level of mixing, the best scientific information available that is used by NMFS in the stock assessment report (SAR) process shows small, but statistically significant, genetic differences between the WNP and ENP stocks (NMFS, 2020a). The WNP stock is currently listed as endangered under the ESA and is consequently considered a "depleted" stock under the MMPA. The ENP stock is not ESA-listed, but remains under the general protection of the MMPA. Gray whales are additionally listed as endangered under the Oregon Endangered Species Act (ORS § 496.171 through 496.192).

The vast majority of gray whales entangled in Oregon crab gear and along the West Coast are believed to be from the non-listed ENP DPS, as evidenced by the assignment of all mortality and serious injuries (M/SI) from West Coast fishery entanglements to ENP gray whales in current SARs. To date, no entanglements along the West Coast have been confirmed to involve listed WNP gray whales. However, the interchange of some whales between the WNP and ENP presents some uncertainty about the likelihood that a WNP whale may become entangled in West Coast fishing gear. The most recent abundance estimate for the ENP stock is 20,580 animals, compared to an estimated 290 animals in the WNP stock (Stewart and Weller, 2021; NMFS, 2020b). A recent study compared photographs of individuals identified on summer feeding grounds off Russia (n=379) to individuals in the wintering lagoons of Mexico (n=1,685). The authors found a total of 43 matches which, in combination with 11 previous matches, represent movement between the WNP and ENP of 14% (n=54) of the gray whales identified off Russia from 1994 to 2016 (Urbán *et al*., 2019). The relative abundances of ENP and WNP, combined with the fact that only a portion of WNP whales are expected to be present in the ENP in winter, suggests that the chance of encountering a WNP gray whale off Oregon is exceedingly low.

While most ENP gray whales travel from wintering grounds off Mexico to feeding grounds in the Chukchi, Beaufort, and northwestern Bering Seas, a small group of ENP whales (a minimum of ~227 animals) known as the Pacific Coast Feeding Group (PCFG) exhibit seasonal fidelity (June 1 to November 30) to summer feeding grounds between northern California and northern Vancouver Island (from 41°N to 52°N). Scientists have studied the PCFG for several decades, including examination of photo identification, genetic, and satellite tag data by a NMFS task force to determine whether the PCFG constitutes a separate stock under the MMPA. To date, NMFS has concluded that the existing information does not provide evidence that PCFG whales are reproductively isolated from the rest of the ENP stock and, therefore, does not support designation of the PCFG as a stock at this time; however, the PCFG may warrant consideration as a stock in the future (NMFS, 2020a).

For this CP, species coverage is assessed based on the current stock status determinations made by NMFS. As such, ODFW is not seeking coverage for gray whales. However, given the uncertainties in stock status and small estimated population size of the PCFG, ODFW will give special consideration to the potential impacts of any management action taken under this CP on PCFG gray whales.

1.4.1.2 Other non-covered species

While all killer whales are under the general protection of the MMPA, only the Southern Resident DPS is listed, as endangered, under the ESA. Historically, a low number of killer whales have been confirmed entangled in crab gear originating from California. However, all entanglements are believed to have involved animals from the ENP transient stock, which are not ESA-listed (Saez *et al*., 2021). To date, there have been no confirmed entanglements of listed Southern Resident killer whales along the West Coast (NMFS WCR whale entanglement data, provided April 2021).

Fin and sperm whales, both of which are ESA-listed throughout their range, have been confirmed as entangled in other fishing gears on the West Coast (e.g., nets), but not in crab gear to date (NMFS WCR whale entanglement data, provided April 2021). Similarly, ESA-listed loggerhead, olive ridley, green, and hawksbill turtles have been confirmed entangled in other West Coast fishing gear types, but not in West Coast crab gear (NMFS WCR leatherback sea turtle entanglement data, provided April 2021).

Minke whales have been confirmed as entangled in West Coast fishing gear and a single entanglement in 2021 involved Oregon crab gear (NMFS WCR whale entanglement data, provided April 2021); however, the species is not listed under the ESA. Finally, both sei and North Pacific right whales are ESA-listed and utilize Oregon waters to a varying degree (Saez *et al*., 2013), but neither have been confirmed entangled in West Coast fishing gear of any type (NMFS WCR whale entanglement data, provided April 2021).

1.5 Regulatory framework

1.5.1 Federal

1.5.1.1 Federal Endangered Species Act

Section 9 of the ESA and federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as "*to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct*" (16 USC § 1532(19)). Harm is further defined by NMFS to include "*significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering*" (50 CFR § 222.102). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity (50 CFR § 402.02).

Individuals and state and local agencies proposing an action that is expected to result in the take of federally listed species are encouraged to apply for an ITP under section 10(a)(1)(B) of the ESA to be in compliance with the law. Such permits are issued by the U.S. Fish and Wildlife

Service (USFWS) or NMFS when take is not the intention of and is incidental to otherwise legal activities. An application for an ITP must be accompanied by a CP. The regulatory standard under section 10(a)(1)(B) of the ESA is that the effects of authorized incidental take must be minimized and mitigated to the maximum extent practicable. Under section 10(a)(1)(B) of the ESA, a proposed project also must not appreciably reduce the likelihood of the survival and recovery of the species in the wild, and adequate funding for a plan to minimize and mitigate impacts must be ensured.

Section 7 of the ESA requires federal agencies to ensure that their actions, including issuing permits, do not jeopardize the continued existence of listed species or destroy or adversely modify listed species' critical habitat. "Jeopardize the continued existence of…" pursuant to 50 CFR § 402.2, 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. Issuance of an ITP under section 10(a)(1)(B) of the ESA by NMFS is a federal action subject to section 7 of the ESA. As a federal agency issuing a discretionary permit, NMFS is required to conduct an internal section 7 consultation on issuance of a section 10(a)(1)(B) permit. Delivery of the CP and a section 10(a)(1)(B) permit application are precursors to the section 7 consultation process within NMFS.

The requirements of section 7 and section 10 of the ESA substantially overlap. Elements unique to section 7 include analyses of impacts on designated critical habitat, analyses of impacts on listed plant species, if any, and analyses of cumulative effects on listed species. Cumulative effects are effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area, pursuant to section 7(a)(2) of the ESA. The action area is defined by the influence of direct and indirect impacts of covered activities. The action area may or may not be solely contained within the CP boundary. These additional analyses are included in this CP to meet the requirements of section 7 and to assist NMFS with its internal consultation.

ESA Section 10(a)(1)(B) process

The section 10(a)(1)(B) process for obtaining an ITP has three primary phases: (1) the CP development phase; (2) the formal permit processing phase; and (3) the post-issuance phase.

During the CP development phase, the project applicant prepares a plan that integrates the proposed project or activity with the protection of listed species. A CP submitted in support of an ITP application must include the following information:

- impacts likely to result from the proposed taking of the species for which permit coverage is requested;
- measures that will be implemented to monitor, minimize, and mitigate impacts; funding that will be made available to undertake such measures; and procedures to deal with unforeseen circumstances; and
- alternative actions considered that would not result in take.

The CP development phase concludes and the permit processing phase begins when a complete application package is submitted to NMFS. A complete application package consists of 1) a CP, 2) an implementing agreement, if applicable, and 3) a permit application. Implementation details for this CP are provided in *Section 6* and will be used in place of an implementing agreement. NMFS must also publish a Notice of Availability of the CP package in the Federal Register to allow for public comment. NMFS also prepares an Intra-Service Section 7 Biological Opinion and prepares a Set of Findings, which evaluates the section 10(a)(1)(B) permit application as in the context of permit issuance criteria (see below). An Environmental Action Statement, Environmental Assessment, or Environmental Impact Statement serves as NMFS' record of compliance with the National Environmental Policy Act (NEPA), which has gone out for a 30-day, 60-day, or 90-day public comment period. A section 10(a)(1)(B) ITP is granted upon a determination by NMFS that all requirements for permit issuance have been met. Statutory criteria for issuance of the permit specify that:

- the taking will be incidental;
- the impacts of incidental take will be minimized and mitigated to the maximum extent practicable;
- adequate funding for the CP and procedures to handle unforeseen circumstances will be provided;
- the taking will not appreciably reduce the likelihood of survival and recovery of the species in the wild;
- the applicant will provide additional measures that NMFS requires as being necessary or appropriate; and
- NMFS has received assurances, as may be required, that the CP will be implemented.

During the post-issuance phase, the Permittee and other responsible entities implement the CP, and NMFS monitors the Permittee's compliance with the CP as well as the long-term progress and success of the CP. The public is notified when an ITP application is received and being processed, as well as when a decision is made on permit issuance.

1.5.1.2 National Environmental Policy Act

The purpose of the National Environmental Policy Act is two-fold: to ensure that federal agencies examine environmental impacts of their actions (in this case deciding whether to issue an ITP) and to utilize public participation. NEPA serves as an analytical tool on direct, indirect, and cumulative impacts of the proposed project alternatives to help NMFS decide whether to issue an ITP. NEPA analysis must be done by NMFS for each CP as part of the ITP application process.

1.5.1.3 Marine Mammal Protection Act

Section 101 of the MMPA and its implementing regulations prohibit the harassment, hunting, capturing, or killing of marine mammals, or any attempt to do so. However, the section provides several exemptions for specific activities or circumstances that incidentally take a small number of marine mammals. Additionally, section 7(b)(4)(C) of the ESA requires that any take of an ESA-listed marine mammal must be authorized pursuant to section 101(a)(5) of the MMPA, before federal agency action (e.g., issuance of an ITP) is taken.

Section 118 of the MMPA requires that each commercial fishery be classified according to the level of mortality and serious injury of marine mammals that occurs incidental to the fishery. Fisheries with frequent deaths and serious injuries incidental to commercial fishing are designated as Category I, while fisheries with occasional or remote deaths and serious injuries are designated as Category II and III, respectively. This information is published annually by NMFS in the MMPA List of Fisheries (e.g., 85 FR 21079).

Annual exemptions for the incidental take of non-ESA-listed marine mammals during commercial fishing operations are provided by the Marine Mammal Authorization Program through marine mammal authorization certificates issued to vessel owners operating in a Category I or II fishery.

1.5.1.4 Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act is the primary law governing the management of marine fisheries in U.S. waters. Through specific provisions of the MSA, permanent management authority for the West Coast Dungeness crab fishery operating in state (0 – 3 nm) and adjacent federal (3 – 200 nm) waters is delegated to the states of California, Oregon, and Washington (PL 115–49).

1.5.2 Regional

1.5.2.1 Tri-State Dungeness Crab Memorandum of Understanding

In 1980, the state fishery agency directors for Washington, Oregon, and California signed a memorandum of understanding (MOU) declaring their intent to take mutually supportive crab management actions (Fullerton *et al.*, 1980). This led to the formation of the Tri-State Dungeness Crab Committee in 1990 under the auspices of the Pacific States Marine Fisheries Commission (PSMFC) (LaRiviere and Barry, 1998).

The Tri-State Committee is a board of crab industry members (i.e., fishers and processors) and state resource agency advisors who meet to discuss and resolve interstate issues among the three states (e.g., development of a preseason testing protocol, see *Section 2.2.4.1*) (ODFW, 2014a). Industry members volunteer from the commercial fishing fleet and are appointed by ODFW to represent their port and Oregon at Tri-State Committee meetings. The committee provides recommendations to state managers and is facilitated by a representative from the PSMFC.

1.5.3 State

1.5.3.1 Oregon statutes and administrative laws

Oregon's crab fishery is governed by a series of Oregon Revised Statutes (ORSs) which are adopted or modified by the Oregon Legislature, and Oregon Administrative Rules (OARs) which are adopted or modified by the Oregon Fish and Wildlife Commission. The OFWC (established under ORS 496.090) consists of seven governor-appointed commissioners who are charged with setting policies and developing general state programs that provide for the productive and sustainable utilization of fish and wildlife resources by all user groups. The OFWC establishes rules and regulations (in the form of OARs) related to recreational and commercial fishing and hunting seasons, gear, and operations throughout the state. See *Section 6.1.6* for a description of the OFWC's role in CP implementation.

The ORSs adopted for the crab fishery (ORS § 508.921 through 941 and 509.415) contain regulations and requirements addressing fees, licensing, gear, and limited entry, while OARs (OARs 635-007-0502 through 0509, 635-005-0500 through 0515 and 635-039-0080 through 0090) pertain to seasons, gear, and fishery operations, among other things. Implementation of ORSs and OARs is overseen by ODFW with enforcement functions carried out by the Oregon State Police (OSP).

1.5.3.2 Food Fish Management Policy

The Food Fish Management Policy (ORS § 506.109) codifies the state of Oregon's policy that food fish (defined as all fish, shellfish, and all other animals living intertidally on the bottom over which the OFWC has jurisdiction in ORS § 506.036) be managed to provide the optimum economic, commercial, recreational, and aesthetic benefit for present and future generations of the citizens of the state. The goals of food fish management are:

- To maintain all species of food fish at optimum levels in all suitable waters of the state and prevent the extinction of any indigenous species;
- To develop and manage the lands and waters of the state in a manner that will optimize the production, utilization, and public enjoyment of food fish;
- To permit an optimum and equitable utilization of available food fish;
- To develop and maintain access to the lands and waters of the state and the food fish resources thereon;
- To regulate food fish populations and the utilization and public enjoyment of food fish in a manner that is compatible with other uses of the lands and waters of the state and provides optimum commercial and public recreational benefits;
- To preserve the economic contribution of the sports and commercial fishing industries in a manner consistent with sound food fish management practices; and
- To develop and implement a program for optimizing the return of Oregon food fish for Oregon's recreational and commercial fisheries.

1.5.3.3 Wildlife Policy

The Wildlife Policy (ORS § 496.012) codifies Oregon's policy that wildlife (defined to include fish and shellfish) shall be managed to prevent serious depletion of any indigenous species and to provide the optimum recreational and aesthetic benefits for present and future generations of the citizens of the state. Nothing in Oregon's wildlife laws is intended to affect the provisions of the state's commercial fishing laws. The Wildlife Policy was adopted to implement the following coequal goals in wildlife management:

- Maintain all species of wildlife at optimum levels;
- Develop and manage the lands and waters of the state in a manner that will enhance the production and public enjoyment of wildlife;
- Permit an orderly and equitable utilization of available wildlife;
- Develop and maintain public access to the lands and waters of the state and the wildlife resources thereon;
- Regulate wildlife populations and the public enjoyment of wildlife in a manner that is compatible with primary uses of the lands and waters of the state;
- Provide optimum recreational benefits; and
- Make decisions that affect wildlife resources of the state for the benefit of the wildlife resources and to make decisions that allow for the best social, economic, and recreational utilization of wildlife resources by all user groups.

1.5.3.4 Oregon Endangered Species Act

Under ORS § 496.171 through 496.192, the OFWC maintains a list of native wildlife species determined to be threatened or endangered in Oregon. The Oregon ESA shares similar conservation goals with the federal ESA (i.e., broad prohibition on the take of a listed species); however, the species survival guidelines established as a result of listing are limited to state-owned or state-leased land, or land over which the state has a recorded easement. Furthermore, management planning for endangered species is limited to state agencies.

Federal agencies maintain jurisdiction for federally listed species, and Oregon is an active participant in federal decision-making and recovery planning processes. The OFWC makes policy decisions regarding animal and fish species that are not federally listed, but are listed under the Oregon ESA (LPRO, 2019).

Section 2 Covered Activities and Fishery Description

2.1 Covered activities

ODFW is seeking coverage for the ocean and Columbia River commercial Dungeness crab fishery (or "crab fishery") which operates within the plan area defined in *Section 1.3*. In Oregon, there are three active fishery sectors which target Dungeness crab: the ocean and Columbia River commercial fishery, the bay commercial fishery, and the recreational fishery. Each fishery is managed under the same basic management structure (i.e., the 3-S strategy described in *Section 2.2.2*); however, separate regulations exist for each. For the following reasons, ODFW is not seeking coverage for the bay commercial or recreational crab fisheries at this time.

The bay commercial fishery is comparatively very small with around 20–30 vessels (Ainsworth *et al.*, 2012) delivering <1% of the annual crab harvest in Oregon. Bay commercial harvesters are limited to 15 crab rings per vessel and crab pots are prohibited (OAR 635-005-0510). The bay commercial season is relatively short, open from Labor Day through December 31, excluding weekends and holidays. Additionally, the fishery closes during December if the adjacent ocean area remains closed during that time (OAR 635-005-0505). Geographically, the bay commercial fishery is confined to bays and estuaries (excluding the Columbia River) and so little to no overlap exists between the active bay commercial gear and covered species. To date, there have been no confirmed entanglements of covered species in Oregon bay commercial crab gear. Gear marking requirements implemented in the bay commercial Dungeness crab fishery in 2019 will help to identify any entanglements with Oregon bay commercial crab fishery that may occur moving forward.

The recreational fishery is also relatively small compared to the ocean commercial fishery. The boat-based recreational fishery is estimated to harvest ~5% of the total annual crab taken in Oregon (not including land-based effort) (ODFW, unpublished data). Beyond the relative size of the sectors, spatial overlap between active recreational crab gear and covered species is expected to be low, as a significant portion of recreational gear is fished in bays and estuaries, and recreational gear that is used in the ocean is typically fished in shallower water and often left soaking for less than a day. To date, there have been no confirmed entanglements of covered species in Oregon recreational crab gear, though there have been three confirmed entanglements of humpback whales in recreational crab gear from other states (Saez *et al.*, 2021). Like the bay commercial fishery, additional gear marking requirements implemented in 2019 will help to identify any entanglements with Oregon recreational crab gear that may occur.

2.2 Fishery description

This section provides a description of the various components of the ocean and Columbia River commercial Dungeness crab fishery.

2.2.1 Overview

The crab fishery season is targeted to open on December 1 and runs through August 14, operating in both state and federal waters off Oregon. Harvesters are restricted to retaining only male crab that are at least 6 ¼" in carapace width. In addition to size, sex, and season regulations, the fishery operates under a limited entry system and pot limit program (200, 300, and 500 pot tiers) which control effort in the fishery through restrictions on the number of vessels and amount of gear each permitted vessel can use. Additional regulations are in place during the summer months (June to August) to limit fishing on softshell crab at the end of the season.

The Oregon crab fleet is diverse, with vessels ranging from small boats that fish for several hours and hold less than 1000 lbs of crab, to those that spend days or weeks at sea and return with over 100,000 pounds of crab. See *Section 2.2.11.3* for an overview of major vessel classifications from Davis *et al.* (2017).

Dungeness crab are caught in commercial crab pots which are set at depths ranging from 1 to 120 fathoms. Logbook data indicate that, since the 2007-08 season, an average of 63 – 91% of crab gear is fished in waters 30 fathoms or shallower throughout the season (ODFW, unpublished data). As of the 2019-20 season, the 25-year average crab fishery harvest was 16.6 million pounds per season. The vast majority of crab, 83 – 91% in recent seasons, are caught during the first eight weeks of the ocean commercial season (ODFW, 2020a).

2.2.2 3-S management structure

Along the U.S. West Coast, Dungeness crab fisheries are managed using a 3-S management strategy which restricts harvest based on crab size, sex, and season. Over time, this strategy has been combined with a series of gear requirements and effort controls. Size, sex, and season regulations are generally consistent across states and have remained largely unchanged since the 1960s.

Minimum size limits are intended to allow male crab to reach sexual maturity and reproduce for one to two seasons before becoming vulnerable to harvest (PFMC, 1979). Currently, the minimum size limit is set at 6 ¼" measured as the shortest distance across the carapace of the crab from edge of shell to edge of shell from directly in front of the tenth anterolateral spine (OAR 635-005-0495). Additionally, to minimize impacts to the reproductive capacity of the stock, fishers are prohibited from harvesting female crab (OAR 635-005-0495).

Ocean commercial crab seasons are set to provide some measure of protection during the time of year when crab molting (i.e., periodic shedding of the exoskeleton to allow for growth) typically takes place. Softshell crab are more vulnerable to the impacts of handling, so injury and mortality is reduced by restricting harvest of poor condition crab. Also, a higher meat yield is provided by crab that are in a hardshell condition (PFMC, 1979). Additional regulations are in place during the summer months (June to August) to limit fishing on softshell crab at the end of the season (see *Section 2.2.6*).

The determination of open seasons has been a topic of debate since the early days of the fishery due largely to the spatial and temporal variation in crab molting patterns, fluctuations in harvest, and socioeconomic considerations. The current regulation prohibits harvest from August 15 through 8:59am on December 1 (OAR 635-005-0465). Additionally, season opening delays may be implemented for several reasons (e.g., meat fill, biotoxin management) through temporary rule (see *Section 2.2.4*).

2.2.3 Crab fishing gear

Gear specifications for the crab fishery are found in OAR 635-005-0475. Both crab rings and pots may be used to harvest crab in the fishery, though crab pots are almost exclusively used. Commercial crab pots are limited to a volume of 13 cubic feet calculated by the external dimensions of the pot. Pots must be equipped with at least two 4 ¼" (inside diameter) escape ports on the top or side (upper half only) of the pot, in addition to a release mechanism. Release mechanisms (also called "rotten cotton") refer to degradable materials incorporated into the lid or stainless steel mesh of a crab pot to allow for the escape of legal-sized crab from lost or derelict fishing gear once the material degrades.

Crab pots utilized in the fishery are designed to be practical and effective, while minimizing impacts to crab and habitat (Figure 2-1). Most crab pots are cylindrical and constructed with welded steel frames wrapped with rubber to insulate from seawater corrosion and minimize handling difficulty. Frames are covered with stainless steel mesh and include tunnels on opposite sides that allow crab one-way entry. A hinged lid allows crab to be easily taken from the pot and is secured with a rubber strap and metal hook.

Pots are rigged with a single vertical line between the pot and one or more surface buoys (typically two), which are marked with a color pattern for distinguishing between pots from other vessels (Goblirsch and Theberge, 2008). Pots are required to be individually buoyed and may not be attached to one another by a common groundline or any other means (known as "longlined pots"; OAR 635-005-0485). This prohibition on longlining supports enforcement of pot limits, eliminates the potential for derelict longline strings of crab gear, and makes it easier for crab and other fishers to determine the location of gear and reduce conflicts over gear setting. However, because the likelihood of interactions with covered species is believed to be directly related to the overall number of vertical fishing lines, some form of a modified longline has been discussed as a potential technique for reducing interactions with covered species. This remains a topic of discussion and a measure under long-term consideration within the crab fishery (see *Section 5.6.2.1*).

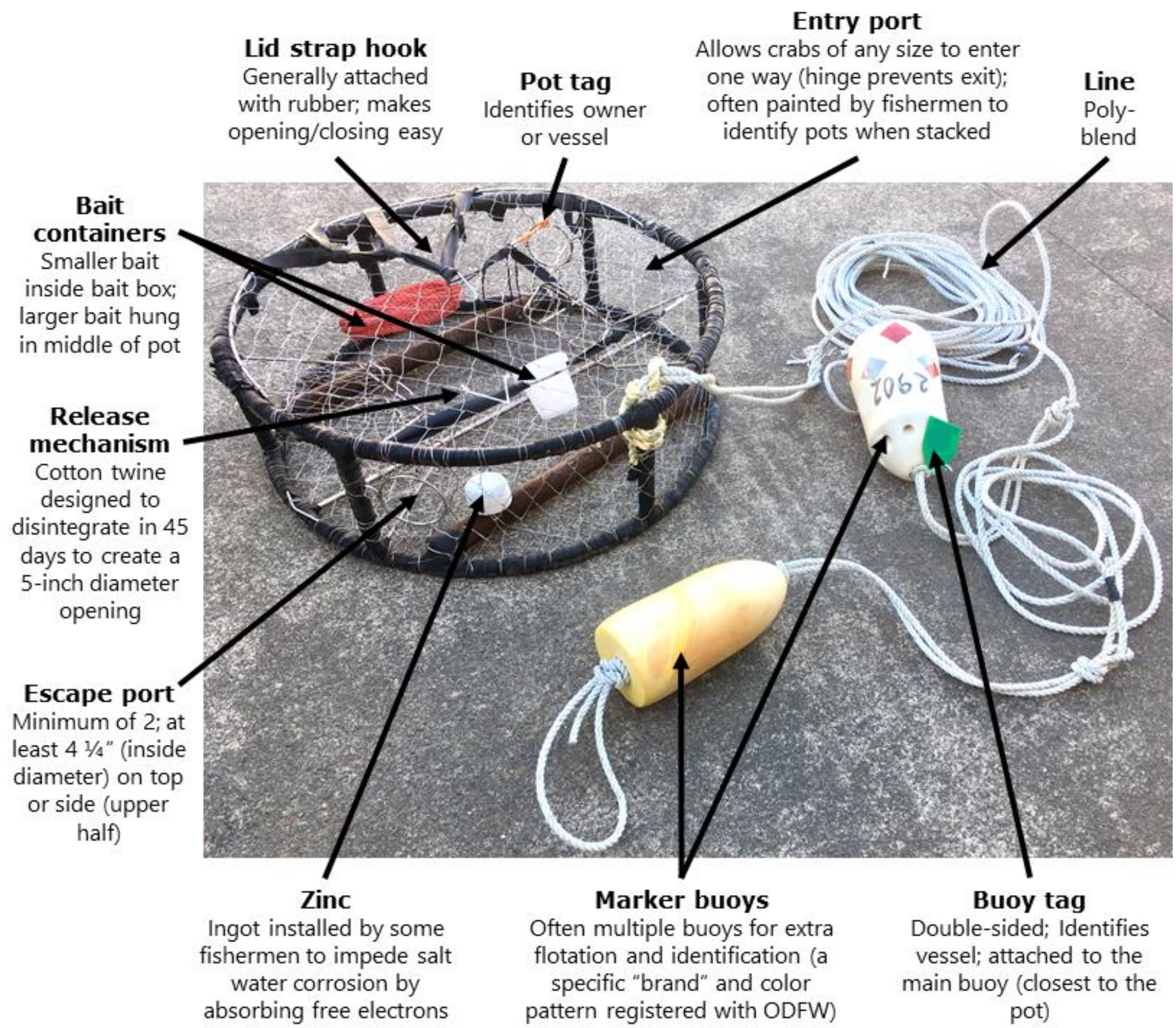

Figure 2-1. Anatomy of a modern ocean commercial crab pot.

Series of single commercial pots, referred to as strings, are individually deployed in the ocean. Generally, strings are deployed along a bathymetric contour and retrieved after one to 14 days (ODFW, 2014b), though logbook data indicate variable soak times depending on location, season, and weather conditions. In order to ensure gear is being regularly tended, fishery participants are required to make a crab landing at least once every 14 days if they have crab gear deployed in the ocean or Columbia River (OAR 635-005-0485).

2.2.3.1 Gear marking

Buoy tag and gear marking requirements for the crab fishery are found in ORS § 509.415 and OAR 635-005-0480. Crab rings or pots used to commercially harvest crab are required to have a tag identifying the owner or vessel from which the gear is operated. Additionally, a buoy tag must be attached to the main buoy (closest to the pot) identifying the owner or vessel from which they are operated (Figure 2-2). Buoys must be clearly marked with a specific buoy brand (letters and/or numbers) and each buoy color pattern must be registered with ODFW. Replacement buoy tags, which are easily distinguishable by color from primary tags, may be issued to replace tags lost due to catastrophic loss (as defined in ORS 635-005-0240) or due to an extraordinary event (requirements defined in OAR 635-005-0480). See *Section 5.3.1.2* for a description of the elimination of the standard replacement tag allowance in 2020 as a conservation measure for reducing the risk of marine life entanglements.

Figure 2-2. Example ODFW-issued primary season buoy tag, late-season buoy tag, and replacement tag for vessels participating in the crab fishery. All tags are double-sided with replicate information on both sides. The valid permit year will be specified on late-season buoy tags in future seasons, but is not pictured here.

2.2.4 Season opening

A number of processes take place prior to the start of the ocean commercial crab season to ensure that a safe, quality product is available to consumers and that fishers have orderly, equitable access to the Dungeness crab resource.

2.2.4.1 Tri-State preseason testing protocol

In 1980, state fishery agency directors from Washington, Oregon, and California entered into an MOU to formalize their commitment to interstate cooperation in coastal Dungeness crab management. This led to the formation of the Tri-State Dungeness Crab Committee (see *Section 1.5.2.1*) and, subsequently, the development of a preseason testing procedure (i.e., the 'Tri-State protocol') for determining season openings based on crab condition and market quality. Since its inception, the Tri-State protocol has been revised several times in response to management needs, to provide a standardized and consistent coastwide procedure from the California Mendocino-Sonoma County border (near Point Arena) to the United States-Canadian border (i.e., the Tri-State coastal Dungeness crab commercial fishery). The latest revision was signed in May 2020.

In accordance with the Tri-State protocol, all three states collect crab from test stations spanning the primary range of the fishery. Meat recovery results, including any deviations from the protocol, are provided to each state and the PSMFC as soon as possible. ODFW, Washington

Department of Fish and Wildlife (WDFW), and California Department of Fish and Wildlife (CDFW) then consult and a decision to open the season on December 1 or delay is made based on a recommended meat recovery rate of 23% north of Cascade Head and 24% south of Cascade Head (without rounding). In the case of a season delay due to poor meat recovery rates, two or more fishing zones may be established, taking into account traditional fishing patterns, by mutual agreement of WDFW, ODFW, and CDFW.

2.2.4.2 Fair start provisions

Since the first iteration of the Tri-State protocol in 1993, the procedure for establishing fishing zones has included a fair start provision. If the season opening is delayed and the coastal fishery is divided into fishing zones, fishers may elect to fish crab in any zone and must declare which zone they will fish in during preseason hold inspections (see *Section 2.2.4.4*). A vessel used for fishing crab in an open zone is prohibited from fishing in any zone that opens later within the same crab season until 30 days after the later-opening zone has opened.

The 2020 Tri-State protocol includes a fair start regulation clarification table with additional details for each state.

2.2.4.3 Gear setting and barging

Prior to the season, fishers are allowed to set commercial crab pots during a 73-hour gear setting period (OAR 635-005-0485). A gear setting period has been in place since the mid-1960s to provide equal opportunity to small boats with a limited capacity to transport pots, reduce congestion at the docks, and improve safety. The length of the gear setting period has been changed several times to improve enforcement ability and rule compliance, with the current rule adopted in 2014 (OFWC, 2014).

Under OAR 635-005-0405, an Ocean Dungeness Crab Permit is not required for vessels engaged solely in gear setting for a permitted vessel in the crab fishery. This practice, referred to as barging, allows smaller vessels to remain competitive and safe on opening day by having the option to enlist a larger vessel to haul and set some or all of their pots. Additionally, vessels that are involved only in barging are not subject to the fair start provisions of the Tri-State protocol (OAR 635-005-0465).

2.2.4.4 Hold inspections

All harvesters participating in the first 30 days of the crab fishery are required to have their vessel holds inspected and certified to be free of crab as described in OAR 635-005-0465. Hold inspections were first implemented during the 1986-87 crab season to address observed abuses of the preseason gear setting period (ODFW, 1986). Over time, additional regulations have been adopted that require fishers to declare the fishing zone in which they intend to participate in the event of a season delay and certify the number of pots that will be used during the season on the hold inspection certificate form.

Hold inspections are conducted by OSP with assistance from ODFW on the day prior to the season opening, or by appointment on any day after.

2.2.5 Fishery effort and capacity

Fishery effort is typically measured by the number of vessels, pots, or trips in a given time period. In Oregon's crab fishery, the number of vessels increased slowly through 1969, but generally remained below 100 boats (Figure 2-3). The number of vessels doubled over the next three years and continued to increase to a maximum of 465 vessels during the 1979-80 season. The estimated number of pots fished each year followed a similar pattern increasing from 29,200 pots in 1969 to over 125,000 pots during the 1979-80 season.

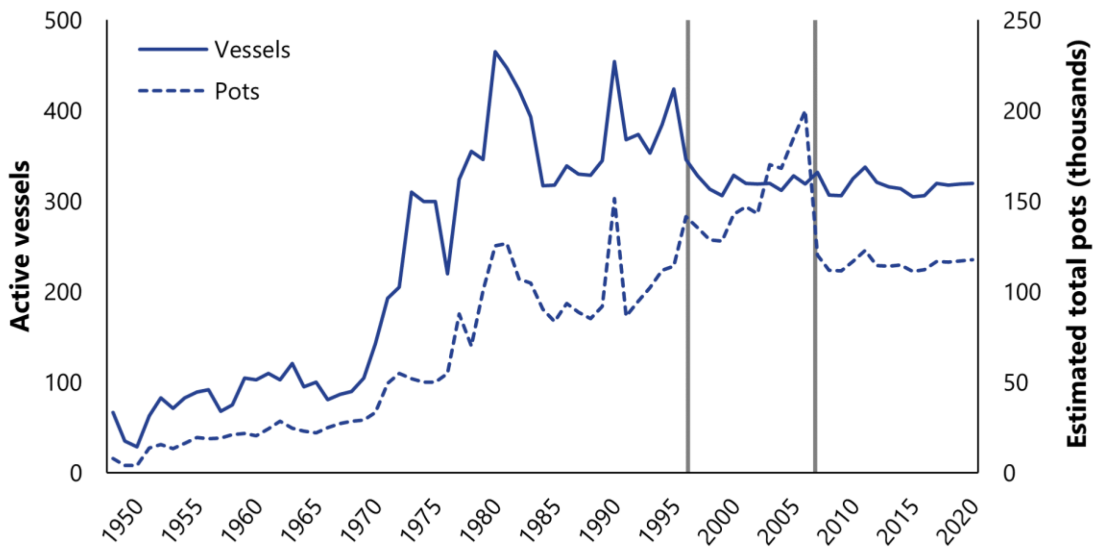

Figure 2-3. Number of active vessels and estimated total pots fished in the crab fishery from the 1947-48 through 2019-20 seasons. Historically, the total number of pots was expanded from port estimates obtained through fisher interviews and vessel counts. Beginning with the 1986-87 season, estimates were derived from pot declarations collected during hold inspections. Since the implementation of pot limits in 2006-07, estimates are made by summing pot tiers (see *Section 2.2.5.4*) for all permits making landings into Oregon by crab season, according to ODFW fish ticket data. These estimates do not account for vessels that do not fish their full allotment of pots or vessels that harvest crab in Oregon but land all crab into another state (see *Section 2.2.5.2*).

2.2.5.1 Limited entry

While the number of boats and pots remained high through the 1980s, the average annual pounds landed per boat and the pounds of crab caught per pot decreased (Demory, 1990). This led to growing competition and the concentration of effort in the first weeks of the season. In 1995, the 68th Oregon Legislative Assembly found the Oregon crab fishery to be overcapitalized and economically unstable due to excess fishing effort (ORS § 508.921). The Legislature passed

HB 3094 which created a limited entry system for the crab fishery restricting participation based on specific vessel permit qualification criteria (ORS § 508.931). The OFWC then adopted a series of OARs implementing portions of the program related to annual renewal, transferability, and vessel length modification requirements. Several amendments have further defined or clarified the original rule language.

Limited entry became effective in all three states prior to the start of the 1995-96 season, with 465 vessels initially qualifying for permits in Oregon (ODFW, 1997). As of 2020, the number of permits has dropped to 423 due to non-renewal. Each year, a portion of permitted vessels that participate in the Oregon crab fishery do not make landings in Oregon, or do not participate entirely (see *Section 2.2.5.2*). From the 2010-11 through 2019-20 seasons, 318 different permit holders, on average, made landings into Oregon ports.

2.2.5.2 Multi-state permitted vessels

As described above, each year there is a portion of vessels with Oregon permits that do not make landings into Oregon. While some of these vessels do not participate in the Oregon crab fishery at all, others may fish off Oregon, but land crab exclusively in other states if they possess permits for both or all three states. These vessels are referred to as dual- or tri-permitted vessels, respectively.

During the 2014-15 through 2018-19 seasons, an average of 32 dual-permitted vessels (possessing both Oregon and Washington permits) made landings only in Washington and 11 dual-permitted vessels (possessing both Oregon and California permits) made landings only in California (Table 2-1). Over the same time period, an average of eight tri-permitted vessels made landings in another state (Washington and/or California), but not in Oregon.

Table 2-1. Average number of active (made one or more landing) and inactive (made no landings) single, dual-, and tri-permitted vessels in Oregon from the 2014-15 through 2018-19 seasons. Data are from ODFW, WDFW, and CDFW fish tickets.

	Single OR permit	Dual-permit (OR+WA)	Dual-permit (OR+CA)	Tri-permit (OR+WA+CA)	Total permits
Active in OR	248	30	30	6	314
Inactive in OR, but active in other state(s)	0	32	11	8	51
Inactive in all states	55	1	2	1	59
Total vessels	303	63	43	15	424

2.2.5.3 LE 200

Under the Magnuson-Stevens Act, each state has jurisdiction over their own permit holders and those making Dungeness crab landings in their state. When limited entry was implemented, commercial crabbers were restricted from fishing in the waters of a state that they were not permitted in (within three miles of shore), but were still able to fish in federal waters anywhere in the Tri-State area (from three to 200 miles).

In 2004, the Tri-State Committee began discussing mechanisms for reducing potential effort shifts and increases through limited entry jurisdiction out to 200 miles, termed ‘LE 200’. The result was reciprocal rules adopted between Oregon and Washington in 2005 and between Oregon and California in 2007, which prohibited permit holders from fishing out to 200 miles off neighboring states (ODFW, 2007). The valid harvest area for fishers with Oregon Dungeness crab permits is designated in OAR 635-005-0460.

2.2.5.4 Pot limits

While limited entry legislation in 1995 effectively limited the number of vessels participating in the crab fishery, the number of pots continued to increase (up to 200,000 pots) through the 2005-06 season (Figure 2-3). Beginning with the 2006-07 season, the OFWC adopted a three-tiered pot limitation system (200, 300, and 500 pots) designed to limit the total number of pots fished in Oregon to 150,000 (ODFW, 2006).

A single pot limit was assigned to each Oregon crab permit based on documented landings of ocean Dungeness crab into Oregon, Washington, or California from December 1, 1995 through August 14, 2001 (OAR 635-005-0405). As part of the pot limit system, additional measures were adopted which included a pot limit appeals process (OAR 635-005-0425), gear specifications (OAR 635-005-0475), buoy tag requirements (OAR 635-005-0480), and a gear leasing prohibition (OAR 635-005-0485). Several minor revisions to the adopted rules have followed to improve implementation of the program.

ODFW was directed by the OFWC to conduct a review of the pot limit program after three years to determine its effectiveness. In October 2009, ODFW reported that the crab fishery had maintained productivity following pot limit implementation in terms of landings and ex-vessel value. Patterns of monthly effort were similar before and after pot limits, indicating that most fishers were adapting well to pot limits. ODFW recommended several minor adjustments to the pot limit program, including development of a long-term derelict gear retrieval program to support the goals of the program and aid in enforcement (ODFW, 2009). This was addressed through the ODFW Post-season Derelict Gear Recovery Program first implemented in 2014 (see *Section 2.2.9.3*).

Since the introduction of pot limits, the number of pots has largely stabilized with an average of 115,000 pots fished in the crab fishery each year (Figure 2-3).

2.2.5.5 Seasonal fishery effort

Crab fishery effort is not constant throughout the season. The crab fishery is most active during the winter months when nearly all active permit holders are making landings. In recent seasons, between 83 – 91% of crab are landed in the first eight weeks of the season (ODFW, 2020a). During spring and summer, fishing activity (both landings and the number of active vessels) greatly diminishes through the end of the season. See *Section 5.3.1* for additional analyses of seasonal fishery effort patterns.

2.2.6 Summer fishery

Until the late 1970s, relatively few commercial vessels fished for crab past the end of May and the number of trips during summer months remained low. However, an increase in late season fishery effort around this time raised concern among industry and managers about the effects of increased sorting and landing of softshell crab (ODFW, 1984).

During the 1990s, two separate regulations were adopted which restrict ocean commercial harvest of Dungeness crab during the summer (June 1 through August 14). First, ocean commercial landings after May 31 are limited to ten percent of the crab landed from December 1 to May 31 (OAR 635-005-0465). In the event that this threshold is met, the commercial season is closed by temporary rule until the following season opener. Second, ocean commercial landings from the second Monday in June through the end of the season are limited to 1,200 cumulative pounds per vessel per week (OAR 635-005-0470).

In recent years (2012-13 through 2019-20 crab seasons), the number of permits active in the fishery during the second half of June has ranged from 49 to 95, with 68 permits on average. This number continues to decline slightly as the summer progresses to a range of 35 to 62, and an average of 48 active permits in August.

2.2.6.1 Discard mortality

The impact of softshell crab discard mortality on future harvestable biomass has remained a conservation concern among managers and industry. In 2017, the Oregon Dungeness Crab Commission (ODCC) sponsored the development of a deterministic bioeconomic model to assess the economic impacts associated with potential management actions (Davis *et al.*, 2017). In particular, the model was developed to explore potential impacts of season closures to protect softshell crab, but it also allowed for evaluation of altering effort and/or delaying the season opening in combination with a range of environmental and economic variables. Results indicated that reduced season length did not result in significant economic benefits to the fishery in future seasons and that, for most management actions, there were winners and losers among different vessel classes or business plans. Additionally, the model demonstrated that the effects of natural mortality are magnitudes greater than the effects of handling mortality. Therefore, any potential savings gained by softshell management actions is very small compared to the loss of biomass due to natural mortality (Davis *et al.*, 2017).

More recently, the bioeconomic model has been used to assess the economic impacts from proposed management measures to reduce the risk of marine life entanglement in crab gear. The results of this work are discussed in *Section 8.3*.

2.2.7 Available fishery data

The ODFW Marine Resources Program (MRP) is actively involved in data collection and monitoring related to the Dungeness crab resource and fishery. A variety of data sources contribute to a better understanding of crab catch, effort, size distributions, and discard in the crab fishery.

2.2.7.1 ODFW fish tickets

Since 1969, crab landings data have been provided by ODFW landing receipts ("fish tickets") issued to vessels by the first receiver for each harvest purchase. This landing information is archived by ODFW in a fish ticket database and by the PSMFC in the Pacific Fisheries Information (PacFIN) database along with data for Washington and California.

Beginning with the 2017-18 season, record keeping requirements were expanded to support and strengthen crab traceability through the market chain. Improved traceability provides for more strategic management actions related to biotoxin management (see *Section 2.2.10*). This included the establishment of 12 crab harvest areas which must be reported on all ODFW fish tickets (Figure 2-4). Additionally, this provides ODFW with near-real time harvest location data which will be useful in continuing to develop and refine whale entanglement mitigation measures.

Since December 2019, all ocean and bay commercial crab fish tickets require electronic submission by the end of the next business day after a landing of Dungeness crab is made (OAR 635-006-0210) (ODFW, 2019a). Electronic fish tickets improve ODFW's ability to efficiently and effectively monitor crab fishery effort and ensure compliance with various requirements (see *Section 5.3.2.2* for additional details).

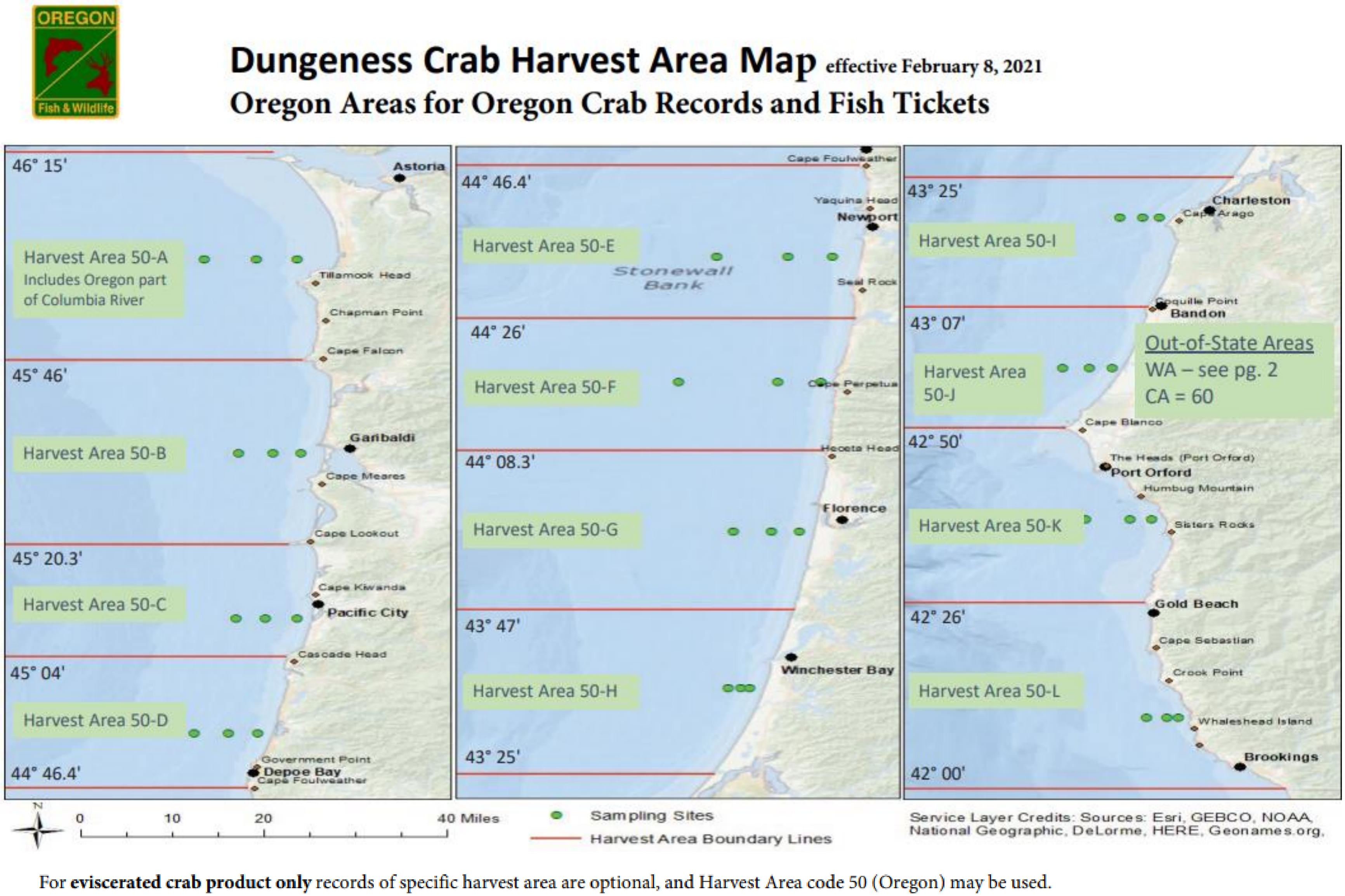

Figure 2-4. Dungeness crab harvest areas recorded on all ODFW fish tickets. The complete map including out-of-state areas is available on ODFW's commercial crab webpage.

2.2.7.2 Crab logbooks

Logbook requirements were adopted for the 2007-08 crab season to address the need for verified documentation of fishing practices. Logbooks are a valuable source of information that aid managers in understanding how a fishery operates and making decisions that ensure effective management of fishery resources. Specifically, information is provided on catch, effort, location, and time, along with details on bait use, lost pots, and in-season derelict pot retrievals. A sample blank page from the ocean commercial crab logbook is shown in Figure 2-5.

Logbooks are received, processed, entered, and assessed by ODFW MRP staff. Logbook data limitations are generally associated with variable compliance rates (i.e., submission and quality) and the labor-intensive data entry process which can result in backlogged data. ODFW plans to develop and implement an electronic logbook system, along with electronic monitoring of vessel location (e.g., solar loggers), in the crab fishery by the 2026-27 season to further increase vessel accountability and streamline the data collection process (see *Section 5.3.3.3*).

OREGON Fish & Wildlife

OREGON COMMERCIAL CRAB LOGBOOK

Office Use				
Date	Trip	Port	Ticket #	Lbs.

Vessel Name: ____________ **Oregon Crab Permit No:** 96 _ _ _ **Year:** 20_ _

Federal or Oregon Vessel No: ____________ **Port(s) of Landing:** ____________

Date Pulled	String ID	Depth (fm)	Num Pots Pulled	Num Pots Lost	Soak Time (days)	Begin Location		End Location		Estimated Pounds	Comments
						Lat.	Lon.	Lat.	Lon.		

Bait(s) used:

Derelict Gear Retrieved: Date:_______ Num Pots:____ Lat:____________ Lon:______________

Date:_______ Num Pots:____ Lat:____________ Lon:______________ Date:_______ Num Pots:____ Lat:____________ Lon:______________

Date:_______ Num Pots:____ Lat:____________ Lon:______________ Date:_______ Num Pots:____ Lat:____________ Lon:______________

Signature:________________________________ **No:**

Figure 2-5. Sample Oregon Commercial Crab Logbook page.

2.2.7.3 Fishery monitoring

In recent years, ODFW has implemented multiple fishing monitoring efforts to collect information on the crab resource and fishery. These include bycatch monitoring (i.e., for crab and non-crab species bycatch within the pot) during coastwide preseason testing (see *Section 2.2.4.1*), as well as dockside and at-sea sampling programs. Dockside sampling consists of ODFW samplers measuring the carapace widths and weighing a portion of the crab landed during offloads in major ports along the coast. During at-sea (or ride-along) sampling, samplers assess and quantify the size distribution and bycatch rates of crab and non-crab species caught during normal commercial crab fishing operations. At-sea sampling is dependent upon voluntary industry participation and in-season sample sizes remain low to date.

2.2.8 Limit reference point

Biological reference points are quantifiable metrics which are utilized by fishery managers to determine the status of a stock or population. A limit reference point (LRP) defines an undesirable state for a fishery or resource which management should take action to avoid, or recover from if reached (Caddy and Mahon, 1995).

In 2014, ODFW adopted an LRP for the crab fishery which is evaluated annually, within about the first eight weeks of the season, and is considered to have been reached when all of the following conditions are met:

1) Fish tickets indicate landings have declined for three consecutive seasons;
2) Landings are projected to decline for a fourth consecutive season (based on early season landings in the fourth season);
3) Fourth season landings are projected to decline below 20% of the 20-year average; and
4) Logbook catch-per-unit-effort falls below the average level predicted to have occurred over the 1980-81 through 1986-87 seasons.

In the event that the LRP is reached, ODFW will work with industry and/or through directed research to attempt to discern the primary cause(s) of the observed decline. Based on this analysis, ODFW will implement an adaptive management response. To date, the LRP has not been reached by the fishery. A complete description of the crab fishery LRP can be found in ODFW (2014a).

2.2.9 Derelict gear

Derelict crab gear has been shown to contribute to ghost fishing, gear conflicts, navigation hazards, and marine mammal entanglements (ODFW, 2014a). To address this issue, ODFW has implemented a number of management measures to reduce the incidence of pot loss and minimize the impacts posed by derelict gear. This management approach includes vessel and pot limits, seasonal closure, in-season derelict gear allowances, and a post-season gear retrieval program.

Estimates of lost crab gear are tracked by ODFW through annual replacement buoy tags and the logbook program (see Figure 2-6). Estimates of derelict gear recovery by the fleet are tracked through the logbook program and the post-season derelict gear recovery program.

2.2.9.1 Seasonal closure

Commercial crab gear must be removed from the ocean, bays, and Columbia River during closed seasons, except during the legal gear setting period (see *Section 2.2.4.3*). Prior to the 2018-19 crab season, unbaited gear with open release mechanisms was also permitted to be left in the Pacific Ocean (not including the Columbia River) during a 14-day post-season gear “clean-up” period following the closure of the ocean commercial season. The intent of this grace period, in effect since the 1991-92 season, was to allow commercial crabbers to more fully utilize the season (ODFW, 1990).

In September 2020, the two-week post-season “clean-up” period was eliminated by permanent rule in order to reduce the risk of whale entanglement by reducing the number of vertical lines in the water at the end of the season when whales are present in higher abundance. This permanent rule was adopted following two years of the provision being eliminated by temporary rule (ODFW, 2020b; see *Section 5.3.1.3*).

2.2.9.2 Derelict gear recovery

During the 2009 review of the pot limit program, ODFW reported that while initial concerns over pot limit implementation were easing, there was growing concern over the issue of derelict crab gear recovery. Building upon the temporary rules adopted during the previous three seasons, ODFW recommended and the OFWC adopted permanent rules outlining conditions for derelict gear retrieval (ODFW, 2009).

Regulations for derelict crab gear recovery by commercially licensed vessels are found in OAR 635-005-0490. No more than 25 derelict pots or rings may be retrieved per trip from the start of the ocean commercial season through the second Monday in June, while no more than 50 pots or rings may be retrieved per trip from the second Monday in June through August 14. From August 15 through October 31, an unlimited number of derelict pots may be retrieved. Any retrieved gear must be transported to shore during the same trip and documented (i.e., date, time, number of pots or rings, location, gear owner identification) in the retrieving vessel’s logbook. During the season and in open areas, legal crab may be retained from derelict gear retrieved (that was otherwise lawful gear) by crab permitted vessels, but all gear must be returned to the owner. This retention of legal crab is intended to further incentivize derelict gear recovery in-season.

2.2.9.3 Permitted post-season derelict gear recovery program

In 2013, the Oregon Legislature passed the ODCC-supported HB 3262 which allowed the OFWC to authorize a permitted derelict gear recovery program for the crab fishery. Under this legislation, pots left in the ocean 15 days after the end of the season are exempt from Oregon’s personal property law and eligible for retrieval through an approved program. In effect, this exemption worked to incentivize derelict gear retrieval by providing flexibility for permitted gear retrievers to decide what to do with retrieved pots (ODFW, 2014c).

Subsequently, the OFWC adopted regulations allowing ODFW to issue Post-Season Derelict Gear Recovery Permits to commercially licensed vessels (OAR 635-005-0491). Permits are subject to a number of conditions, including a prohibition on harvesting any crab or non-crab species taken with the retrieved gear. All recovered gear must be registered according to the permit conditions and post-recovery registration forms are posted on ODFW's website to allow any interested previous gear owners the opportunity to negotiate with the retrieving vessels for their previously owned pots. After documenting retrieval of the gear, retrieved gear may be disposed of at the permit holder's discretion (e.g., keep, sell). ODFW maintains a post-season derelict gear recovery program webpage which includes a list of the locations of any derelict gear reported to ODFW after August 14 each year.

Figure 2-6 shows the estimated number of crab pots lost in the crab fishery, along with the number of replacement buoy tags issued each season, the estimated number of derelict pots retrieved in-season, and the number of derelict pots retrieved through the post-season recovery program. The estimated number of lost pots and estimated pots retrieved in-season are from summarized logbook data with expansion factors applied based on landings (except for the 2018-19 season when ODFW returned to full logbook data entry). Since the 2012-13 season, an estimated 4946 pots are lost each year on average, with 2971 replacement buoy tags issued annually (see *Section 5.3.1.2* for a description of the elimination of the standard replacement tag allowance in 2020 as a conservation measure for reducing the risk of marine life entanglements). Estimated in-season derelict gear retrieval is on average 1138 pots per year, with an additional 724 pots retrieved on average during the post-season each year since 2014. However, in more recent years, post-season retrievals have exceeded in-season retrievals.

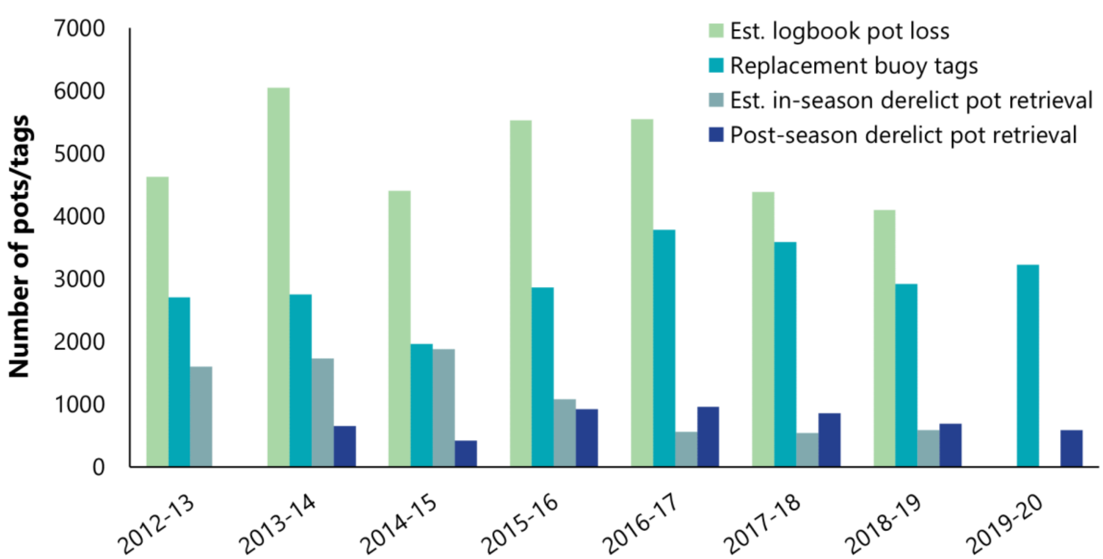

Figure 2-6. Estimated number of pots lost in the crab fishery, along with the number of buoy tag replacements, estimated in-season derelict pot retrieval, and post-season derelict pot retrieval from the 2012-13 through 2019-20 seasons. Pot loss and in-season derelict pot

retrieval estimates are from summarized and expanded logbook data (not yet available for 2019-20), except for 2018-19 when data expansion was not necessary. The post-season derelict gear retrieval program was implemented during the 2013-14 season. Data are from ODFW commercial crab logbooks, post-season derelict pot retrieval registration, and ODFW Licensing Division's replacement tag records.

2.2.10 Biotoxin management

The occurrence and potential impacts of harmful algal blooms (HABs) off Oregon, including the production of marine biotoxins, are described in *Section 3.1.4.3*. Briefly, under certain conditions, some algal species naturally produce specific biotoxins which can accumulate in fish and shellfish species, posing a threat to those that consume them. Dungeness crab are susceptible to the accumulation of domoic acid, which can cause a serious illness, amnesic shellfish poisoning, when consumed. Therefore, domoic acid monitoring and response is a crucial component of ensuring safe, quality crab for consumers and harvesters.

2.2.10.1 Domoic acid alert levels

Alert levels for domoic acid in Oregon follow the thresholds established in the Food and Drug Administration (FDA) Fish and Fishery Products Hazards and Control Guidance (known as the Seafood Hazards Guide). These levels are ≥20 ppm in all seafood, except ≥30 ppm in the viscera of Dungeness crab (OAR 603-025-0410).

2.2.10.2 Domoic acid monitoring and response

ODFW began partnering with Oregon Department of Agriculture (ODA) and industry in 1992 to conduct domoic acid tests prior to the start of the crab season (ODFW, 1992, 1995, 1996). Today, domoic acid testing is done in conjunction with preseason meat yield testing (see *Section 2.2.4.1*). Six crab are collected for domoic acid testing from each preseason station, representing 12 harvest areas off the Oregon coast (Figure 2-4). If domoic acid levels in the viscera are above the alert level but levels in the meat are not, ODFW, in close coordination with ODA and industry advisors, can delay the opening of the crab season through temporary rule and continue testing or proceed with opening the season. If the season is opened under these conditions, ODA will designate one or more harvest areas as biotoxin management zones and will issue an evisceration order (i.e., processors must remove and discard the entire intestinal tract, hepatopancreas, and all associated abdominal organs) for the area(s). Detailed procedures for domoic acid monitoring and determination of harvest restrictions for Dungeness crab are found in OAR 603-025-0410.

ODA also conducts bi-monthly sampling during winter months and weekly sampling during warmer months for domoic acid in various shellfish species. Procedures for in-season crab sampling and domoic acid testing are outlined in OAR 603-025-0410. Briefly, if domoic acid levels at or above 20 ppm are detected in razor clams or another indicator species, ODA will oversee crab sampling every two to four weeks in that harvest area for domoic acid testing. Results are used to inform recreational shellfish safety closures and commercial biotoxin management zones or evisceration orders throughout the season.

2.2.10.3 Timeline of recent Oregon biotoxin management actions

In recent years, ODFW, ODA, and industry partners have taken a series of steps to continue strengthening the protection of public health, while minimizing fishery disruptions and economic impacts. In addition to protecting public health, these collective changes provide ODFW with the ability to start the season more reliably. This serves to prevent delays in peak harvest effort, which has important implications for reducing the risk of marine life entanglements (see *Section 5.3.1.5*). Key crab fishery biotoxin management actions and rule changes are highlighted below:

2017 – ODA and ODFW co-convene a Dungeness Crab and Biotoxin Rules Advisory Committee (RAC) to develop regulatory and non-regulatory recommendations to mitigate impacts of biotoxin events on the crab fishery; first in-season biotoxin event detected in Oregon crab fishery; ODFW expands record keeping requirements for buying and selling crab through temporary rule to strengthen crab traceability and be better prepared for biotoxin events (ODFW, 2017); ODA adopts new rules to provide transparency in biotoxin testing procedures and management responses, including when mandatory evisceration is considered an option (ODA, 2017).

2018 – Senate Bill 1550 is passed which clarifies ODFW's crab traceability authorities and provides ODA access to crab traceability records; the OFWC adopts permanent rules for expanded record keeping requirements for buying and selling Dungeness crab (ODFW, 2018).

2019 – The OFWC adopts a rule requiring electronic fish tickets with harvest area designation for all commercial crab landings (see *Section 5.3.2.2*); the OFWC adopts a rule to reduce the administrative burden of promulgating temporary rules for each biotoxin event, by implementing auto-adoption of in-season crab fishery harvest restrictions (evisceration or closure) in each harvest area based on test results (ODFW, 2019a; see *Section 5.3.1.5*).

2.2.11 Social and economic components

The crab fishery has been a mainstay of the Pacific coast for decades. Today, Dungeness crab is considered an iconic retail product which many visitors anticipate finding on restaurant menus and in stores year-round.

2.2.11.1 Commercial utilization

In the early years of the fishery, Dungeness crab was marketed as a fresh-cooked product that was largely limited to coastal areas. Over time, the market expanded throughout the country with the improvement of transportation, refrigeration, and processing facilities (Waldron, 1958). By the mid-1960s, more than 75% of the crab landed in Oregon were exported to other states, with the majority sold into California markets (Youde, 1967). In recent decades, the demand for live seafood has driven a sharp increase in exports of live Dungeness crab from Oregon to international markets.

Today, crab are utilized in various product forms including whole-cooks (fresh or frozen), sections (frozen), picked meat (fresh, frozen, canned), and live (Davis *et al.*, 2017). The first few weeks of the season are typically characterized by a large pulse of fresh crab that is commonly frozen to be picked out later, with a portion marketed fresh as a seasonal or luxury item. Traditionally, a holiday market exists in December and January driven by demand for whole cooked crab. At the beginning of the season when crab harvest volume is highest, large processors are able to manage the flow of product into the market by freezing crab sections for picking throughout the season (Hankin *et al.*, 2005). This is in addition to fresh cooked and live markets which persist throughout the season.

2.2.11.2 Ex-vessel value

Fluctuations in crab abundance off the Oregon coast have resulted in variable landings in the crab fishery over time. Variations in landings and the price per pound of crab impact the ex-vessel value received by fishers. Generally, ex-vessel value has increased over time with an average of $50.9 million (in 2020 dollars) over the last twenty years (Figure 2-7). The 2017-18 season brought in $76.5 million (in 2020 dollars), a record high for the crab fishery.

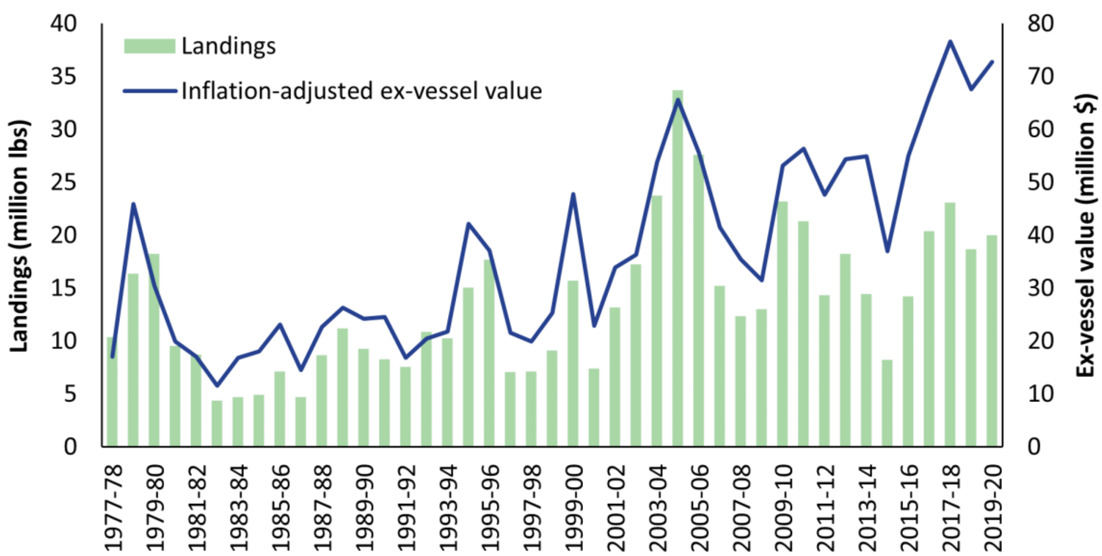

Figure 2-7. Dungeness crab landings and inflation-adjusted ex-vessel value (in 2020 dollars) in the crab fishery from the 1977-78 through 2019-20 seasons. Data are from ODFW fish tickets.

Dungeness crab is a key source of revenue for onshore commercial harvests in Oregon. The more than 20 million pounds of crab harvested during the 2016-17 season, supported over 1,600 jobs (direct and indirect, in full-year equivalents or FYE). During that season, the fishery supported $212.3 million in economic output (i.e., gross value of goods and services produced, including income), of which $113.1 million was paid to workers in labor income (ODFW, 2019b).

2.2.11.3 Fleet profile

Davis *et al.* (2017) used vessel classifications to describe the various subsectors, or business plans, that exist within the Oregon crab fishery (Figure 2-8). These classifications included:

- **Summers** – Vessels harvest ocean Dungeness crab from June 10 through August 14;
- **Early-exiters** – Vessels leave fishery on or before June 31;
- **Highliners** – Crab fishery revenue is the majority of the vessel's revenue, and total revenue is >$250,000;
- **Partakers** – Crab fishery revenue is the majority of the vessel's revenue, and total revenue is ≤$250,000; and
- **Miscellanies** – Crab fishery revenue is less than the majority of the vessel's revenue.

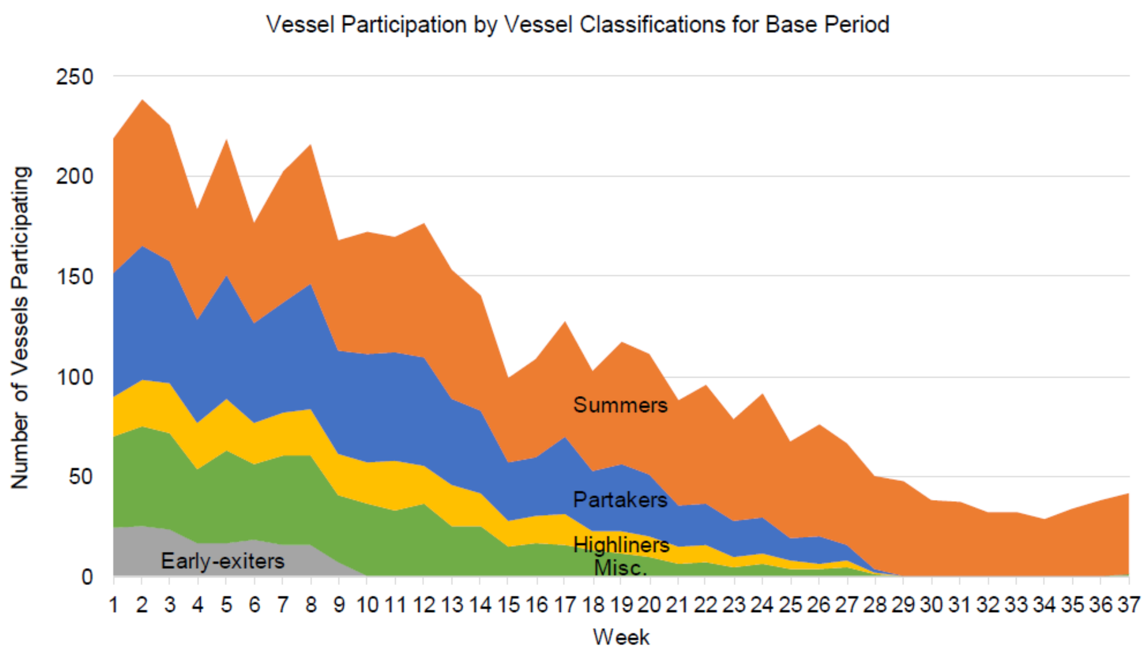

Figure 2-8. Vessel participation throughout the season by vessel classifications for base period, 2007-08 through 2013-14, from Davis *et al*. (2017).

These classifications illustrate the diversity of the crab fleet in Oregon. Disproportionate impacts of management measures to particular vessel classifications are an important consideration during development and implementation of management measures in the fishery.

Section 3 Environmental Setting and Covered Species

3.1 Environmental setting

The marine environment off Oregon is part of the highly productive California Current Ecosystem (CCE) which supports a diversity of species and habitats, and provides significant economic, cultural, social, and aesthetic benefits to the coastal communities of the U.S. West Coast. This setting is affected by a number of oceanographic processes including both local environmental forces and large-scale changes in the North Pacific which contribute spatial and temporal complexity to the system (ODFW, 2012a).

The environmental setting in the CP plan area has been extensively described within the following documents, and is briefly covered below:

- The Oregon Ocean Resources Management Plan which recommends state policies for existing and potential ocean resource management issues within the continental margin (Ocean Resources Management Task Force, 1991);
- The Oregon Territorial Sea Plan which provides a coordination framework for resource management within the state's territorial sea (out to 3 miles offshore; OPAC, 1994);
- The Oregon Nearshore Strategy which provides information and recommendations supporting the long-term sustainability of nearshore resources in Oregon (ODFW, 2016); and
- The Pacific Coast Fishery Ecosystem Plan which provides a framework and guiding information for ecosystem-based management of resources within the U.S. portion of the CCE (PFMC, 2013).

3.1.1 Oceanography

The CCE contains three main circulation features: the equatorward California Current at the surface, the poleward California Undercurrent at depth, and the seasonal poleward Davidson Current along the continental slope. Additionally, the system is characterized by a number of complex physical processes including seasonal wind-driven upwelling, variable local wind dynamics, and freshwater input from estuaries and rivers (e.g., the Columbia River plume) (Hickey and Banas, 2008).

The California Current originates where the West Wind Drift encounters the North American land mass, diverting water north as the Alaska Current or south as the California Current. The California Current is a broad, relatively slow-moving equatorward flow which constitutes the eastern boundary of the North Pacific Subtropical Gyre from ~20° N to ~50° N (Checkley and Barth, 2009). This year-round flow is characterized by cool, low-salinity, and nutrient-rich water (King *et al.*, 2011).

Underneath the California Current is the relatively narrow California Undercurrent which carries warm, high-salinity, and low-oxygen water poleward from the equatorial Pacific to at least ~50° N. This subsurface flow is strongest at depths of 100–300 m (King *et al.*, 2011). During the winter, poleward winds create an additional seasonal surface current, the Davidson Current, which originates near Point Conception and flows north past Vancouver Island over the continental shelf and slope.

Over a period of about a week, during an event called the spring transition, winds from the south shift to a predominately equatorward direction resulting in large-scale changes in coastal currents (Huyer *et al.*, 1979). During this time, the California Current begins flowing south over the continental shelf and, in most years, this instigates a change from coastal downwelling conditions to predominately upwelling conditions where deeper waters of the California Current are transported back onto the shelf.

The seasonal upwelling of cold, nutrient-rich water is highly variable, but a major factor fueling the high productivity of the CCE. The magnitude of upwelling throughout the area during different years is determined by a combination of factors, ranging from local wind patterns to broad-scale climate variability acting on interannual and decadal timescales (e.g., the Pacific Decadal Oscillation or PDO, El Niño Southern Oscillation or ENSO). Off Oregon, upwelling is typically stronger and more persistent on the southern coast, and more intermittent on the central and northern coast (ODFW, 2016).

Waters off Oregon are additionally influenced by substantial freshwater delivery from the Columbia River which accounts for approximately 77% of the drainage along the U.S. West Coast north of San Francisco (Hickey *et al.*, 1998). Freshwater plumes impact marine ecosystems through alterations in stratification, nutrient pathways, light, and circulation patterns. The Columbia River constitutes a major source of nutrients to Oregon's continental shelf, particularly along the north coast (ODFW, 2016). Additionally, plume fronts may provide critical feeding zones for juvenile fish and the organisms that prey upon them.

3.1.2 Ocean habitat

A wide variety of habitats can be found throughout Oregon's nearshore marine environment including open ocean with islands, submerged high-relief rock reefs, soft sandy and muddy bottoms, rocky headlands, mudflats, and estuarine networks. These habitats support an equally diverse array of fish, invertebrates, marine mammals, birds, algae, plants, and other organisms (ODFW, 2016). Comprehensive information on important nearshore species can be found in the Oregon Nearshore Strategy (ODFW, 2016).

The continental shelf off Oregon is relatively flat, gently sloping to a depth of around 145 – 185 m at its outer edge. The shelf is widest off the central coast (~46 miles) and narrowest near Cape Blanco (~10 miles). The inner shelf is home to submerged rock outcrops, sea stacks, and rock islands, while the outer shelf contains four major submarine banks (the Nehalem, Stonewall, Heceta, and Coquille Banks). The shelf merges with a relatively narrow continental slope, which ranges from 12 miles wide at Cape Blanco to 60 miles wide at the Columbia River. The outer shelf and upper slope contain a number of small submarine valleys and two large submarine canyons (the Astoria and Rogue Canyons) which play an important role in sediment transfer offshore (Ocean Resources Management Task Force, 1991).

The continental margin adjacent to Oregon is predominately composed of unconsolidated sediments (sand, mud, or a mixture) with soft sediments (mostly sand) accounting for ~53% of the bottom substrate on the continental shelf (Romsos, 2004; Rasmuson, 2013).

3.1.3 Existing ocean use

The ocean is a vast, publicly owned area which supports wide ranging activities like fishing, recreation, tourism, transportation, scientific research, education, traditional cultural practices, and sight-seeing. Most human uses of marine resources off the Oregon coast take place on the continental margin. In addition to traditional activities, growing interest in ocean renewable energy development and aquaculture is emerging. As human use of the ocean changes and climate change progresses, the relationships between ocean users, coastal communities, and important marine resources may be altered.

Oregon's coastal waters are currently home to five state-managed marine reserves dedicated to conservation and scientific research: the Cape Falcon, Cascade Head, Otter Rock, Cape Perpetua, and Redfish Rocks marine reserves. Within these areas, ocean development and extractive activities are prohibited, except as necessary for monitoring or research.

3.1.4 Changing ocean conditions

Global ocean conditions are changing as a result of a number of different processes operating on different spatial and temporal scales. Many species are vulnerable to the integrated effects of ocean acidification, warming ocean temperatures, decreasing oxygen levels, and other stressors acting in combination with natural variability (Hauri *et al.*, 2009).

3.1.4.1 Ocean warming

The interdisciplinary California Current Integrated Ecosystem Assessment (CCIEA) provides annual information on the status of the CCE based on a range of environmental, biological, economic, and social indicators. The most recent status report was released in October 2020 and contains an in-depth description of climate and ocean variability in recent years (Harvey *et al.*, 2020). Specifically, researchers reported extended ocean warming throughout the CCE over the past seven years as a result of the combined effects of El Niño events and large marine heat waves, most notably the record heatwave from 2013 – 2016. This marine heatwave (the "Blob"), in particular, had strong negative impacts through the CCE including poor productivity, a major harmful algal bloom event, species distribution shifts, and lost fishing opportunities. While the system has exhibited some recovery and return to conditions that were more similar to long-term averages, some lingering effects have remained. In late May 2019, a large marine heatwave once again began in the northeast Pacific, the effects of which are still largely undetermined.

The recent occurrence of large-scale warming in the CCE has led to the development of a new indicator, a Habitat Compression Index (HCI), which measures compression of cooler upwelling habitat along the coast from climate and ocean forcing. Habitat compression alters the composition and distribution of forage species (krill and anchovy), subsequently shifting the distribution of the species that prey upon them. It has been hypothesized that these ecosystem changes may create conditions that increase the likelihood of large whale entanglements in fixed fishing gear (Santora *et al.*, 2020).

3.1.4.2 Ocean acidification and hypoxia

Anthropogenic production of carbon dioxide from fossil fuel combustion and emissions continue to increase with the ocean absorbing 25% of emissions on average each year (Le Quéré *et al.*, 2016). The absorption of carbon dioxide by the ocean lowers the pH resulting in ocean acidification. As an eastern boundary system, the CCE is naturally more acidified than other surface waters and is particularly vulnerable to the effects of ocean acidification. Species from throughout the trophic web are susceptible to the impacts of ocean acidification, including a number of commercially important species in Oregon such as salmon, halibut, Dungeness crab, razor clams, oysters, pink shrimp, lamprey, and rockfish (OAH Council, 2019).

Low oxygen zones and episodes of hypoxia are a common occurrence in many coastal habitats, particularly during summer when temperatures are elevated and vertical stratification is more pronounced. Though hypoxia naturally occurs off the coast of Oregon, it is expected that hypoxic zones will increase in number, frequency, duration, and intensity as climate change continues and ocean temperatures rise (Gobler and Baumann, 2016). Low dissolved oxygen or hypoxic conditions (dissolved oxygen levels < 1.4 mL/L) can compress habitat and act as a stressor on sensitive species.

3.1.4.3 Harmful algal blooms

Along the U.S. West Coast, the frequency, magnitude, and persistence of algal blooms, both benign and harmful, are increasing (Anderson *et al.*, 2008; Kahru *et al.*, 2009). HABs occur when the rapid growth or accumulation of algae has a negative impact on living organisms, which can pose a threat to fisheries, coastal economies, ecosystems, and public health. HABs can be harmful in several different ways including through the production of natural biotoxins which may accumulate in certain shellfish species and pose a threat to those that consume them. Warm events in the CCE, like the 2013 – 2016 marine heatwave, may coincide with extremely toxic HABs (Harvey *et al.*, 2020).

Two major types of HABs occur along the Oregon coast and produce biotoxins that are routinely monitored by the Oregon Department of Agriculture's Food Safety Program. Saxitoxin is a marine toxin which is naturally produced by certain dinoflagellates (e.g., *Alexandrium* spp.) and is known to accumulate in various filter-feeding bivalves. Consumption of sufficient quantities of saxitoxin-contaminated shellfish may result in illness or death from paralytic shellfish poisoning (Tweddle *et al.*, 2010). Domoic acid is a naturally occurring neurotoxin that is produced under certain conditions by several marine algal species (*Pseudo-nitzschia* spp.) and can accumulate in shellfish and fish species. The consumption of contaminated seafood can cause a serious illness, amnesic shellfish poisoning, and the need to protect human health has resulted in commercial and recreational fishery closures and season opening delays along the West Coast (see *Section 2.2.10*).

3.1.4.4 Additional impacts

In addition to the ocean changes outlined above, there are a number of other potential impacts of a changing climate on nearshore marine species and habitat. These impacts include, but are not limited to, sea level rise, changing nutrient availability, increased storm intensity, and altered circulation patterns including changes to upwelling and stratification. These physical changes, in turn, may alter biological processes through shifts in species ranges, invasions and local extinctions, and ecosystem regime shifts (Brierly and Kingsford, 2009).

3.2 Covered species

3.2.1 Humpback whale (*Megaptera novaeangliae*)

Humpback whales are large, baleen whales that are found in all major oceans. They typically have dark dorsal coloration with varying amounts of white on their pectoral fins and underside. Humpback whales have distinctive, long pectoral flippers and flukes which can be up to 18 feet wide. In the Northern Hemisphere, humpback whales reach sexual maturity at an approximate age of 5 – 16 years old, though variance exists within and among populations (Gabriele *et al.*, 2007). Natural markings on the underside of the fluke, along with other identifying features (e.g., scars) can be used to identify and catalog individuals over time through photo identification (e.g., Barlow *et al.*, 2011). Humpback whales exhibit a diverse array of behaviors and produce highly varied sounds, songs, and calls which they rely on for communication and sensing the environment (NMFS, 2020c).

An extensive review of the biology, ecology, and threats facing the humpback whale can be found in Fleming and Jackson (2011) and a companion report assessing the status of the species under the ESA (Bettridge *et al.*, 2015). Additional information sources include the Final Rule Designating Critical Habitat for the Central American, Mexico, and Western North Pacific Distinct Population Segments of Humpback Whales, and the accompanying Biological Report (NMFS, 2020c, 2021a). Relevant information reflecting the best available information on humpback whales is summarized below.

3.2.1.1 Distribution and habitat use

Humpback whales have a broad geographical distribution extending into all ocean basins. In both hemispheres, most humpbacks undertake seasonal migrations over great distances from low latitude, wintering grounds to higher latitude, summer feeding areas (Bettridge *et al.*, 2015).

In the North Pacific Ocean, humpback feeding areas span from California to the Bering Sea, and are typically located near or over the continental shelf where topographic features or oceanographic conditions may serve to aggregate prey (NMFS, 2020c, 2021a). Primary productivity is influenced by a number of physical oceanographic processes which vary on seasonal (e.g., upwelling strength), inter-annual (e.g., El Niño), and decadal (e.g., Pacific Decadal Oscillation cycles) time scales, contributing to variability in prey distribution and humpback whale abundance in feeding areas.

Over half of the humpback whales in the North Pacific feed in U.S. waters (Fleming and Jackson, 2011). Little to no feeding takes place during migrations or on wintering grounds, so the buildup of fat and energy stores while on feeding grounds is essential to support successful calving and migration (NMFS, 2021a). The critical habitat review team, convened in 2018 to assess and evaluate information supporting a critical habitat designation for listed humpback whales DPSs, identified prey as a feature essential to the conservation of the species. Specifically, the prey essential feature is defined as follows for the CAM and MX DPSs (NMFS, 2021a):

> **CAM DPS**: "Prey species, primarily euphausiids (*Thysanoessa*, *Euphausia*, *Nyctiphanes*, and *Nematoscelis*) and small pelagic schooling fishes, such as Pacific sardine (*Sardinops sagax*), northern anchovy (*Engraulis mordax*), and Pacific herring (*Clupea pallasii*), of sufficient quality, abundance, and accessibility within humpback whale feeding areas to support feeding and population growth."
>
> **MX DPS**: "Prey species, primarily euphausiids (*Thysanoessa*, *Euphausia*, *Nyctiphanes*, and *Nematoscelis*) and small pelagic schooling fishes, such as Pacific sardine (*Sardinops sagax*), northern anchovy (*Engraulis mordax*), Pacific herring (*Clupea pallasii*), capelin (*Mallotus villosus*), juvenile walleye pollock (*Gadus chalcogrammus*), and Pacific sand lance (*Ammodytes personatus*) of sufficient quality, abundance, and accessibility within humpback whale feeding areas to support feeding and population growth."

Within feeding areas, humpbacks whales are most abundant off Washington, Oregon, and California during spring, summer, and fall, where they feed on a diverse diet commonly consisting of small pelagic schooling fish and euphausiids (i.e., krill), specifically *Euphausia*, *Thysanoessa*, *Nyctiphanes*, and *Nematoscelis*. A comprehensive description of humpback whale diet studies and reported prey species by region can be found in NMFS (2021a).

Along the U.S. West Coast, humpback whales are known to shift between feeding predominantly on krill and fish, depending on the relative abundance of prey. In some instances, this shift has resulted in changes in humpback whale distribution. For example, a small number of humpback whales have been documented in recent years feeding inside San Francisco Bay and the Columbia River which had not historically been observed. Humpback whales feeding in these new areas appeared to be targeting nearshore concentrations of anchovies (Calambokidis *et al.*, 2017).

Humpback whales are gulp feeders that lunge and capture large mouthfuls of prey and water during feeding (Ingebrigtsen, 1929), as opposed to continuously filtering feeding like some other large baleen whales. In the Northern Hemisphere, humpbacks have been observed employing a variety of feeding methods throughout the water column. Examples include the creation of bubble structures (i.e., bubble nets, columns, clouds, and curtains) to corral and trap schooling fish, kick feeding during surface feeding events, and side rolls when foraging near the bottom (Jurasz and Jurasz, 1979; Hain *et al.*, 1982; Ware *et al.*, 2013). Feeding depth and dive behavior varies among regions, and appears to be driven by bathymetry, individual whale variability, and prey availability. Off California, humpbacks have been documented feeding shallower on the continental shelf where fish species were more readily available and deeper on the continental break/slope where krill availability was higher (Szesciorka, 2015).

While breeding and courting behavior may be observed in many places, including on feeding grounds and during migration, the majority of breeding and calving takes place on wintering grounds. Humpback whale wintering grounds are characterized by warm, shallow waters (Rasmussen *et al.*, 2007). In the North Pacific Ocean, wintering grounds are more geographically distinct than feeding areas with at least four wintering grounds identified in the sub-tropical and tropical waters of the western Pacific Ocean, and waters off the Hawaiian Islands, Mexico, and

Central America (Figure 3-1; NMFS, 2016). In these areas, breeding and calving typically takes places during January through May (NMFS, 2021a) with migration back to biologically productive, temperate regions around spring.

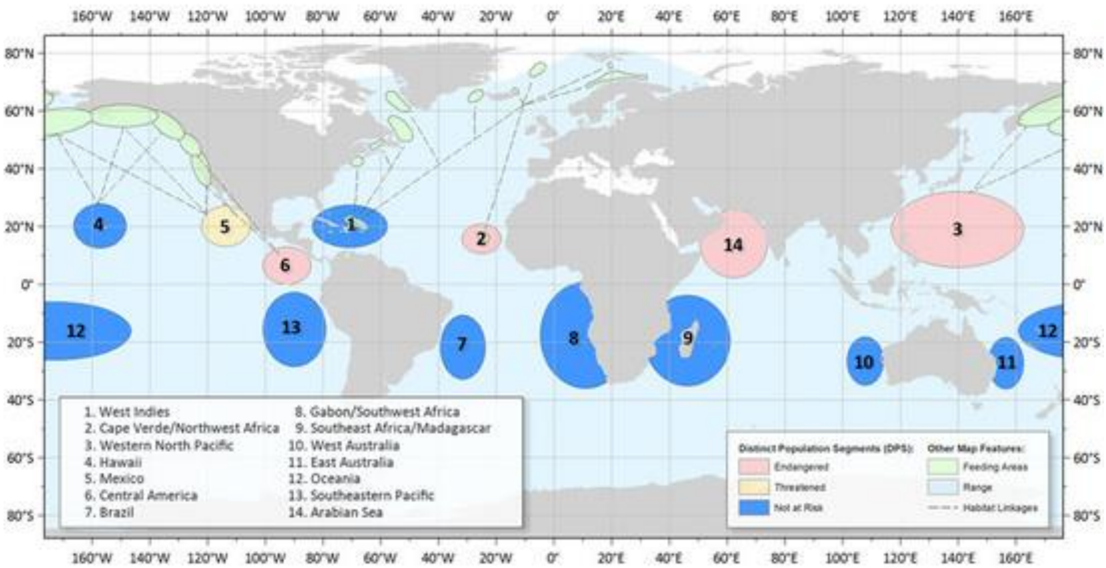

Figure 3-1. Wintering and feeding locations of the 14 distinct population segments of humpback whales worldwide, from the NMFS humpback whale species profile.

3.2.1.2 Status of North Pacific populations

Technological advances beginning in the late 19th century ushered in an era of modern commercial whaling which targeted humpback whales extensively throughout their range. In 1946, the International Convention for the Regulation of Whaling was signed which established the International Whaling Commission (IWC), detailed reporting requirements, and several limitations for the harvest of North Pacific humpback whales (i.e., minimum size limit of 10.7 m, prohibition on the killing of lactating females and calves, and restriction of any pelagic operations between 0 and 20–35 N latitude). Beginning in 1966, all catches of humpback whales in the North Pacific were prohibited; however, by that time it was assumed that humpback populations had been greatly overexploited. Over 29,000 humpback whales are estimated to have been caught by industrial whaling operations in the North Pacific during the 20th century (Ivashchenko *et al.*, 2015).

As a result of overexploitation from commercial whaling, humpback whales were designated by the United States as “endangered” in June 1970 under the Endangered Species Conservation Act (ESCA; 35 FR 18319), a status which was transferred to the ESA in 1973. In 2016, the globally endangered ESA-listing status for the humpback whale was revised to include 14 distinct population segments (81 FR 62259). DPSs are considered discrete from other populations of the species and significant in relation to the entire species (Bettridge *et al.*, 2015). Humpback whale DPSs are geographically designated based on wintering grounds, with at least four occurring in the North Pacific, including:

- The MX DPS which breeds along the Pacific coast from Mexico to the Revillagigedo Islands, transits the Baja California Peninsula, and feeds from California to the Aleutian Islands;
- The CAM DPS which breeds along the Pacific coast of Central America and feeds off the West Coast of the United States and southern British Columbia;
- The HI DPS which breeds in the main Hawaiian Islands and feeds in most of the known feeding grounds in the North Pacific, particularly Southeast Alaska and northern British Columbia; and
- The WNP DPS which breeds around Okinawa, Japan and the Philippines, and feeds in the northern Pacific, particularly in the West Bering Sea and off the Russian coast and the Aleutian Islands.

Of these, the CAM and WNP DPSs are listed as endangered, the MX DPS is listed as threatened, and the HI DPS is no longer listed under the ESA. Only the CAM DPS, MX DPS, and HI DPS are documented to occur off the contiguous U.S. West Coast, and only the CAM DPS and MX DPS are known to feed in Oregon waters (NMFS, 2019a). Since humpback whales from the WNP DPS are not present off the U.S. West Coast, they are not discussed in the remainder of this plan.

The relationship between ESA DPSs and MMPA stocks is complex. For MMPA purposes, NMFS defines humpback whales that feed off the U.S. West Coast as one California/Oregon/Washington stock ("CA/OR/WA stock") which primarily includes whales from the endangered CAM DPS and the threatened MX DPS, with a small number of whales from the HI DPS. Due to the high proportion of whales originating from ESA-listed DPSs, the CA/OR/WA stock is currently considered "depleted" under the MMPA.

A recovery plan for humpback whales was approved by NMFS in 1991, prior to the species being divided into DPSs in 2016 (NMFS, 1991). The recovery plan outlines potential threats facing the species, methods for controlling those threats through beneficial activities, and benchmarks for downlisting or delisting. Revised recovery plans have not been developed for the listed DPSs. NMFS prioritizes species for recovery plan preparation and implementation based on the species' demographic risk and recovery potential. As of 2019, the recovery priority number for the Central America DPS is 2C and the Mexico DPS is 4C. See the Recovery Priority Guidelines (April 30, 2019; 84 FR 18243) for an explanation of the recovery priority numbers (NMFS, 2019c).

3.2.1.3 North Pacific population structure

A combination of photo identification, genetics, and satellite tagging techniques have been used to assess North Pacific humpback whale population structure. To date, the most complete population structure information comes from the international, collaborative photo identification and genetics work conducted as part of the Structure of Populations, Levels of Abundance and Status of Humpbacks (SPLASH) project from 2004 to 2006 (Calambokidis *et al.*, 2008). Samples collected over three winter seasons and two summer seasons have been analyzed as part of studies on various topics including regional and population-level abundance estimates (Barlow *et al.*, 2011; Wade *et al.*, 2016; Wade, 2017; Wade, 2021), genetic population structure (Baker *et al.*, 2013), persistent organic pollutants (Elfes *et al.*, 2010), and stable isotopes (Witteveen *et al.*, 2009).

The study found complex migratory movements and population dynamics, with most individual whales exhibiting strong site fidelity to both breeding and feeding areas (Calambokidis *et al.*, 2008). Multiple lines of evidence supported this general pattern and collectively contributed to the delineation of DPSs (Bettridge *et al.*, 2015), and the resultant ESA listing rule (NMFS, 2016). While interchange between wintering grounds appears to be rare, acoustic monitoring studies have found shared song composition among different North Pacific breeding populations which suggests that some form of contact may occur (Darling *et al.*, 2019).

Along the U.S. West Coast, NMFS currently recognizes two separate feeding groups within the CA/OR/WA stock: the California/Oregon ("CA/OR") and Washington-southern British Columbia feeding groups. These feeding groups are recognized based on photo identification and genetics (Calambokidis *et al.*, 2017).

3.2.1.4 North Pacific abundance and growth estimates

By the time modern commercial whaling was officially prohibited, the North Pacific humpback whale population may have been as low as around 1,000 whales (Rice, 1978). Since this time, populations have been steadily increasing, but historical abundance levels have not been reached by some stocks (NMFS, 2019a).

There is significant uncertainty about actual population sizes, and how to reconcile the most recent sources of DPS-specific information (Wade, 2021) and stock-specific information (Calambokidis and Barlow, 2020) for humpback whales.

Wade (2021) describes estimated migration rates (or movement probabilities) of North Pacific humpbacks whales between wintering grounds and summer feeding areas, based on multistrata model analyses utilizing 2004 to 2006 photographic mark-recapture data from the SPLASH project. Model results estimate that the majority of animals within the CA/OR feeding group migrate to wintering grounds in Mexico (~58%) while the remainder move to Central America (~42%). Meanwhile, the vast majority (97%) of CAM DPS whales are expected to migrate to CA/OR to feed, while the remainder feed off Washington and Southern British Columbia. Approximately 21% of MX DPS whales are expected to move to CA/OR to feed, while the remainder move farther north, mostly in the Aleutian Islands and Bering Sea (Wade, 2021). NMFS considers the probability of animals feeding off the West Coast and migrating to Mexico and Central America to be the most informative for assessing risk posed to ESA-listed DPSs while inhabiting summer feeding areas. Accordingly, the probability of movement from CA/OR to wintering grounds in Mexico and Central America is used to inform the mixing proportions of the listed CAM and MX DPSs foraging in waters off Oregon (NMFS, 2021b). While it is generally understood that there have been changes in the abundance and/or distribution of humpback whale DPSs since the data that were used in Wade (2021) were gathered, an analysis providing current estimates for specific DPSs is not available.

Recent information in Calambokidis and Barlow (2020) using photographic mark-recapture data from a combination of sources through 2018 estimates the minimum abundance of CA/OR humpbacks is 4,776 animals. This represents a substantial increase over the most recent minimum population estimate (2,784 whales) for the CA/OR/WA stock used in the current humpback whale SAR (NMFS, 2019a). Assuming there have been no pauses in growth, an abundance estimate of 4,776 animals would imply an 8.2% annual growth rate from the late 1980s (Calambokidis and Barlow, 2020). This rate is slightly above the 7.5% annual growth rate previously calculated and incorporated in the current humpback whale SAR (NMFS, 2019a). Growth trends for individual DPSs are considered unknown (Bettridge *et al.*, 2015).

3.2.1.5 Occurrence off Oregon

A review of observations from small boat surveys, ship surveys, and opportunistic sources revealed seven Biologically Important Areas (BIAs) where humpback whales are commonly sighted feeding in high concentrations in U.S. waters (Figure 3-2). Of these, one BIA was found off Oregon (i.e., the plan area) encompassing a 2,573 km^2 area including Stonewall and Heceta Banks where sightings were high from spring through fall (May – November) (Calambokidis *et al.*, 2015).

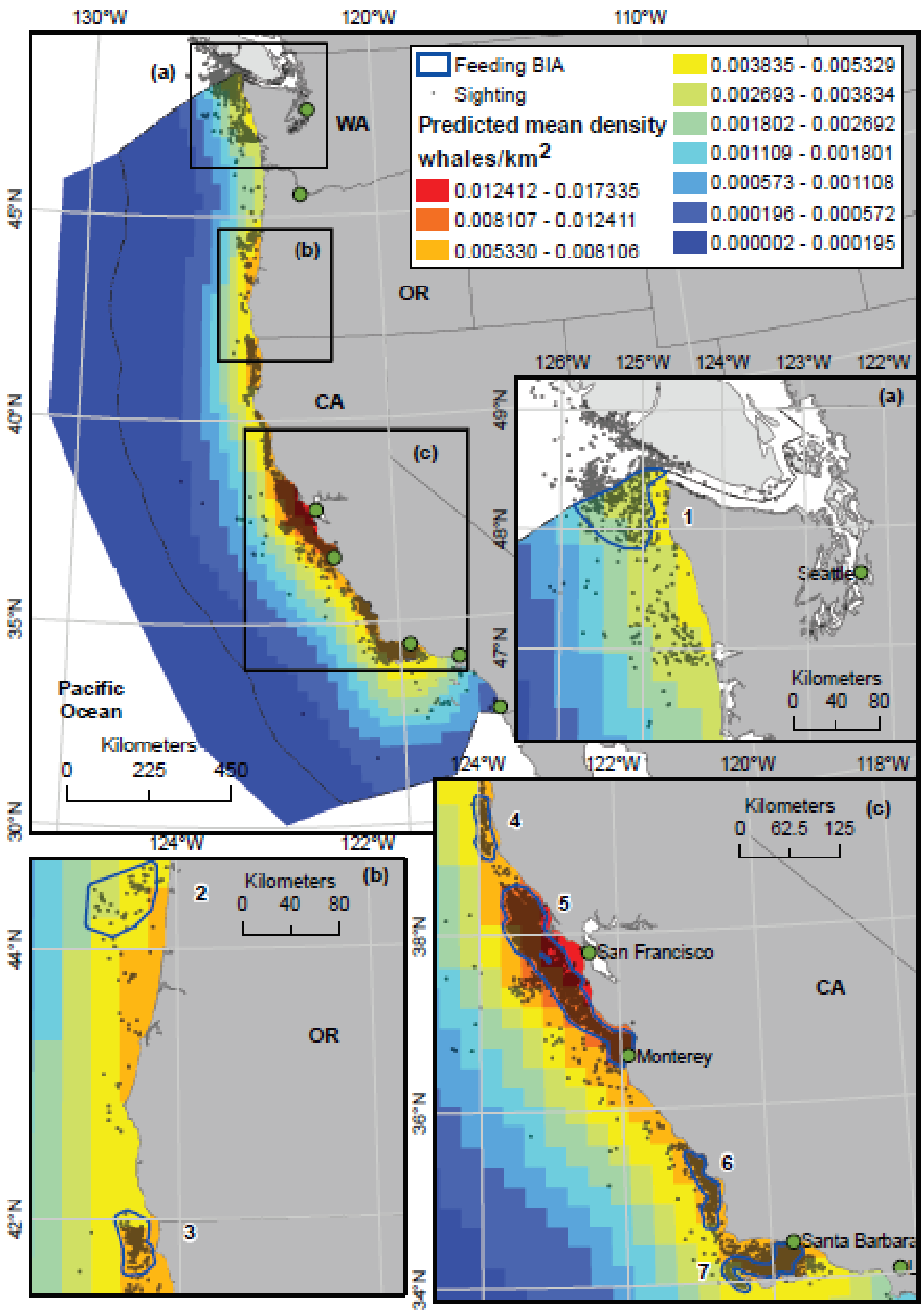

Figure 3-2. Humpback whale Biologically Important Areas and predicted mean densities in the CCE, from Calambokidis *et al.* (2015). "*Seven humpback whale (*Megaptera novaeangliae*) feeding BIAs overlaid with all sightings and predicted mean densities of humpback whales from [habitat-based density] HD models generated from Southwest Fisheries Science Center ship surveys (see Becker* et al.*, 2012). Panels a, b, and c show more detail in the areas where the BIAs are located. The BIAs are (from north to south) (1) Northern Washington, May-Novemeber; (2) Stonewall and Heceta Bank, May-November; (3) Point St. George, July-November; (4) Fort Bragg to Point Arena, July-November; (5) Gulf of Farallones-Monterey Bay, July-November; (6) Morro Bay to Point Sal, April-November; and (7) Santa Barbara Channel-San Miguel, March-September (see Table 4.3 for details).*"

Pursuant to section 4 of the ESA, critical habitat for humpback whales from the CAM and MX DPSs has been designated off Oregon. The critical habitat includes all marine waters extending from a nearshore boundary defined by the 50-m isobath to an offshore boundary defined by the 1200-m isobath, except in the area south of 42°10′ where the offshore boundary is defined by the 2000-m isobath. According to the designation, this habitat includes three specific areas occupied by humpback whales from both the CAM and MX DPSs: the Columbia River Area (Unit 12), Coastal Oregon (Unit 13), and Southern Oregon/Northern California (Unit 14). A complete description of the essential prey features and habitat contained in each area can be found in the final rule designating critical habitat and the accompanying biological report (NMFS, 2020c, 2021a).

Additional insight into fine-scale whale distribution in Oregon waters throughout the year is being provided by an ongoing three-year collaborative research project initiated in 2019 (see project description in *Section 5.3.2.6*). As of May 2021, preliminary results from helicopter and vessel-based surveys collecting whale presence and absence data off Oregon have observed humpback whales out to 3000 m (~1640 fathoms) with the majority (80%) of individuals observed between 76 and 370 m (~42-202 fathoms). Humpback whales have been the most commonly observed whale species during monthly helicopter surveys, particularly between May and November, consistent with the primary seasonal occurrence reported for the Oregon BIA in Calambokidis *et al.* (2015). Over this time period, surveys have covered waters out to 3480 m, with 80% of survey effort concentrated in waters that were 30-775 m deep. Caution should be used when interpreting these preliminary results, as they do not fully account for survey efforts and conditions at this time. However, completion of this project will fill a critical information gap on fine-scale whale distribution off Oregon throughout the year.

3.2.2 Blue whale (*Balaenoptera musculus*)

Blue whales are baleen whales with a long, slender body shape and mottled gray-blue coloration. This mottling pattern is a distinguishing characteristic that can be used to identify individual whales over time (Calambokidis *et al.*, 1990; Sears *et al.*, 1990). Blue whales are the largest animals to have ever lived on Earth, reaching up to 32.6 m in length and weighing over 150,000 kg (NMFS, 2020d). In the Northern Hemisphere, blue whales are typically smaller than those in the Southern Ocean (NMFS, 2020d) and, as with other baleen whales, females are typically slightly larger than males (Ralls, 1976). On average, blue whales reach sexual maturity at approximately ten years of age, though estimates vary within and across regions (NMFS, 2020d).

The calls produced by blue whales are among the loudest and lowest frequency sounds made by any animal. They consist of various types of sounds, pulses, and tones, that may vary based on region, season, time of day, or behavior. Like other baleen whales, blue whales can produce long patterned calls referred to as songs (e.g., McDonald *et al.*, 2009).

A comprehensive description of blue whale life history, population structure, and potential threats facing the species can be found in the revised Recovery Plan for the Blue Whale (*Balaenoptera musculus*) (NMFS, 2020d). Relevant information reflecting the best available information on blue whales is summarized below.

3.2.2.1 Distribution and habitat use

Blue whales are distributed throughout all major oceans except the Arctic, with food availability (i.e., krill abundance) largely driving their distribution. Specifically, blue whale distribution is strongly associated with oceanographic conditions that serve to aggregate prey, including upwelling and underwater thermal fronts (Doniol-Valcroze *et al.*, 2007). Blue whales may be found in both coastal and pelagic environments, coincident with shifting feeding areas (Fiedler *et al.*, 1998; Croll *et al.*, 2005; Calambokidis *et al.*, 2015).

In the western North Pacific Ocean, blue whales range from Kamchatka to southern Japan. In the eastern North Pacific, they may be found as far north as the Chukchi Sea, but more commonly range from the Gulf of Alaska along the U.S. West Coast to areas off Central America, with small numbers observed in the Hawaiian Islands (NMFS, 2020d).

Blue whales typically undergo seasonal migrations associated with feeding at mid- to high-latitudes during peak productivity in summer and fall, followed by migration to low-latitude regions for breeding and calving in the winter and spring (Burtenshaw *et al.*, 2004). However, unlike with many other baleen whales, blue whale foraging and reproduction may not be spatially or temporally segregated. Evidence suggests that blue whales continue to feed throughout the winter both in northern latitude areas and in productive offshore waters at lower latitudes (Bailey *et al.*, 2009; Calambokidis *et al.*, 2009).

Since the 1970s, blue whales have been reported feeding each year during the summer and fall off California (Calambokidis *et al.*, 1990). Beginning in the late 1990s, northward shifts in the distribution of blue whales to secondary feeding areas off British Columbia and the Gulf of Alaska have been documented. It has been speculated that this shift may represent a return to a historical, pre-whaling migratory route and could be tied to changes in oceanographic conditions that impact prey availability (Calambokidis *et al.*, 2009).

The distribution of blue whales is not even along the West Coast, but consists of feeding aggregations, particularly on the continental shelf edge (Keiper *et al.*, 2011). Aggregations are more common off California than Oregon or Washington, with nine BIAs for blue whale feeding identified off the California coast (six in southern California and three in Central California) and none off Oregon or Washington (Calambokidis *et al.*, 2015).

Blue whales achieve their impressive size on a diet consisting almost exclusively of krill. Primary prey species include *Euphausia pacifica* and *Thysanoessa spinifera* in the North Pacific Ocean (Schoenherr, 1991; Fiedler *et al.*, 1998), and *Nyctiphanes simplex* in the Gulf of California (Gendron, 1992).

During winter and spring, blue whales in the eastern North Pacific Ocean migrate to low latitudes, especially to areas along Baja California and near the Costa Rica Dome, to breed and continue feeding (Reilly and Thayer, 1990; Mate *et al.*, 1999). While knowledge of blue whale reproduction is limited, the Gulf of California is a known nursing ground for a portion of blue whales that feed during summer along the U.S. West Coast. However, another unknown calving area also likely exists (Sears *et al.*, 2013).

Predictive distribution model estimates for blue whales off the U.S. West Coast are available through WhaleWatch, a NASA-funded project coordinated by NMFS West Coast Region (WCR). Near-real-time estimates of where blue whales are provided by habitat-based models (developed by Hazen *et al.*, 2016) which combine satellite telemetry data on whales with environmental information to estimate the likelihood of blue whale occurrence.

3.2.2.2 Status of the species

Many populations of blue whales are heavily depleted due to intensive whaling throughout the late 19th and 20th centuries. Globally, over 382,000 blue whales were killed from 1868 to 1978, of which the vast majority were Antarctic whales (Branch *et al.*, 2008). As a result of overexploitation from commercial whaling worldwide, the blue whale was listed as "endangered" throughout its range under the ESCA in 1970, which transferred to the ESA in 1973 (35 FR 8491) and has remained since.

For MMPA purposes, NMFS recognizes blue whales found in the eastern North Pacific from the northern Gulf of Alaska to the eastern tropical Pacific as one Eastern North Pacific stock. Due to the globally endangered status of blue whales, the ENP stock is automatically designated as "depleted" under the MMPA.

A recovery plan for blue whales was approved by NMFS in 1998, with a revision released in 2020. The plan provides information on the current status the species, along with a recovery strategy, goals, objectives, and criteria (NMFS, 2020d).

3.2.2.3 North Pacific population structure

North Pacific blue whale population structure has previously been evaluated using a combination of whaling data, length frequencies, acoustic surveys, and tagging techniques. While historical records indicate the possibility of as many as five North Pacific populations (NMFS, 1998), recent acoustic evidence suggest that blue whales in the North Pacific comprise two populations: an eastern and a western/central population (Stafford *et al.*, 2001).

North Pacific blue whales produce two distinct, stereotypic calls: a "northwestern" and "northeastern" call type. It has been proposed that these represent distinct populations with some degree of geographic overlap (Stafford *et al.*, 2001; Monnahan *et al.*, 2014). The northeastern call is most commonly heard among blue whales in the Gulf of Alaska, along the U.S. West Coast, and in the eastern tropical Pacific. Meanwhile, the northwestern call predominates from along the Aleutian Islands to the Kamchatka Peninsula. Both call types have been recorded concurrently in the Gulf of Alaska and at a much lower occurrence in the central North Pacific Ocean at lower latitudes (Stafford *et al.*, 2001).

The separation of blue whales from the North Pacific into an eastern and western/central population is further supported by length frequency analysis which has demonstrated that whales off California and Central America (i.e., the ENP stock) are approximately two meters shorter, on average, than the length of whales measured in historical whaling records from the central and western North Pacific (Gilpatrick and Perryman, 2008). Additionally, satellite tagging and photo identification studies have helped to identify and refine the distribution range of eastern population whales moving between the Gulf of Alaska and the Costa Rica Dome off Central America (Mate *et al.*, 1999; Bailey *et al.*, 2009; Calambokidis *et al.*, 2009)

Under the MMPA, NMFS recognizes an Eastern North Pacific and a Central North Pacific stock of blue whales. The ENP stock includes whales found from the northern Gulf of Alaska to the eastern tropical Pacific, consistent with the northeastern call type, length determinations, and photo identification studies (NMFS, 2019b).

3.2.2.4 North Pacific abundance and growth estimates

It is estimated that 9,773 blue whales were killed by commercial whaling operations in the North Pacific Ocean from 1905 to 1971. Of these, approximately 35% are believed to have been from the eastern North Pacific population while the remainder were from the western North Pacific population. This suggests that the pre-whaling western population was significantly larger than the eastern population (Monnahan *et al.*, 2014).

Population size has been estimated for U.S. West Coast blue whales by line-transect and mark-recapture methods, which provide different measures of abundance for the ENP stock. Because line-transect estimates tend to be negatively biased by the recent northward shifts in blue whale distribution, mark-recapture methods are considered the best gauge of current population trends for this stock (NMFS, 2019b). Still, abundance estimates for blue whales are more problematic than for some other baleen whales due to their expansive range and offshore distribution which limits photo-identification efforts.

The most recent estimate of blue whale minimum abundance used for SAR purposes is 1,050 whales, based on 2014 California Current line-transect surveys (Barlow, 2016). However, recent work by Calambokidis and Barlow (2020) provides an updated estimate based on photographic mark-recapture data through 2018. Based on a 4-year sampling period (2015–2018) Chao model that incorporates heterogeneity and time varying capture probability, they estimate a minimum abundance of 1,767 whales, which suggests a possible slight increase in abundance since the 1990s.

The most recent blue whale SAR information describes that there has been concern that, unlike other eastern North Pacific baleen whale species (e.g., fin, humpback, and gray whales), blue whale populations have not shown clear signs of increase since the early 1990s (NMFS, 2019b). This may indicate that eastern North Pacific blue whales have not shown signs of recovery from whaling over the last two decades (Calambokidis and Barlow, 2013; Calambokidis *et al.*, 2015). Conversely, population dynamics modeling has been used to estimate that the population was at 97% of carrying capacity in 2013, suggesting that the observed lack of population increase since the early 1990s is due to density dependence (Monnahan *et al.*, 2015). In 2016, the IWC Scientific Committee endorsed the findings of Monnahan *et al.* (2015) that eastern North Pacific blue whales are almost recovered, while acknowledging the value of additional work on North Pacific blue whale stock structure (IWC, 2016).

Since an estimate of maximum net productivity for any blue whale population is lacking, a default rate of 4% is used by NMFS for all blue whale stocks in marine mammal SARs (NMFS, 2019b).

3.2.2.5 Occurrence off Oregon

Unlike with humpback whales, no BIAs for blue whale feeding have been identified off Oregon (Figure 3-3; Calambokidis *et al.*, 2015) and critical habitat has not been designated or proposed for the species. However, blue whales have been shown to utilize secondary feeding areas off Oregon and Washington during the fall (Burtenshaw *et al.*, 2004), and the northward shift of blue whales into waters off Oregon continues to be documented (Barlow, 2016).

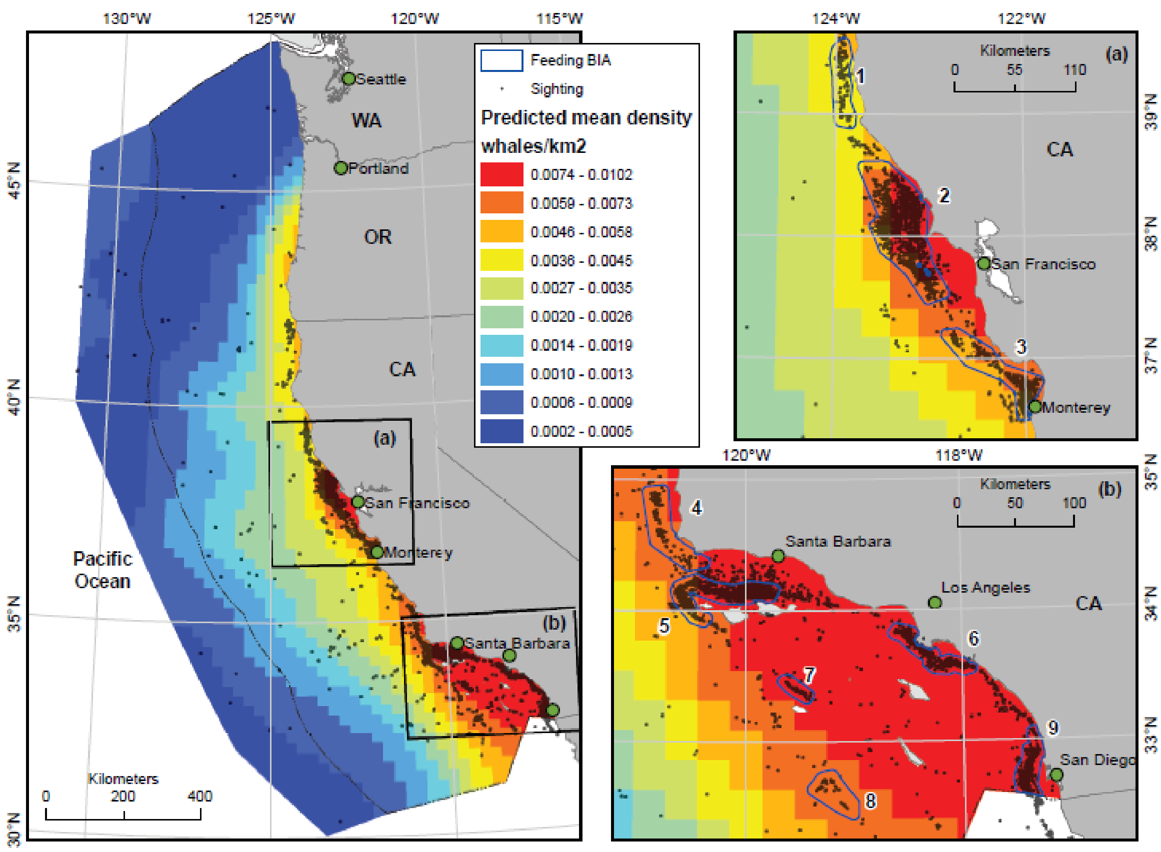

Figure 3-3. Blue whale Biologically Important Areas and predicted mean densities in the CCE, from Calambokidis *et al.* (2015). *"Nine blue whale (*Balaenoptera musculus*) Biologically Important Areas (BIAs), overlaid with all sightings and predicted mean densities of blue whales from habitat-based density (HD) models generated from Southwest Fisheries Science Center ship surveys (see Becker* et al.*, 2012). Panels a and b show more detail for the areas where the BIAs are located. The BIAs are (from north to south) (1) Point Arena to Fort Bragg, August-November; (2) Gulf of the Farallones, July-November; (3) Monterey Bay to Pescadero, July-October; (4) Point Conception/Arguello, June-October; (5) Santa Barbara Channel and San Miguel, June-October; (6) Santa Monica Bay to Long Beach, June-October; (7) San Nicholas Island, June-October; (8) Tanner-Cortez Bank, June-October; and (9) San Diego, June-October (see Table 4.1 for details)."*

Ensemble modeling used to predict year-round habitat suitability for blue whales, based on satellite tracking data from 1994–2008, found that temperature, seafloor topography, and subsurface water properties strongly influence habitat use (Abrahms *et al*., 2019). Model predictions generally matched latitudinal migratory patterns described in literature (Burtenshaw *et al*., 2004; Bailey *et al*., 2009), with habitat suitability remaining low throughout the CCE from January through April, increasing off Southern California in May and June, and continuing to increase northward through late summer and early fall before contracting southward into winter. Several hotspots of habitat suitability were identified within the CCE, with one occurring in the vicinity of Cape Blanco in Oregon (Abrahms *et al*., 2019).

Additionally, blue whale presence and absence data are currently being collected as part of the monthly surveys off Oregon that are described in *Section 5.3.2.6*. Preliminary helicopter survey results collected through May 2021 indicate the majority (80%) of blue whales are observed between July and November, consistent with the seasonal latitudinal patterns described in Abrahms *et al.* (2019). Helicopter and ship-based surveys, concentrated primarily in waters 30-775 m deep, observed the majority (80%) of individuals between 62 and 225 m (~34-123 fathoms). Over this time period, 41 of the 408 validated and identified sightings of baleen whale groups were blue whales. Caution should be used when interpreting these preliminary results, as they do not fully account for survey efforts and conditions at this time.

3.2.3 Leatherback sea turtle (*Dermochelys coriacea*)

The leatherback sea turtle is the largest and most migratory turtle in the world, and the only living species from the Dermochelyidae family. Leatherback sea turtles are uniquely adapted to be able to occupy a wide variety of habitats and migrate vast distances between nesting and foraging grounds. Often over two meters in length, these turtles have a primarily black carapace with characteristically rubber-like skin (Eckert *et al*., 2012), for which they are named. A number of critical information gaps (e.g., age at maturity, population structure, distribution) exist and have significant implications for the management and recovery of leatherback populations. However, since the species was listed, substantial efforts have been made to improve understanding of the biology and ecology of leatherback sea turtles, relevant to conservation and protection (NMFS and USFWS, 2020).

Key information sources for leatherback sea turtles include:

- The Recovery Plan for U.S. Pacific Populations of the Leatherback Turtle (*Dermochelys coriacea*) (NMFS and USFWS, 1998);
- The 2020 Endangered Species Act Status Review of the Leatherback Turtle (*Dermochelys coriacea*) (NMFS and USFWS, 2020);
- The Species in the Spotlight: Pacific Leatherback Turtles (*Dermochelys coriacea*), Priority Actions 2021-2025 (NMFS, 2021c);
- The Final Rule to Revise the Critical Habitat Designation for the Endangered Leatherback Sea Turtle (NMFS, 2012a);
- The Final Biological Report accompanying the critical habitat designation revision in 2012 (NMFS, 2012b); and

- The USFWS's Synopsis of the Biological Data on the Leatherback Sea Turtle (Eckert *et al.*, 2012).

Relevant information reflecting the best available information on leatherback sea turtles is summarized below.

3.2.3.1 Distribution and habitat use

Leatherback sea turtles occur in the Atlantic, Pacific, and Indian Oceans, inhabiting waters that range from ~71°N to 47°S (NMFS and USFWS, 2020). Several unique physiological, anatomical, and behavioral adaptations enable leatherbacks to occupy a wide variety of marine ecosystems, including cold temperate regions of the oceans, and exploit areas of high productivity to meet their energetic needs. These include a countercurrent circulatory system (Greer *et al.*, 1973), a thick insulating layer of fat (Davenport *et al.*, 1990, 2009), gigantothermy that limits heat loss and helps avoid overheating (Paladino *et al.*, 1990), and the ability to behaviorally control heat gain and loss through metabolic activity (Bostrom *et al.*, 2010).

Leatherbacks routinely migrate thousands of kilometers between high-latitude, sub-polar foraging areas, and tropical or sub-tropical nesting beaches. Migratory routes are not well understood; however, transoceanic migrations over more than 10,000 kilometers in a single year have been documented in the Pacific Ocean (Benson *et al.*, 2011). Despite their extensive range, leatherback sea turtle distribution is not uniform and large nesting aggregations are not common.

Based on their distribution and biological and genetic characteristics, Pacific leatherbacks are divided into an eastern and western Pacific population (a potential East Pacific DPS and West Pacific DPS as described by NMFS and USFWS, 2020; See *Section 3.2.3.2*). Eastern Pacific leatherbacks primarily nest in Mexico and Costa Rica, with some isolated nesting scattered along the coast of Central America (Marquez, 1990) and very rarely in the Gulf of California (Seminoff and Dutton, 2007). Eastern Pacific leatherbacks nest from October through March, before migrating to coastal and pelagic waters of the southeastern Pacific to feed (Eckert *et al.*, 2012). In contrast, western Pacific leatherback turtles nest year round at several Pacific island beaches (e.g., Indonesia, Papua New Guinea, and the Solomon Islands), and exhibit a bimodal nesting strategy whereby a proportion of females nest from November through February and other females nest from May through September (NMFS and USFWS, 2020). Western Pacific turtles do not have distinct migratory corridors; however, there is clear separation between the migration patterns of boreal "winter" and "summer" nesting turtles. Those that nest in the winter typically migrate south to high-latitude areas of the South Pacific Ocean or Tasman Seas, while summer nesters migrate to various foraging areas in the northern hemisphere including in the CCE off the U.S. West Coast (Benson *et al.*, 2011).

Based on the ranges provided by NMFS and UWFWS (2020), leatherback sea turtles encountered off the U.S. West Coast are expected to belong to the potential West Pacific DPS. Additional, comprehensive information on leatherback migration can be found in the sources listed at the top of this section.

Leatherbacks primarily eat gelatinous prey including jellyfish (cnidaria), tunicates (tunicate/urochordata), and ctenophores (ctenophora), with other putative prey apparently ingested opportunistically or accidentally (Eckert *et al*., 2012). During the summer and fall months, leatherback sea turtles have been documented feeding off the U.S. West Coast (Benson *et al*., 2007). Foraging areas are typically characterized by oceanic processes that serve to aggregate prey, including convergence zones, coastal retention areas, or eddies (Benson *et al*., 2011; Eckert *et al*., 2012).

In 2012, NMFS issued a final rule to revise the critical habitat designation for the leatherback sea turtle by designating additional areas within the Pacific Ocean. Through this designation, the critical habitat review team identified occurrence of prey (primarily scyphomedusae) as a primary constituent element essential for the conservation of leatherbacks in the marine waters off the U.S. West Coast.

3.2.3.2 Status of the species

The leatherback sea turtle population is rapidly declining in many parts of the world and, particularly, in the Pacific Ocean (Spotila *et al*., 2000). Primary threats facing leatherback sea turtles in the Pacific include incidental catch in fisheries (entanglement and/or hooking), direct harvest of both eggs and turtles, natural and anthropogenic impacts to nesting beaches and habitat, and changing ocean conditions. Additional threats include vessel strikes, ingestion of plastics, and entanglement in marine debris (including derelict fishing gear) (NMFS, 2021c).

The leatherback sea turtle was listed as “endangered” throughout its entire range under the ESCA in 1970 and, subsequently, under the ESA in 1973 (35 FR 8491). Pursuant to a 1977 joint agreement, the USFWS and NMFS share jurisdiction of listed sea turtles. USFWS has jurisdiction over sea turtles on land and NMFS has jurisdiction over sea turtles in the marine environment. The status of the species under the ESA was reviewed by NMFS and/or the USFWS in 1985, 1991, 1995, 2007, and 2013 and, in each case, it was recommended that leatherbacks retain their listing as an endangered species. In 2007 and 2013, an additional recommendation was made that a review and analysis of the species listing relative to the DPS policy be conducted. In 2017, NMFS and USFWS jointly announced that they would convene a status review team to review the best available information on the species, apply the DPS policy, and evaluate the extinction risk of any potential DPSs. The results of this work were shared in a 2020 status review report identifying seven potential leatherback turtle DPSs, including a West Pacific and East Pacific DPS, that meet the discreteness and significance criteria of the DPS policy. The team found that all potential DPSs meet the definition of high risk of extinction, and that fisheries bycatch is a primary threat for all DPSs (NMFS and USFWS, 2020).

A recovery plan for U.S. Pacific populations of the leatherback sea turtle was approved by NMFS and the USFWS in 1998. The plan provides a description of the Pacific leatherback populations, potential threats facing the species, and recovery objectives (NMFS and USFWS, 1998).

3.2.3.3 West Pacific abundance estimates

Historical descriptions of leatherback sea turtles are rarely found and population sizes prior to the mid-20th century are speculative (NMFS, 2013). While nesting beaches are now known in all major ocean basins, the high variability in nesting patterns makes accurate total population estimates difficult to obtain. However, regional abundance estimates and trends, by either nesting population or total population where known, are detailed in NMFS and USFWS (2020).

NMFS and USFWS (2020) estimate the total index of nesting female abundance of the potential West Pacific DPS to be 1,277 females, based on recently (as of 2014) and consistently monitored nesting beaches. Given the potential for unidentified or unmonitored nesting beaches, the actual nesting female abundance could be higher. This small nesting female abundance restricts the capacity of the DPS to buffer impacts to habitat or losses in individuals and is a major factor in the high extinction risk of this potential DPS.

Leatherback abundance off the U.S. West Coast varies between years since individuals spend almost two years migrating to and from nesting beaches, and subsequently return to foraging grounds during one or more consecutive years. The number of seasons that each individual animal requires to meet energetic needs likely depends on variable habitat conditions and foraging success in a given season. However, model results using long-term survey data from a major foraging ground off central California estimate a -5.6% annual rate of decline in leatherback abundance between 1990 and 2017 (Benson *et al.*, 2020). While long-term monitoring data for this potential DPS are geographically limited, trend analysis indicates low hatching success and an overall declining nest trend that are likely due to anthropogenic and environmental impacts at nesting beaches and in foraging habitats (NMFS and USFWS, 2020).

3.2.3.4 Occurrence off Oregon

Seasonally, leatherback sea turtles have been documented arriving off the U.S. West Coast in April-July and departing in late November. Off Oregon and Washington, foraging behavior has been documented particularly in shelf and slope habitat (200 – 2000 m) adjacent to the Columbia River Plume where seasonal retention of gelatinous prey is common (Benson *et al.*, 2011).

Pursuant to section 4 of the ESA, critical habitat for leatherback sea turtles was designated off Oregon in 2012 through a revision of the existing critical habitat designation at that time (in the U.S. Virgin Islands) to include areas within the Pacific Ocean (77 FR 4169). Among these was an area including the nearshore waters between Cape Flattery, Washington and Cape Blanco, Oregon extending offshore to the 2000-m isobath. Cape Blanco is a well-documented “break” in physical and biological ocean properties, with the area north of this point containing high seasonal densities of a primary leatherback prey species, brown sea nettle (*C. fuscescens*). A complete description of the critical habitat and assessment process can be found in the final rule (NMFS, 2012a) and accompanying biological report (NMFS, 2012b).

Section 4 Potential Biological Impacts and Take Assessment

4.1 Impacts to covered species

Biological impacts to covered species occur when animals become entangled in some portion of crab gear, often either the vertical line that connects the pot to the surface buoys and/or the surface gear itself. Whale or turtle entanglements may result from interactions with crab gear that is actively fishing or that is lost or derelict. Depending on the severity of the entanglement and resulting actions (e.g., self-release by the animal, intervention by a disentanglement team), the entanglement may compromise the health of the individual animal and be categorized by NMFS as a non-serious injury (NSI), serious injury (SI), or mortality (M) accordingly.

NMFS uses nationally consistent and transparent guidelines for distinguishing between human-caused serious and non-serious injuries of marine mammals, and for assessing and quantifying injuries (see NMFS, 2012c). NMFS interprets the regulatory definition of SI as "an injury that is *more likely than not* to result in mortality" (NMFS, 2012d). Examples of human-caused serious injuries to large whales include ingested gear, constricting warps, deep lacerations, and certain vessel strikes (NMFS, 2012c). The injury determinations for each region over the most recently evaluated five-year period are documented in an annual report which, for the U.S. West Coast, is prepared by the Southwest Fisheries Science Center. The most recent injury determination report was published in 2020 and contains records from 2014 through 2018 (Carretta *et al.*, 2020).

Summarized injury determinations are also incorporated into marine mammal stock assessment reports published by NMFS, as required under the MMPA. Within SARs, human-caused mortality and serious injury is evaluated relative to Potential Biological Removal (PBR) levels for each marine mammal stock under the MMPA. The PBR level is "*the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population*" (16 USC § 1362(2)).

Additionally, human-caused M/SI levels are considered by NMFS when making a negligible impact determination (NID) under section 101(a)(5)(E) of the MMPA for the purpose of authorizing incidental take of certain marine mammal stocks that are designated as depleted because of their listing under the ESA, during commercial fishing.

4.1.1 West Coast entanglement record

Information gleaned from previous entanglements sets the foundation for predicting the outcomes of any future entanglements, and provides a basis for comparison and tracking change over time. A comprehensive review and analysis of whale entanglements observed off coastal California, Oregon, and Washington waters from 1982 to 2017 can be found in Saez *et al.*, 2021. A review of West Coast sea turtle entanglements has not been published; however, a sea turtle entanglement database for the West Coast region was provided to ODFW by NMFS for conservation plan development in April 2021.

When an entanglement occurs, first-hand observers provide detailed information and documentation to NMFS. NMFS then uses the submitted documents, follow-up sightings, and entanglement response information to evaluate specific criteria in order to identify unique instances of entanglement, weed out redundant or spurious reports, and maintain accuracy. NMFS is able to “confirm” the majority of entanglement reports (~84% on average) based on the following criteria (Saez *et al*., 2021):

- Photos/videos of the whale with entangling gear;
- Direct visual observation by NMFS staff;
- The report is from a trusted source (i.e., trained or professional reporting party);
- A NMFS expert or experienced partner from the West Coast Marine Mammal Stranding Network interviews the reporting party and receives information that is detailed and specific enough to confirm; and/or
- Corroborated, independent, and multiple sources provide reports with detailed descriptions of the animal and entanglement.

For the purposes of this CP, we will be focusing on confirmed entanglements documented from 2013 through 2020. The time period since 2013 is considered by NMFS to represent the “modern” era of entanglement documentation and reporting, and will be used as a baseline from which to measure any future progress or changes in the impacts of entanglements on covered species. Since 2013, the number and quality of entanglement reports has improved, along with an increasing availability of digital images or videos accompanying entanglement reports. This time period also coincides with major efforts by NMFS WCR Protected Resources Division (PRD) to broaden outreach about entanglement reporting and improve the quality of documentation and evaluation of these events (NMFS, 2020e). Additionally, this time period largely overlaps with the large marine heatwave described in *Section 3.1.4.1* and the sharp increase in West Coast whale entanglements and, in particular, humpback whale entanglements, documented since 2014 (Saez *et al*., 2021). All of the entanglement data discussed throughout this section were provided to ODFW in April 2021 by the NMFS WCR.

From 2013 through 2020, there were 329 whale entanglements reported and 263 confirmed entanglements off the West Coast. Entanglements were reported from across the West Coast (British Columbia to Mexico), indicating that whales can travel great distances before being observed and documented. Just over half of the confirmed entanglements during this time period involved gear that could not be identified (n=134; 51%), while approximately 36% involved pot/trap gear (n=95), 12% involved nets (n=32), and <1% involved other gear (n=2) (Figure 4-1).

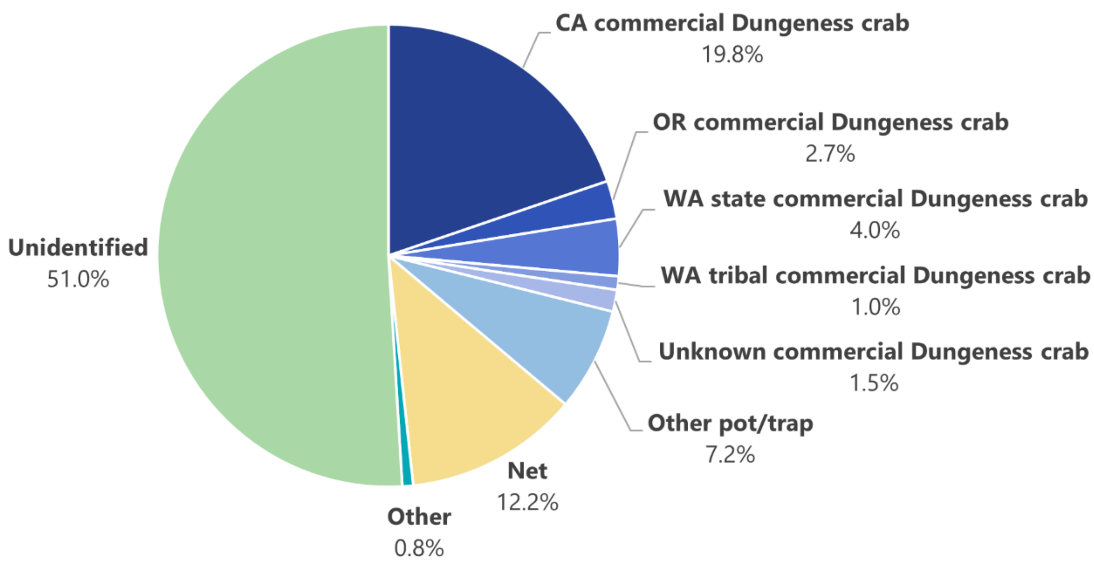

Figure 4-1. Percentage of West Coast confirmed whale entanglements (n=263) attributed to different general gear types from 2013–2020. Data provided by NMFS WCR, April 2021.

Pot/trap is a general gear category describing any entanglement where the identified recreational or commercial fishery utilizes a pot or trap to target fishery species (e.g., spot prawn, sablefish, Dungeness crab, lobster, rock crab). Of the 263 confirmed entanglements between 2013 and 2020, 29% involved gear identified as commercial Dungeness crab gear (n=76). Confirmed whale entanglements, by species, with commercial Dungeness crab gear from California (n=52), Oregon (n=7), and Washington (n=13) over this period are shown in Figure 4-2.

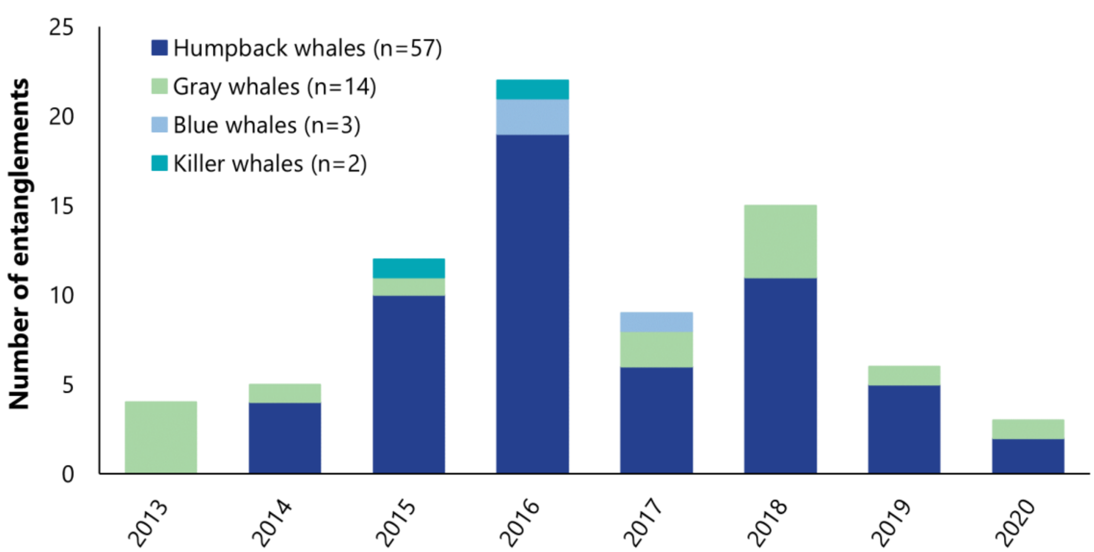

Figure 4-2. Confirmed whale entanglements, by species, with commercial Dungeness crab gear from West Coast states from 2013–2020. This includes entanglements in crab gear attributed to Washington (n=13), Oregon (n=7), and California (n=52), in addition to four entanglements in

crab gear where the state is unknown. Washington entanglements include whales entangled in state and tribal commercial crab gear. Data provided by NMFS WCR, April 2021.

Of the confirmed entanglements involving West Coast commercial Dungeness crab gear, humpback whales were the most common species involved (n=57; 75%), followed by gray whales (n=14; 18%). Blue whales were involved in only ~4% of entanglements (n=3) and transient killer whales were involved in less than 3% (n=2).

Documented interactions between leatherback sea turtles and fishing gear are less common than those recorded for whale species. With increased attention on the entanglement issue and improved documentation of events, NMFS WCR began documenting entanglement records involving leatherback sea turtles in a manner similar to whale entanglement records in 2015 (Dan Lawson, personal communication). Since this time, three fishery interactions with leatherback sea turtles have been documented. Of these, one involved fishery gear that could not be identified in 2015, one involved gear belonging to the California commercial Dungeness crab fishery in 2016, and one involved gear belonging to the California rock crab fishery in 2019.

4.1.2 Oregon entanglement record

Entanglements involving Oregon fishery gear make up a relatively small proportion of confirmed West Coast entanglements, as do entanglements first observed in Oregon waters (regardless of the origin of the gear). Of the 263 confirmed coastwide entanglements from 2013 through 2020, 3.4% (n=9; 2 sablefish and 7 Dungeness crab) are attributed to fishery gear originally set in Oregon. Over this same period, 6.8% (n=18) were reported from observations made in Oregon.

Of the 76 confirmed coastwide entanglements specifically involving commercial Dungeness crab gear from 2013 through 2020, numbers are similarly low. Entanglements attributed to Oregon crab fishery gear represent 9.2% (n=7) of cases, while those reported from observations made in Oregon make up 5.3% (n=4). For comparison, over 70% (n=54) of those cases were reported from observations made in California (including the northern, central, and southern region), around 13% (n=10) of cases were reported from observations made in Washington, and around 11% were reported from observations made in either Mexico (n=6) or British Columbia (n=2). Whale entanglements are reported opportunistically and are likely biased towards areas of higher human populations where there are more “eyes on the water” (Saez *et al.*, 2021). The somewhat lower rate of reporting in Oregon (compared to reporting rates elsewhere on the West Coast) may be reflective of that bias to some degree.

Confirmed entanglements involving Oregon crab gear from 2013 through 2020 are shown in Figure 4-3**.** Six of these entanglements involved ESA-listed humpback whales, while one involved a gray whale. Entanglements involving Oregon crab gear have been reported from Washington to Mexico (although none have been reported from observations in Oregon waters) and have been reported from April through October (Table 4-1). For comparison, along the West Coast, humpback whale entanglements involving commercial Dungeness crab gear (from Washington, Oregon, and California) have been reported in all months of the year except February, with the majority reported from April through September and the peak occurring in May (see Figure 5-3).

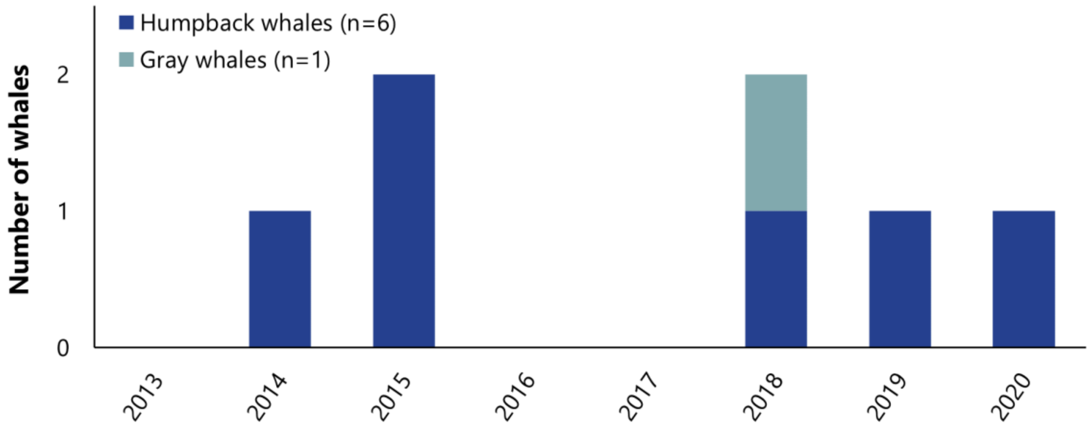

Figure 4-3. Confirmed whale entanglements, by species, with Oregon commercial Dungeness crab gear from 2013–2020. Data provided by NMFS WCR, April 2021.

Table 4-1. Detailed descriptions of confirmed whale entanglements with Oregon commercial Dungeness crab gear from 2013–2020. The most recent injury determination report includes records through 2018, so injury assessments for 2019 and 2020 entanglements are currently available. SI = serious injury; NSI = non-serious injury; U = unavailable. Data provided by NMFS WCR, April 2021.

Month/ Year	Species	Report location	Alive/ Dead	Entanglement response	Gear removed	Initial Injury assessment	Final injury assessment
May 2014	Humpback whale	WA	Alive	Yes	Full release	SI	NSI; 0
July 2015	Humpback whale	Central CA	Alive	Yes	Partial release	SI	NSI; 0
Sept 2015	Humpback whale	Southern CA	Alive	Yes	Full release	SI	NSI; 0
Apr 2018	Gray whale	WA	Alive	Yes	Partial release	SI (prorate)	SI (prorate); 1
Oct 2018	Humpback whale	Central CA	Alive	Yes	Partial release	SI	SI; 1
Apr 2019	Humpback whale	Mexico	Alive	Yes	Full release	U	U
June 2020	Humpback whale	Central CA	Dead	N/A	N/A	U	U

Of the five entanglements involving Oregon commercial Dungeness crab gear from 2013 through 2020 for which final injury determinations have been made, three were initially categorized as a serious injury, but assigned a final determination of non-serious injury due to human intervention. The other two cases also involved an entanglement response which resulted in partial removal of gear, but a final injury determination of serious injury was made.

During this time period, there were four additional entanglements (two humpback whales in August 2014 and May 2018; two gray whales in May 2014 and June 2019) involving commercial Dungeness crab gear that could not be attributed to a specific state, and one entanglement (a humpback whale in November 2019) involving Dungeness crab gear that could not be attributed to a specific sector (commercial or recreational).

4.1.3 Entanglement of covered species

Confirmed entanglements of covered species involving commercial crab gear originating from the West Coast, and specifically from Oregon, are summarized for the period of interest in Table 4-2.

Table 4-2. Confirmed entanglements of covered species, by calendar year, with commercial Dungeness crab gear from all West Coast states (California, Oregon, and Washington) and from Oregon, from 2013–2020. Data provided by NMFS WCR, April 2021.

	West Coast			Oregon		
Year	Humpback whales	Blue whales	Leatherback sea turtles	Humpback whales	Blue whales	Leatherback sea turtles
2013	0	0	0	0	0	0
2014	4	0	0	1	0	0
2015	10	0	0	2	0	0
2016	19	2	1	0	0	0
2017	6	1	0	0	0	0
2018	11	0	0	1	0	0
2019	5	0	0	1	0	0
2020	2	0	0	1	0	0
TOTAL	57	3	1	7	0	0

Estimation of current take levels by the crab fishery is complicated by the prevalence of entanglements where the fishing gear type or associated fishery cannot be identified. Furthermore, the time and location that entanglements are reported does not necessarily reflect when and where those animals became entangled initially. Just over half of the confirmed West Coast whale entanglements in recent years could not be attributed to a specific fishery. Of the fishing gear that is attributable, commercial Dungeness crab gear is the most common source. As such, the numbers in Table 4-2 should be considered minimum estimates of fishery interactions.

4.2 Anticipated take of each covered species

Under the ESA, take is defined as "*to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct*" (16 USC § 1532(19)). Harm is further defined by NMFS to include "*significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering*" (50 CFR § 222.102). Accordingly, any interaction (i.e., entanglement) with crab gear is considered take of a covered species under the ESA.

As mentioned above, roughly half of the fishing gear involved in confirmed entanglements from 2013 through 2020 could not be identified. To address this issue, improved gear marking requirements have been implemented in Oregon and throughout the West Coast crab fishery (see *Section 5.3.2*) which is expected to potentially increase the number of entanglements attributed to crab fisheries in California, Oregon, and Washington, while simultaneously decreasing the number of entanglements with unidentified gear.

4.2.1 Humpback whale

For humpback whales, it is often not possible to identify an individual to the DPS level during an entanglement response or forensic review. Additionally, under the MMPA, PBR levels are defined and NIDs are made at the CA/OR/WA stock level, including incorporation of an appropriate recovery factor (for PBR) or conservative negligible impact factor (for NIDs) to account for an endangered stock or DPS. For these reasons, anticipated take of humpback whales is described at the CA/OR/WA stock level, while recognizing that the majority of humpback whales that feed off Oregon belong to either the CAM DPS or the MX DPS (see *Section 3.2.1*).

From 2013 through 2020, 172 humpback whales were entangled coastwide with 90 cases involving known gear (i.e., attributed to a specific fishery) and 82 cases involving unknown gear (i.e., not attributable to a specific fishery). Of the known-gear entanglements, six (or 6.7%) were attributed to Oregon crab gear. If the fishery of origin for unknown gear is proportional to the fishery of origin for known gear, we can apportion around 6.7% of the 82 unknown-gear entanglements, or 5.47 additional entanglements, to Oregon crab gear. Using this as an estimate, the total entanglements from 2013 through 2020 would equal the sum of the observed (6) and apportioned (5.47) entanglements, or 11.47. Over the eight-year period, this would equate to an estimated rate of 1.43 humpback whales entangled per year.

A unit of take must be practicable (whole numbers), so that it can be readily monitored and applied to adaptive management decisions. Therefore, the anticipated incidental take of humpback whales by the crab fishery is defined as up to two animals per year over the 20-year duration of the permit.

4.2.2 Blue whale

To date, there have been no confirmed entanglements involving blue whales in commercial Dungeness crab gear from Oregon. However, there were three blue whale entanglements in California crab gear between 2013 and 2020, and four additional blue whales entangled in unknown gear. Additionally, the northward shift of blue whales into waters off Oregon continues to be documented (Barlow, 2016). Therefore, coastwide entanglement records are used to anticipate take of blue whales, with certain assumptions used to scale the anticipated impacts to Oregon gear.

From 2013 through 2020, all seven blue whale entanglements (three confirmed in California commercial Dungeness crab gear, four in unknown gear) were reported from observations made in California. During this time period, there were 68 confirmed entanglements (including all species) where the gear set region (i.e., the region where gear was originally deployed) is known. Of these, 69% (n=47) were reported in the same region where the gear was set. If we apply that percentage to unknown gear, we would estimate that 69% of the four blue whale entanglements in unknown gear (or 2.76 entanglements) may be attributed to gear set in California (i.e., matching the report region). Applying this estimate, the estimated blue whale entanglements attributed to California gear during this time period would be the sum of the observed (3) and apportioned (2.76) entanglements, or 5.76. This would leave 1.24 blue whale entanglements that occurred from 2013 through 2020 as potentially attributable to either Oregon or Washington gear. If we conservatively assume that all of those (1.24) entanglements may be attributed to Oregon crab gear, that would result in an estimated entanglement rate of 0.15 blue whales entangled per year throughout the 20-year duration of the permit.

For measurability and enforceability, the anticipated incidental take of blue whales by the crab fishery is defined as up to one animal every five years.

4.2.3 Leatherback sea turtle

For leatherback sea turtles, there is even less information available on historical entanglements in fishing gear. There have been no confirmed entanglements of leatherback sea turtles in Oregon commercial Dungeness crab gear to date, and only one confirmed entanglement in California commercial Dungeness crab gear from 2015 to 2020. This equates to a coastwide entanglement rate over that timeframe of 0.17 animals per year. As a conservative approach, if we assume that entanglement risk is equal between the three West Coast states, an entanglement rate of 0.06 animals per year may be expected involving Oregon gear. For measurability and enforceability, the anticipated take of leatherback sea turtles by the crab fishery is defined as up to one animal every ten years.

4.2.4 Anticipated take estimates summary

The anticipated (or requested) take of each covered species by the Oregon crab fishery over the permit period (20 years) is summarized in Table 4-3. The requested take for humpback whales is commensurate with entanglement records involving the Oregon crab fishery from 2013 through 2020, with some additional allowance for more accurately attributed gear in the future from improved gear marking and identification that is expected to decrease the proportion of entanglements in “unknown” fishing gear. For blue whales and leatherback sea turtles, the amount of take is estimated based on West Coast records, as described above, since no entanglements have yet been confirmed in Oregon. In practice, ODFW expects that the conservation program implemented through this CP will minimize interactions between covered species and crab gear so that the actual take levels are lower than those listed below.

Table 4-3. Anticipated (or requested) take (i.e., entanglements) of covered species by the Oregon crab fishery over the permit period (20 years).

Species/stock	Anticipated take
Humpback whale (CA/OR/WA stock)	Up to two animals per year
Blue whale	Up to one animal every five years
Leatherback sea turtle	Up to one animal every ten years

4.3 Anticipated impacts of covered activities on critical habitat

Section 7(a)(2) of the ESA provides that federal agencies must ensure that any actions that they authorize, fund, or carry out (e.g., issuance of an ITP) are not likely to result in the destruction or adverse modification of designated critical habitat. This section describes anticipated impacts of take on critical habitat.

4.3.1 Humpback whale

In 2021, critical habitat was designated by NMFS for humpback whales from the CAM, MX, and WNP DPSs under section 4 of the ESA (86 FR 21082). Within the CP plan area (i.e., waters of the U.S. EEZ off Oregon), critical habitat includes all marine waters extending from a nearshore boundary defined by the 50-m isobath to an offshore boundary defined by the 1200-m isobath, except in the area south of 42°10′ where the offshore boundary is defined by the 2000-m isobath (Figure 4-4). This habitat includes portions of three specific areas occupied by humpback whales from both the CAM and MX DPSs: the Columbia River Area (Unit 12), Coastal Oregon (Unit 13), and Southern Oregon/Northern California (Unit 14) (NMFS, 2021a).

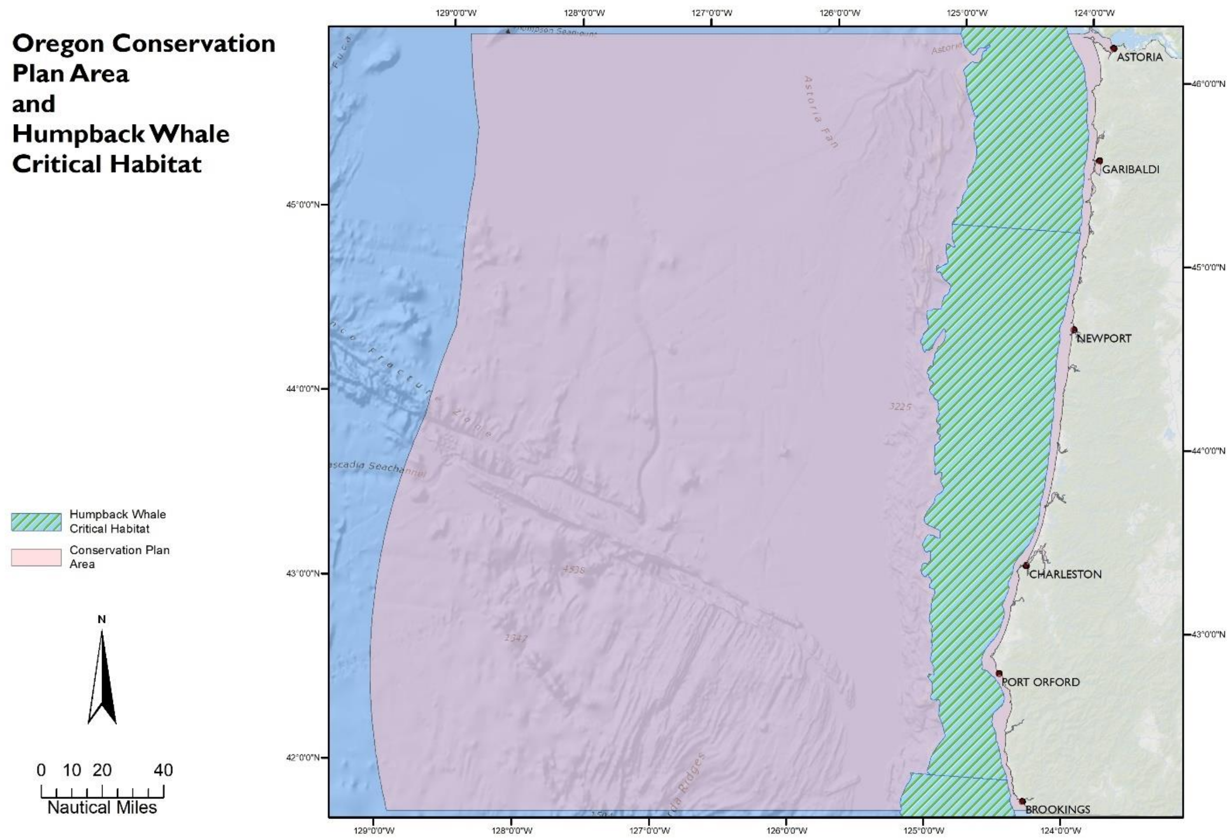

Figure 4-4. Critical habitat for the Central America and Mexico DPSs of humpback whales (turquoise) in relation to the Oregon CP plan area (light pink). Critical habitat GIS data are from NMFS' supporting materials accompanying the final rule (86 FR 21082).

Within the critical habitat designation, prey species, primarily euphausiids and small pelagic schooling fishes of sufficient quality, abundance, and accessibility within humpback whale feeding areas to support feeding and population growth, are defined as a biological feature that is essential to the conservation of the whales (NMFS, 2020c, 2021a; see *Section 3.2.1.1* for complete definitions by DPS).

The CA/OR/WA stock of humpback whales is estimated to be increasing at a rate of approximately 8% per year (NMFS, 2019a) which indicates that the stock is not compromised by a lack of available prey. Additionally, there is no evidence that crab gear used in the Oregon commercial crab fishery has any effect on the quality, abundance, or accessibility of humpback whale prey. Therefore, it is reasonable to conclude that authorization of the requested ITP is unlikely to negatively impact humpback whale critical habitat.

4.3.2 Blue whale

Critical habitat has not been designated by NMFS for blue whales. However, identification of important habitat and reduction of the threats to blue whale habitat have been identified as actions that are integral to recovery (NMFS, 2020d). ODFW is not aware of any direct or indirect threats posed by the crab fishery to blue whale habitat that would impact recovery of the species.

4.3.3 Leatherback sea turtle

In 2012, the existing critical habitat for leatherback sea turtles was revised to include additional areas within the Pacific Ocean (77 FR 4169). Within the CP plan area (i.e., waters of the U.S. EEZ off Oregon), critical habitat includes a portion of Area 2 encompassing the nearshore waters between Cape Blanco, Oregon and the Oregon/Washington border, extending offshore to the 2000-m isobath (Figure 4-5; NMFS, 2012a).

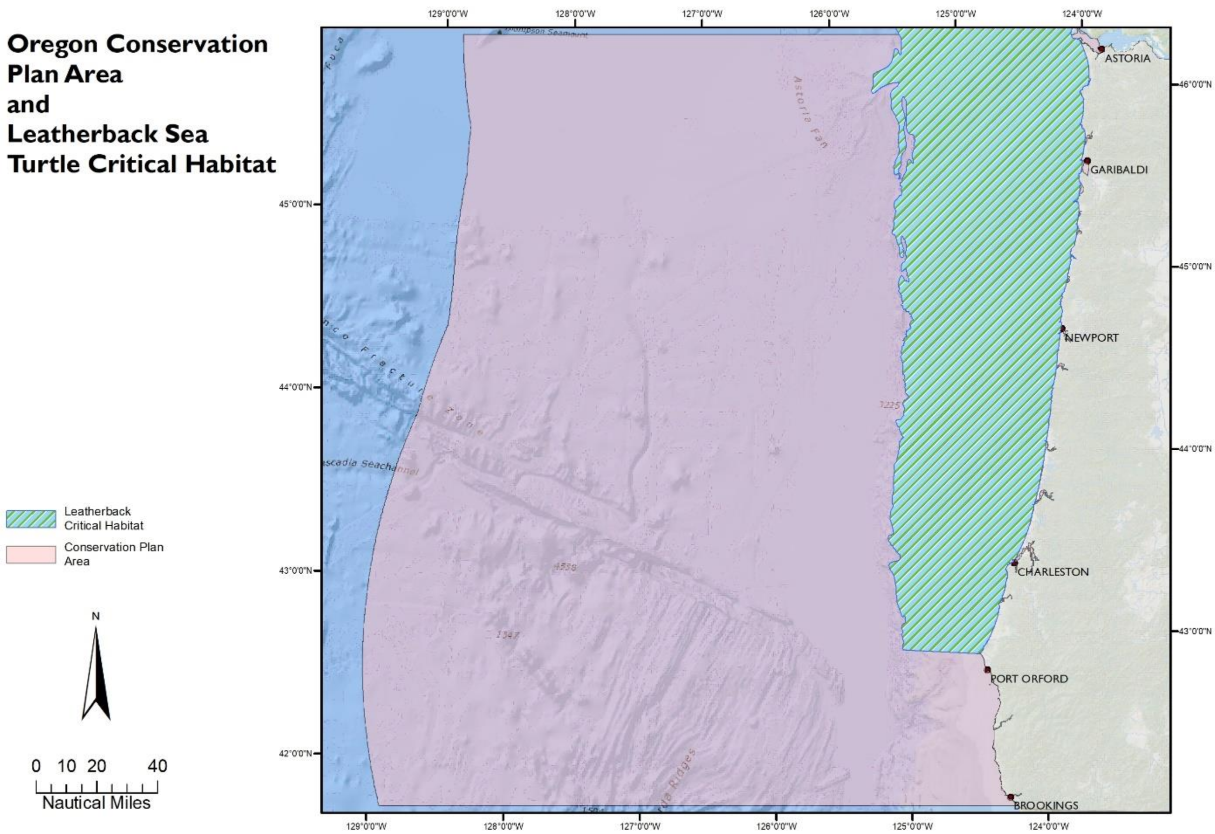

Figure 4-5. Leatherback sea turtle critical habitat (turquoise) in relation to the Oregon CP plan area (light pink). Critical habitat GIS data are from NMFS' supporting materials accompanying the final rule (77 FR 4169).

Within the designated critical habitat, "*the occurrence of prey species, primarily scyphomedusae of the order Semaeostomaeae (e.g.,* Chrysaora*,* Aurelia*,* Phacellophora*, and* Cyanea*), of sufficient condition, distribution, diversity, abundance and density necessary to support individual as well as population growth, reproduction, and development of leatherbacks*" is defined as a primary constituent element essential for the conservation of leatherback sea turtles in marine waters off the U.S. West Coast (NMFS, 2012a, 2012b). There is no evidence that gear used in the crab fishery affects the condition, distribution, diversity, abundance, or density of leatherback sea turtle prey. It is reasonable to conclude that authorization of the requested ITP is unlikely to negatively impact leatherback sea turtle critical habitat.

4.4 Cumulative impacts

NEPA analysis of cumulative impacts accounts for incremental impacts of an action on the environment when added to other *past, present, and reasonably foreseeable future actions* regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time (40 CFR § 1508.7). In contrast, cumulative effects under section 7 of the ESA have a narrower regulatory meaning which applies to only those effects of *future* state or private activities, not involving federal activities, that are reasonably certain to occur within the action area of a federal action subject to consultation (50 CFR § 402.02). To the extent possible, the information in this section uses the NEPA perspective of cumulative impacts.

As directed by the MMPA, marine mammal SARs include information on the stock's geographic range, minimum population estimate, current population trends, current and maximum net productivity rates, PBR levels, stock status, estimates of human-caused M/SI by source, and other factors that may cause a decline or impede the recovery of strategic stocks. The most recent and complete information on past and present anthropogenic impacts to humpback and blue whales can be found in the 2019 U.S. Pacific Marine Mammal SARs (NMFS, 2019a, 2019b) based on injury determination records for the period from 2013 through 2017 (Carretta *et al.*, 2019). This information is summarized below and largely accounts for the impacts of past and present actions on humpback and blue whales. For leatherback sea turtles, the impacts of past and present actions are qualitatively described from a review of recent literature. In the future, it is reasonable to expect that present actions and their impacts to covered species will continue.

ODFW has not identified any additional federal, state, or private activities that are reasonably certain to occur within the plan area in the future. Activities that may occur will likely consist of state or federal government actions related to ocean use policy and management of public resources (e.g., renewable energy development). These changes are highly uncertain, and subject to change in response to political and financial developments, making it difficult to anticipate with any reasonable certainty at this time.

4.4.1 Humpback whale

Sources of human-caused mortality and serious injury involving humpback whales for the five-year period of 2013 to 2017 include pot/trap fishery interactions, unidentified fishery interactions, gillnet fishery interactions, non-fishery interactions (e.g., marine moorings), and vessel strikes. The total M/SI and mean annual M/SI for each source is presented in Table 4-4.

Table 4-4. Summary of observed or estimated incidental mortality and serious injury of humpback whales (CA/OR/WA stock) in the U.S. West Coast EEZ based on 2013 – 2017 data, adapted from NMFS (2019a) and Carretta *et al*. (2019).

Source	Total 5-year observed or estimated M/SI	Mean annual M/SI
Commercial pot/trap fisheries[a]	42.25	8.45
Gillnet fisheries	1	0.2

Unidentified fishery[b]	43.25	8.65
Prorated unidentified whale entanglements	10.3	2.1
Observed vessel strikes	10.8	2.2
Recreational Dungeness crab fishery	1.75	0.35
Tribal Dungeness crab fishery	1	0.2
Non-fishery entanglement	1	0.2
Total mean annual M/SI		**22.35**

[a]Includes 5-year observed M/SI totals for the following fisheries: CA Dungeness crab pot (19.25), unspecified pot or trap including generic 'Dungeness' crab gear not attributed to a specific state fishery (7.0), CA spot prawn pot (2.5), WA Dungeness crab pot (1.75), WA/OR/CA sablefish pot (1.5), and OR Dungeness crab pot (0.75). Additionally, includes the sum of statistical estimates derived from observer program data from the five-year period of 2012-2016 for the WA/OR/CA sablefish pot fishery and the open access fixed gear pot fishery (9.5).
[b]Based on the proportion of humpback whale entanglements where the fishery gear type is identified, it is likely that most records involving unidentified fishery gear represent pot/trap gear.

The observed mean annual M/SI due to commercial fishery entanglements is 17.3 animals/year (8.45 M/SI per year from commercial pot/trap fisheries + 0.2 M/SI per year from gillnet fisheries + 8.65 M/SI per year from unidentified fisheries). However, unidentified whales represent approximately 15% of U.S. West Coast entanglement cases. When unidentified entanglements are not assigned to a species, entanglement risk for commonly-entangled species may be underestimated. Using a cross-validated species identification model, it is possible to remedy this negative bias by assigning a prorated M/SI value to represent additional serious injuries for unidentified whale entanglement cases (Carretta, 2018). For the period from 2013 through 2017, this method would estimate at least 10.3 additional humpback whale serious injuries from 20 unidentified whale entanglement cases, or 2.1 additional humpback whale M/SI annually (NMFS, 2019a). This value is included in Table 4-4.

Additionally, increasing disentanglement efforts in recent years have led to an increase in the proportion of cases reported as non-serious injuries, which would have been serious injuries in the absence of human intervention. Over the five-year period assessed, an additional 11.5 serious injuries total, or 2.3 serious injuries per year, would have been represented in the absence of human intervention. It is also recognized that the reported entanglement totals do not represent all interactions due to incomplete detection of incidents (i.e., unobserved entanglements). There is currently no method available to correct for the number of undetected entanglements (NMFS, 2019a).

The estimated mean annual M/SI from reported vessel strikes over the period from 2013 – 2017 was 2.2 per year. However, Rockwood *et al.* (2017) estimated that 22 humpback whales die annually due to vessel strikes. This indicates a potential reporting rate of about 10% for humpback whale vessel strikes.

Finally, NMFS (2019a) also recognizes habitat concerns, specifically increasing levels of anthropogenic sound, as a concern for humpback whales. Low- and mid-frequency sounds, including those produced by shipping traffic and used in active sonar military exercises, can reduce acoustic space used for communication (i.e., masking). Noise-related injuries are not included in injury determinations as NMFS scientists are unlikely to detect noise-related injuries in live animals and because the available science on identification of noise-related injuries in live marine mammals is still being developed (NMFS, 2012c).

4.4.1.1 Potential Biological Removal

As described in *Section 4.1*, human-caused M/SI is evaluated relative to a PBR level for each marine mammal stock in SARs as directed by the MMPA. By definition, the PBR level is "*the product of the following factors:*

(A) The minimum population estimate of the stock.
(B) One half the maximum theoretical or estimated net productivity rate of the stock at a small population size.
(C) A recovery factor of between 0.1 and 1.0." (16 USC § 1362(2)).

The most recent PBR published for the CA/OR/WA stock of humpback whales in U.S. waters is 16.7 whales per year. This is calculated as the minimum population size (2,784) times one half the estimated population growth rate for the stock (1/2 of 8%) times a recovery factor of 0.3 (for an endangered species; with minimum population estimate >1,500 and coefficient of variation <0.50; Taylor *et al.*, 2003). To get the PBR for U.S. waters, the total value is then divided by two to account for this stock spending approximately half its time outside of the U.S. EEZ.

$$\frac{2784 \times (0.08 \div 2) \times 0.3}{2} = \mathbf{16.7\ whales\ per\ year}$$

From 2013 through 2017, the observed mean annual M/SI due to commercial fishery entanglements, recreational crab fishery entanglements, tribal crab fishery entanglements, non-fishery entanglements, and serious injuries assigned to unidentified whale entanglements, plus observed vessel strikes, was equal to 22.35 whales per year (see Table 4-4). This exceeds the PBR level for this stock in U.S. waters of 16.7 whales per year.

4.4.2 Blue whale

Sources of human-caused mortality and serious injury involving blue whales for the five-year period of 2013 to 2017 include interactions with California commercial Dungeness crab gear, unidentified pot/trap gear, unidentified fishery gear, and vessel strikes. The total M/SI and mean annual M/SI for each source is presented in Table 4-5.

Table 4-5. Summary of observed and estimated incidental mortality and serious injury of blue whales (ENP stock) in the U.S. West Coast EEZ based on 2013 – 2017 data, adapted from NMFS (2019b).

Source	Total 5-year observed + estimated M/SI	Mean annual M/SI
CA commercial Dungeness crab fishery	2.75	0.55
Unidentified pot/trap fishery	2.5	0.5

Unidentified fishery	1.5	0.3
Prorated unidentified whale entanglements	0.46	0.09
Observed vessel strikes[a]	2	0.4
Total mean annual M/SI	**9.21**	**1.84**

[a]Observations of blue whale vessel strikes have been highly variable in previous five-year periods, and estimated rates of detection are consistently low (NMFS, 2019b).

The observed mean annual M/SI due to commercial fishery entanglements is 1.35 animals/year (0.55 M/SI per year from the CA commercial Dungeness crab fishery + 0.5 M/SI per year from unidentified pot/trap fisheries + 0.3 M/SI per year from unidentified fisheries). As demonstrated above for humpback whales, a cross-validated species identification model can be used to adjust for the negative bias that occurs when entanglements with unidentified whales are not assigned to a species (Carretta, 2018). For the period from 2013 through 2017, this method would estimate at least 0.46 additional blue whale serious injuries from 20 unidentified whale entanglement cases, or 0.09 additional blue whale M/SI annually (NMFS, 2019b). This value is included in Table 4-5.

Additionally, total observed M/SI due to commercial fisheries likely represents a negatively-biased accounting of M/SI of blue whales along the U.S. West Coast. For example, during a 28-year observer program, there have been no observations of entangled blue whales in the California swordfish drift gillnet fishery. However, some gillnet mortality may go unobserved when whales swim away with a portion of the net. It is likely that some cases are not detected, and there is currently no method available to correct for the number of undetected (i.e., unobserved) entanglements (NMFS, 2019b).

Finally, as with humpback whales, NMFS (2019b) also recognizes increasing levels of anthropogenic sound, such as that associated with shipping, oil and gas extraction, and military activities, as a concern for blue whales. A variety of significant behavioral responses, including cessation of feeding behavior, have been demonstrated by tagged blue whales exposed to simulated mid-frequency sonar and other mid-frequency sounds (Goldbogen *et al.*, 2013). Noise-related injuries are not included in injury determinations as NMFS scientists are unlikely to detect noise-related injuries in live animals and because the available science on identification of noise-related injuries in live marine mammals is still being developed (NMFS, 2012c).

4.4.2.1 Potential Biological Removal

The most recent PBR published for the ENP stock of blue whales in U.S. waters is 1.23 whales per year. This is calculated as the minimum population size (1,050) times one half the default maximum net growth rate for cetaceans (1/2 of 4%) times a recovery factor of 0.1 (for an endangered species with a minimum abundance <1,500; Taylor *et al.*, 2003) To get the PBR for U.S. waters, the total value is then multiplied by 7/12 to account for this stock spending approximately five months (from about November to March) outside of U.S. waters (based on satellite telemetry data; Hazen *et al.*, 2016).

$$1050 \times (\frac{0.04}{2}) \times 0.1 \times \frac{7}{12} = \mathbf{1.23\ whales\ per\ year}$$

From 2013 through 2017, the observed mean annual M/SI due to commercial fishery entanglements, serious injuries assigned to unidentified whale entanglements, and observed vessel strikes was equal to 1.84 whales per year (see Table 4-5). This exceeds the PBR level for this stock in U.S. waters of 1.23 whales per year.

4.4.3 Leatherback sea turtle

Anthropogenic impacts to leatherback sea turtles are not quantitatively recorded and assessed according to the same M/SI criteria as marine mammals. However, the leatherback sea turtle has been identified by NMFS as among the most at-risk of extinction, and many of the threats facing the species are known. Pacific leatherback sea turtles are at risk from fisheries entanglement or bycatch, direct harvest of eggs and adults, coastal development, pollution and marine debris, disease, and climate change. As with humpback and blue whales, vessel strikes are also a factor affecting leatherbacks (NMFS, 2021c).

Leatherback sea turtles are highly migratory (see *Section 3.2.3*) and a large portion of the aforementioned threats occur outside of U.S. waters and jurisdiction, necessitating regular cooperation and collaboration with domestic and international partners towards recovery and conservation efforts. Along the U.S. West Coast, incidental take in fisheries, particularly in gillnet and pelagic longline fisheries, has been identified as the primary threat facing leatherbacks.

PBR is a marine mammal-specific metric under the MMPA and is, therefore, not required for Pacific leatherback sea turtles; however, the International Union for Conservation of Nature (IUCN) predicts that the western Pacific subpopulation will have declined by 96% and the eastern Pacific subpopulation will have declined by nearly 100% within one generation (i.e., by 2040), if current trends continue (Wallace *et al.*, 2013).

4.5 Anticipated impacts of the taking

Interactions between large whales and fishing gear has been documented as one of the largest contributors to human-caused serious injury and mortality of large whales on the West Coast, including fishing gear that has been definitively linked with the West Coast and Oregon commercial Dungeness crab fisheries (Carretta *et al.*, 2020; Saez *et al.*, 2021).

In order to anticipate the potential impacts of future entanglements of covered species on the species or stock, it is useful to understand the severity of impacts (i.e., rate of M/SI) from recent entanglements involving crab gear and covered species. In July 2020, NMFS provided ODFW, WDFW, and CDFW with draft analysis of M/SI rates from whale entanglements that occurred from 2013 through 2018 (NMFS, 2020e). Due to the relatively low sample size of humpback whale entanglement records involving Oregon crab gear and the lack of records of blue whale entanglement records involving Oregon crab gear, coastwide M/SI rate information will be used to inform this discussion. Key rates provided by this analysis include:

- Overall M/SI rate for all humpback whale entanglements (dead or alive) with Dungeness crab gear: 0.80 M/SI

- Overall M/SI rate for all blue whale entanglements (dead or alive) with Dungeness crab gear: 0.86 M/SI

Assuming that the conditions impacting the rate of M/SI from humpback and blue whale entanglements remain the same (e.g., fishery activity, gear configurations), the M/SI information provided from recent entanglements can be used to describe the impact expected to result from the anticipated levels of take described in *Section 4.2* for these species. Human-caused M/SI is considered in the context of "negligible impact thresholds" (see *Section 4.5.1*) for authorizing take that occurs incidental to commercial fishing under MMPA section 101(a)(5)(E), of marine mammal stocks that are designated as MMPA depleted because of their listing status under the ESA (e.g., CA/OR/WA humpback whales and blue whales). In this section, the negligible impact determination process is used as a tool to illustrate the potential impact of anticipated M/SI incidental to the crab fishery.

Importantly, the rates above are based on the initial injury assessment of each entanglement before any human intervention. In entanglement cases where the entangling gear is partially or fully removed through human intervention, a final injury determination may differ from the initial assessment. In fact, three of the five confirmed entanglements involving Oregon crab gear from 2013 through 2020, for which final injury determinations have been made, were changed from an initial injury determination of serious injury to a final injury determination of non-serious injury due to human intervention (see *Section 4.1.2*). However, the recent procedural directive, *Criteria for Determining Negligible Impact under MMPA Section 101(a)(5)(E),* dictates that NMFS should rely on M/SI determinations assuming that no human intervention occurred, in order to more accurately reflect the actual level of M/SI occurring incidental to commercial fisheries (NMFS, 2020f). For this reason, the same approach is taken in this CP.

4.5.1 Negligible Impact Determination analysis

NID analysis is one component of the decision-making process undertaken by NMFS when determining whether issuance of a Section 101(a)(5)(E) permit can be authorized. It is important to note that, in this section, NID analysis is simply used to illustrate the potential outcomes of the analysis that NMFS will undertake. It is not meant to be determinative.

Negligible impact is not explicitly defined in the MMPA, but a description of its historical interpretation can be found in NMFS (2020f). A regulatory definition for negligible impact used to implement MMPA sections 101(a)(5)(A) and 101(a)(5)(D), which can be used to inform the discussion in this CP, is "*an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival*" (50 CFR § 216.103).

NMFS (2020f) includes a thorough description of the negligible impact determination process and rationale. Briefly, under Section 101(a)(5)(E), there are two thresholds used by NMFS for NID analyses: (1) a Total Negligible Impact Threshold (NIT_t) representing the maximum total amount of human-caused M/SI from all sources that NMFS would consider negligible for a given stock, and (2) a Single Negligible Impact Threshold (NIT_s) representing the amount of M/SI from a single fishery that NMFS would consider negligible for a given stock if the total human-caused M/SI from all sources reported for the stock exceeds NIT_t. Calculations of NIT_t and NIT_s are similar to the PBR and used to represent levels of removal that result in small or undetectable differences to the population dynamics of the stock.

For transboundary stocks with PBR apportioned based on the fraction of time spent in U.S. water, NIT_s analysis is appropriate because the M/SI that occurs outside of U.S. water cannot be known for certain. This applies to both humpback and blue whales which spend a portion of each year outside of U.S. waters.

By definition, NIT_s is the product of the minimum population abundance estimate for the species or stock (N_{min}), one half of the maximum net productivity rate (R_{max}), and a "negligible impact factor" of 0.013 (corresponding to no more than a 1% delay in time to recovery). This simplifies to:

$$\mathrm{NIT_s} = \mathrm{N_{min}} \times 0.0065\mathrm{R_{max}}$$

where N_{min} and R_{max} are equal to the values applied to the calculation of PBR in the most recent SAR for a given stock, or other estimates considered by NMFS to represent the best available science, if available.

4.5.1.1 Humpback whale

The take level proposed in *Section 4.2.1* for humpback whales is up to two whales per year, in any single year, in Oregon crab gear.

For humpback whales, the initial M/SI rate (i.e., before any human intervention) for all entanglements (dead or alive) with Dungeness crab gear was 0.80 whales seriously injured or killed per year, from 2013 through 2018 (NMFS, 2020e). If this M/SI rate is applied to an anticipated entanglement rate of up to two whales per year, it can be estimated that up to 1.6 humpback whales may be seriously injured or killed per year due to anticipated interactions with Oregon crab gear.

According to NMFS (2020f), NID analysis must rely on the best available science. If verified information that is more recent than the information contained in the latest SAR is considered the best available science, then it should be used in NID analysis. For humpback whales, the best available minimum abundance estimate comes from Calambokidis and Barlow (2020) which estimates the minimum abundance of humpback whales to be 4,776 animals. This information has not yet been incorporated into the humpback whale SAR which provides a minimum abundance estimate of 2,784 animals.

For humpback whales, NIT_s is calculated as:

$$\mathrm{NIT_s} = 4776 \times 0.0065 \times 0.08 = \mathbf{2.48\ whales\ per\ year}$$

Therefore, the humpback whale M/SI anticipated to occur as a result of interactions with Oregon crab gear (up to 1.6 whales per year) does not exceed NIT_s (2.48 whales per year) and is expected to be negligible.

4.5.1.2 Blue whale

The take level proposed in *Section 4.2.2* for blue whales is up to one whale every five years, or 0.2 whales per year, in Oregon gear (derived from the West Coast entanglement rate, since there have not been entanglements confirmed in Oregon crab gear to date).

From 2013 through 2018, the overall M/SI rate for all blue whale entanglements (dead or alive) with Dungeness crab gear was 0.86 whales seriously injured or killed per year (NMFS, 2020e). If this rate is applied to an anticipated entanglement rate of up to 0.2 whales per year, it can be estimated that up to 0.17 blue whales may be seriously injured or killed per year due to anticipated interactions with Oregon crab gear.

As with humpback whales, the best available minimum abundance estimate for blue whales comes from Calambokidis and Barlow (2020) which estimates the minimum abundance of blue whales to be 1,767 animals, as opposed to the information in the most recent blue whale SAR which provides a minimum abundance estimate of 1,050 animals.

For blue whales, NIT_s is calculated as:

$$\mathrm{NIT_s} = 1767 \times 0.0065 \times 0.04 = \mathbf{0.46\ whales\ per\ year}$$

Therefore, the blue whale M/SI anticipated to occur as a result of interactions with Oregon crab gear (up to 0.17 whales per year) does not exceed NIT_s (0.46 whales per year) and is expected to be negligible.

4.5.2 Leatherback sea turtle

For leatherback sea turtles, a comparable method does not exist for determining impacts to the species or stock. Therefore, the anticipated impacts of incidental take on the Pacific leatherback subpopulations must be considered qualitatively.

Documented interactions between leatherback sea turtles and Dungeness crab gear are extremely rare along the U.S. West Coast, and leatherback sea turtle entanglement involving Oregon gear has not been documented to date. However, the species is critically endangered and the long-term declining trend in the West Pacific population warrants a precautionary approach. When the magnitude of potential interactions with Oregon crab gear are considered together with the status of West Pacific leatherback sea turtles and all of the other activities and conditions that continue to act on the species (see *Section 4.4.3*), the anticipated impact of *up to* one interaction over a ten-year period is likely to be inconsequential to the recovery or survival of the species.

Section 5 Conservation Program

5.1 Overview

This overview provides a roadmap to the various components of this CP's conservation program and their relationship to one another. The overarching vision, goals, and objectives for this CP are laid out in *Section 5.2*, followed by a detailed description of the specific conservation measures designed to support those goals and objectives in *Section 5.3*.

Specifically, *Section 5.3.1* describes a series of strategic risk reduction measures that aim to reduce the number of vertical line-days (i.e., one vertical line deployed for one day) in the water during the late-season, when covered species are present in higher abundance, in support of Objective 1.1. These include a combined late-season pot limit reduction and depth restriction, elimination of the two-week post-season gear clean-up period, biotoxin management actions taken to prevent a delay in peak harvest effort, and a series of steps taken to increase flexibility in the Tri-State protocol to minimize season opening delays. Several of those measures, in combination with the elimination of the standard replacement tag allowance, will reduce the total number of line-days associated with crab gear throughout the season contributing to achievement of Objective 1.2. Finally, risk reduction measures including the incorporation of a taut line best practice into regulation, and education and outreach efforts within the crab industry to promote best gear practices for minimizing the risk of marine life entanglements, will improve gear configuration and design in support of Objective 1.3.

Section 5.3.2 describes various accountability measures that have been implemented in order to reduce Oregon's contribution to covered species entanglements involving unidentified or unattributed fishing gear, in support of Objective 2.1. These include a requirement for registration of buoy color patterns, a requirement for submission of electronic fish tickets with harvest area information, modifications and coordination to improve the identifiability of buoy tags, a prohibition on the use of other West Coast fishery buoy line markings, and a requirement for an additional late-season tag identifying gear deployed after May 1. Additionally, ODFW plans to recommend adoption of a line marking scheme in the crab fishery which will further support this objective. Fleetwide implementation of electronic monitoring for vessel tracking and electronic logbooks, in addition to the required electronic fish tickets, will improve the timeliness of spatial and temporal harvest data collection in the crab fishery, in support of Objective 2.2. Finally, informational measures that include ongoing collaborative research efforts and support for future efforts to fill critical information gaps will contribute to achievement of Objective 2.3.

In addition to these risk reduction, accountability, and information measures, ODFW has committed to maintaining several CP advisory committees which will periodically assess progress towards achievement of several objectives and provide recommendations in those areas. These committees are described in *Section 6.1.5* and will be convened in support of Objectives 1.3, 1.4, 2.1, and 2.3.

Section 5.4 outlines a monitoring plan for determining progress towards meeting goals and objectives, in addition to collecting baseline information and ensuring compliance with the terms and conditions of this CP. Monitoring of both covered species and the crab fishery will provide data and/or information that will be analyzed with reference to the performance criteria in *Section 5.5* to track progress towards achieving CP objectives.

Section 5.6 details the adaptive management strategy which provides a framework for evaluation and refinement of the overall conservation program, in support of Objective 1.4 and the broader vision of this CP.

Finally, *Section 5.7* outlines the reporting requirements that ODFW will adhere to for the duration of the requested ITP, including the specific information that will be provided to NMFS in order to assess compliance with permit terms and conditions.

The relationship between the goals, objectives, conservation measures, and overarching vision of this CP are depicted in Figure 5-1.

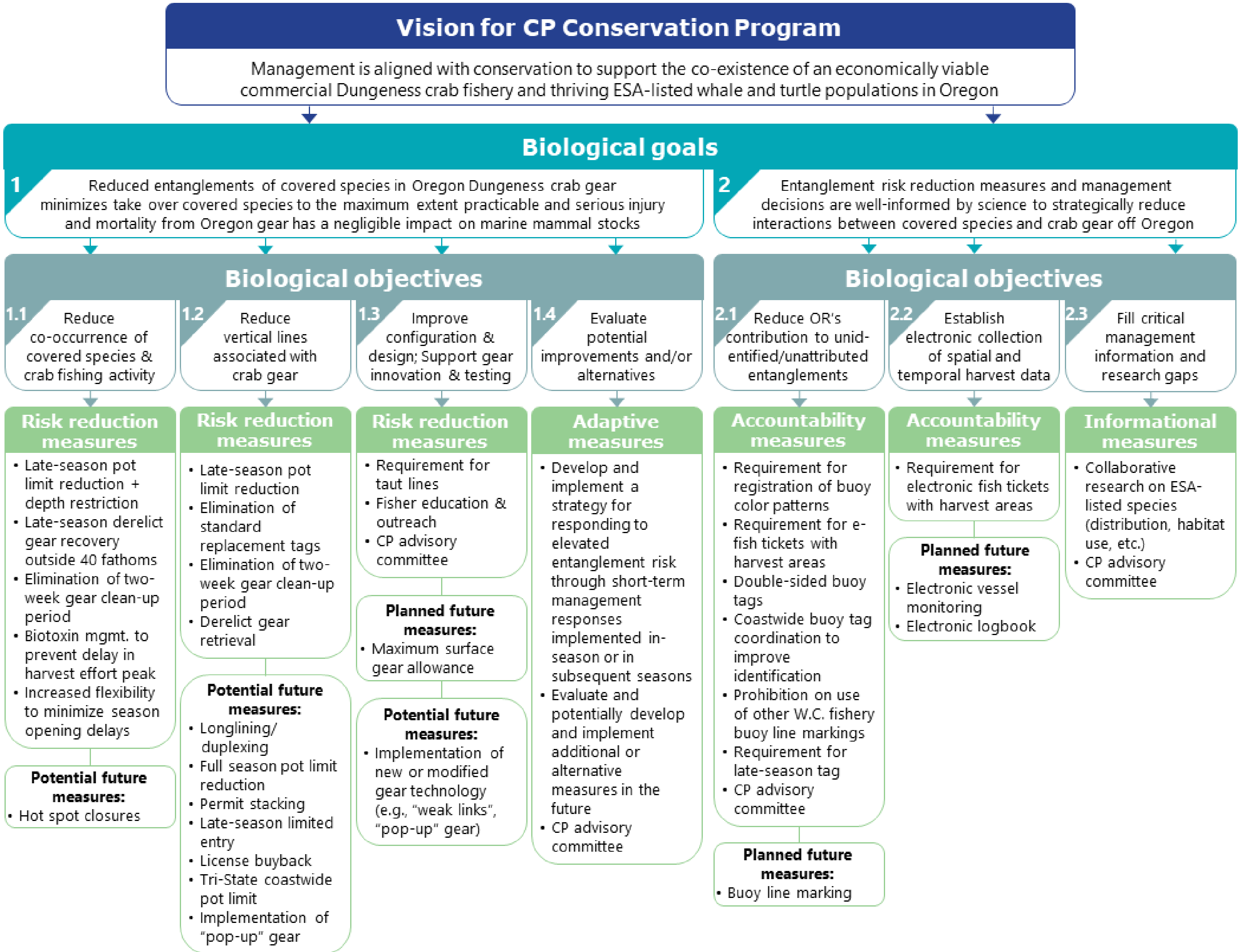

Figure 5-1. Relationship between the CP conservation program's vision, biological goals, biological objectives, and conservation measures implemented in support of each.

5.2 Biological goals and objectives

The overarching vision of the conservation program described in this section is for management that is aligned with conservation to support the co-existence of an economically viable commercial Dungeness crab fishery and thriving ESA-listed whale and turtle populations in Oregon. To this end, biological goals have been developed that broadly describe the desired future conditions to be achieved through implementation of the conservation program. These goals are the foundation of the conservation program, and the various measures and management tools included within.

5.2.1 Goals

The following goals are identified within the context of the crab fishery in support of the conservation of listed whale and turtle species in Oregon:

Goal 1: Reduced entanglements of covered species in Oregon Dungeness crab gear minimizes take of covered species to the maximum extent practicable and serious injury and mortality from Oregon gear has a negligible impact on marine mammal stocks; and

Goal 2: Entanglement risk reduction measures and management decisions are well-informed by science to strategically reduce interactions between covered species and crab gear off Oregon, thereby realizing the conservation benefit to covered species while minimizing impacts to the crab fishery.

5.2.2 Objectives

To achieve the goals of the conservation program, a number of biological objectives have been identified. These will be met with specific steps that will be implemented by ODFW through various conservation measures in support of each goal and the overarching vision of the conservation program. For any objectives that will be measured against baseline levels, baseline levels refer to data collected from 2013 through 2020 (or the 2012-13 through 2019-20 crab seasons) which aligns with the "modern" era of entanglement reporting and documentation, and the time period used to assess the West Coast and Oregon entanglement record in this CP (see *Sections 4.1.1* and *4.1.2*). Specific baseline levels are reported in *Section 5.5*. For several objectives, goal achievement will be measured through the line-days metric, where one line-day is equal to one vertical line actively deployed for one day (also described in *Section 5.4.2.1*). The biological objectives include:

5.2.2.1 Objectives in support of Goal 1

1.1 Reduce co-occurrence of covered species and commercial crab fishing activity in critical whale habitat seasonally by implementing fishery management measures which lessen spatial and temporal overlap between covered species and crab gear, without increased crowding of crab fishing gear elsewhere off Oregon, by:

- **a.** Achieving a 20% reduction in average active vertical line-days fished from May 1 through the end of the crab season, relative to baseline levels, by 2025; and

- **b.** Achieving at least a 50% reduction in average active vertical line-days fished from May 1 through the end of the crab season outside of the 40-fathom management line, relative to baseline levels, by 2025.

1.2 Reduce vertical lines associated with deployment of crab gear off Oregon to minimize take of covered species, by:

- **a.** Achieving a 5% overall reduction in average active vertical line-days fished across the entire season, relative to baseline levels by 2025; and
- **b.** Maintaining fishery management measures that facilitate in-season and post-season derelict gear recovery, evaluating the effectiveness of existing measures at least every five years throughout the permit period, and pursuing regulatory actions to augment recovery provisions for retrieval of derelict gear from Oregon waters.

1.3 Improve gear configuration and design to reduce gear interactions with covered species, support gear innovation and gear testing off Oregon, and implement related gear modifications as they are demonstrated to be feasible for fishery operations and beneficial to covered species conservation off Oregon, by:

- **a.** Conducting outreach to the crab industry to promote best fishing practices to reduce entanglement risk, and incorporating best practices into fishery regulations, when possible, to improve enforceability;
- **b.** Convening and leading a diverse advisory committee to evaluate and recommend gear modifications at least every five years throughout the permit period; and
- **c.** Pursuing regulatory actions to implement feasible recommendations for gear configuration and design improvements.

1.4 Evaluate the overall fishery management measures and potential improvements and/or alternatives (i.e., adaptive management) that are at least as protective of covered species as the existing management measures, to further reduce entanglement risk while supporting ODFW's ability to make targeted decisions that minimize impacts to the crab fishery, by:

- **a.** Convening and leading a diverse advisory committee to evaluate and recommend adaptations to the overall management strategy (including improvements and alternatives) at least every five years throughout the permit period; and
- **b.** Pursuing regulatory actions to implement feasible recommendations for improved, additional, and/or alternative risk reduction management measures.

5.2.2.2 Objectives in support of Goal 2

2.1 Reduce Oregon's contribution to unidentified and/or unattributed entanglement events, by:

- **a.** Requiring specific gear marking strategies (e.g., marks, tags, and/or buoys) in all state-managed fixed gear fisheries by 2020;
- **b.** Convening and leading a diverse advisory committee to evaluate and recommend further gear marking modifications to improve identification of gear

involved in entanglement reports at least every five years throughout the permit period; and

- **c.** Pursuing regulatory actions to implement feasible recommendations for gear marking modifications to improve gear identification.

2.2 Establish electronic data delivery systems for more timely collection of spatially and temporally explicit harvest information to provide for more strategic decision-making and expand potential options for in-season management measures by:

- **a.** Developing, evaluating, and implementing an electronic fish ticket fleetwide requirement in the crab fishery by the 2019-20 crab season;
- **b.** Developing, evaluating, and implementing a vessel monitoring fleetwide requirement in the crab fishery by the 2026-27 crab season; and
- **c.** Developing, evaluating, and implementing a voluntary electronic logbook system in the crab fishery by the 2026-27 crab season, and a fleetwide requirement in the crab fishery by the 2030-31 crab season.

2.3 Fill critical management information and research gaps for Dungeness crab, covered species, fishery gear, and management measures to improve information-based decision-making throughout the permit duration, by:

- **a.** Convening and leading a diverse advisory committee to evaluate and recommend research priorities at least every five years throughout the permit period; and
- **b.** Pursuing funding and research collaborations to fill gaps, as funding allows.

5.3 Conservation measures

This section describes the specific conservation measures (or management actions) that constitute ODFW's conservation program designed to support the goals and objectives listed in *Section 5.2*. These measures were developed through collaboration with many different entities, including the commercial crab industry, Oregon Whale Entanglement Working Group (OWEWG), NMFS, PSMFC, WDFW, CDFW, and various experts (i.e., marine mammal, disentanglement, gear). Conservation measures fall into two broad categories: (1) risk reduction measures which address Goal 1 and its objectives, and (2) informational and accountability measures which address Goal 2 and its objectives.

5.3.1 Risk reduction measures

Risk reduction measures are designed to reduce the likelihood of marine life entanglements in crab gear by minimizing the overlap of covered species and crab gear, reducing the number of vertical lines in the water, and supporting gear practices or configurations that may help to avoid or minimize impacts to covered species. Risk reduction measures include:

1. Late-season pot limit reduction and depth restriction;
2. Elimination of standard replacement tag allowance;
3. Elimination of two-week post-season gear clean-up period;
4. Requirement for taut line best practice;
5. Biotoxin management to prevent delay in peak harvest effort;

6. Increased flexibility to minimize season opening delays;
7. In-season and post-season derelict gear retrieval; and
8. Fisher education and outreach.

The crab fishery is most active during the winter months when nearly all active permit holders are making landings. Through the spring and summer, fishing effort, in terms of both landings and vessels participating, greatly diminishes. The season start date is set through an annual Tri-State management action and, over the baseline period, ranged from December 1 to as late as February 7. Regardless of the specific opening dates within this range, fishery effort starts to significantly decline by April, and continues to decline through the end of the season (August 14), as shown by the number of active permits being utilized in the fishery (Figure 5-2). Despite this annual attrition of effort throughout the season, there has still been an increase in confirmed entanglements of ESA-listed humpback whales in Oregon commercial crab gear in recent years.

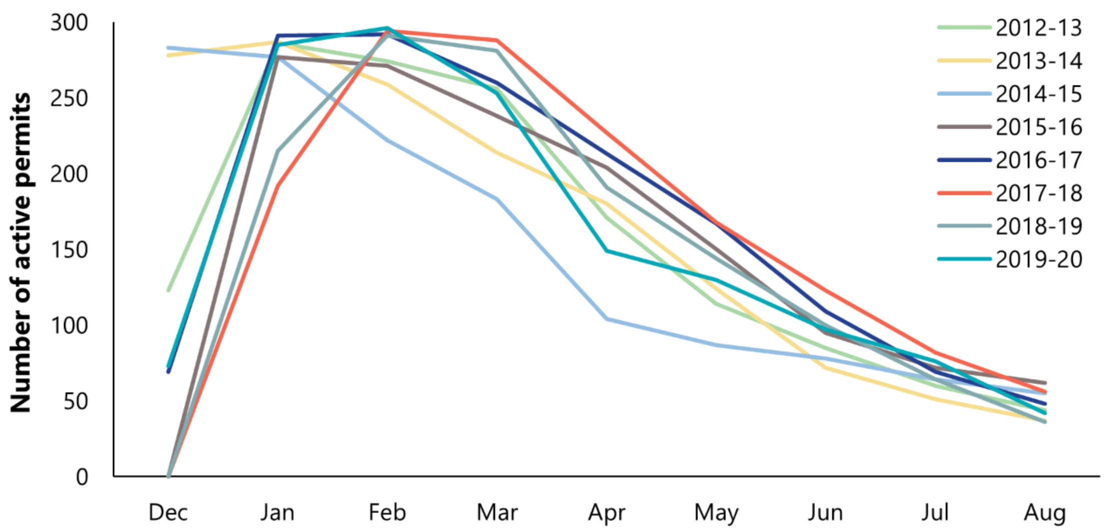

Figure 5-2. Number of monthly active permits utilized in the Oregon Dungeness crab fishery from the 2012-13 through 2019-20 seasons. The season opening date was delayed on some or all of the Oregon coast during all but one season (2014-15 season) due to low meat yield, elevated domoic acid detected in the viscera of crab, or a combination of both. Pounds landed by season ranged from 8.2 million (2014-15 season) to 23.1 million (2017-18 season). Data are from ODFW fish tickets.

The risk reduction measures included herein, are intended to reduce the amount of crab gear (i.e., fishing lines) in the water when and where covered species are feeding in Oregon's coastal and offshore waters. There is currently limited information on the quantitative relationship between co-occurrence of covered species and crab gear, and the resultant entanglement risk. However, the best available information is that every line in the water has the potential to interact with marine life and, thus, poses some level of entanglement risk. Research to evaluate entanglement risk as a product of co-occurrence is ongoing and is using the co-occurrence and entanglement risk relationship as a framework for examining tradeoffs between conservation and fishery goals (e.g., Samhouri *et al.*, in review).

Based on this relationship, vertical line reduction is the most widely implemented means to reduce the risk of entanglements and is central to the recommendations put forth by whale entanglement working groups in multiple states (OWEWG, 2018; WWEWG, 2018). For example, reduction of gear (fishing lines) in fixed gear fisheries has been implemented to address lobster pot gear and North Atlantic right whale entanglements on the U.S. East Coast (NMFS, 2014), and Dungeness crab pot gear and humpback whale entanglements on the U.S. West Coast (ODFW, 2020b; WDFW, 2020).

5.3.1.1 Late-season pot limit reduction and depth restriction

In September 2020, the OFWC adopted rule amendments (OAR 635-005-0405 and 635-005-0460) that reduce each commercial Dungeness crab permit holders' pot limit by 20% (i.e., 200 pot limit to 160 pots, 300 pot limit to 240 pots, and 500 pot limit to 400 pots), in combination with a 40-fathom depth restriction (i.e., gear excluded outside of 40 fathoms), effective May 1 during the 2020-21, 2021-22, and 2022-23 crab seasons (ODFW, 2020b). A required additional late-season buoy tag serves to validate gear deployed from May 1 onward as the enforcement mechanism for these measures (see *Section 5.3.2.5*).

Each component of this set of measures is described below along with the rationale for the specific management design.

May 1 implementation date

The pot limit reduction and depth restriction are being implemented in May of each year to decrease the co-occurrence of crab gear and whales in Oregon based on the estimated timing of the humpback whale feeding migration to Oregon waters and timing of observed humpback whale entanglements involving Oregon crab gear.

Humpback whale feeding aggregations are widely known to be off Oregon in highest abundance during the spring, summer and fall months (Bettridge, 2015; NMFS, 2020c). Preliminary data from collaborative aerial whale surveys that have taken place off Oregon from February 2019 through May 2021 (see *Section 5.3.2.6*) include at least one humpback observation during every month of the year except January, with peak occurrence in early-mid August and 80% of individuals observed between May and November. These preliminary results do not fully account for survey effort and conditions and so caution should be exercised when interpreting the data. However, these general trends suggest that a gear reduction beginning on May 1 reduces the amount of gear during the months that humpback whales are likely present in greater abundance off Oregon.

Although these management measures are primarily designed to reduce co-occurrence with humpback whales, they will also reduce the likelihood of interactions with other covered species. Preliminary aerial survey data include at least one observation of blue whales off Oregon during every month of the year except for December, with peak occurrence in early-mid September (when the crab fishery is closed) and 80% of individuals observed between July and November. Similarly, leatherback seas turtles have been documented foraging off Oregon during the summer and fall months (Benson *et al.*, 2011). The May 1 reduction will also reduce the amount of gear used during peak months of blue whale and leatherback sea turtle abundance in Oregon.

Secondly, with active gear in Oregon deployed through August, a May 1 reduction reduces gear during four months (May through August) when over 60% of the confirmed humpback whale entanglements (n=35) involving commercial Dungeness crab gear have been reported coastwide (Figure 5-3). Though the sample size is limited, a May 1 reduction also coincides with the timing of the three blue whale entanglements that have been reported involving California crab gear (two in June, one in July). There has only been a single leatherback sea turtle entanglement involved West Coast Dungeness crab gear, so temporal patterns of entanglements reports cannot be assessed.

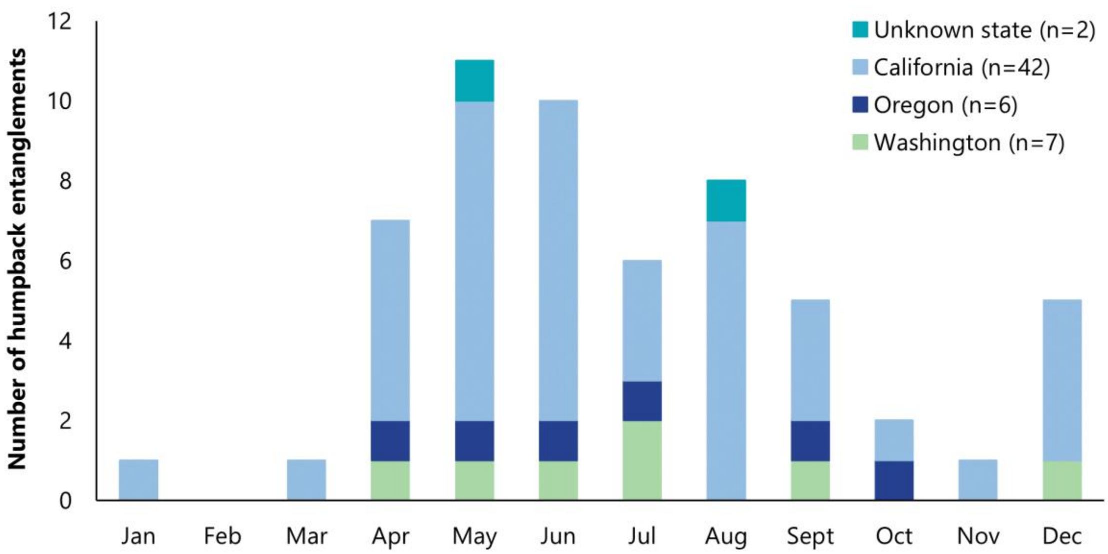

Figure 5-3. Confirmed monthly reports of entangled humpback whales in commercial Dungeness crab gear from California, Oregon, and Washington from 2013–2020. In the legend, "n" represents the total number of humpback whales confirmed entangled by state. Washington entanglements include whales in state and tribal commercial crab gear. Data provided by NMFS WCR, April 2021.

40-fathom depth restriction

A 40-fathom depth restriction beginning May 1 is intended to move gear out of deeper waters where humpback whales have typically been observed off Oregon, and exclude crabbing in the majority of designated humpback whale critical habitat (inshore boundary at 27.3 fathoms; NMFS, 2020c). This measure specifically prohibits gear being placed seaward of the 40-fathom depth contour (defined by latitude and longitude) as defined in 50 CFR § 660.71.

The precise depth where fishing gear was originally set is not known for the majority of historical West Coast entanglement cases. Of the six humpback whales confirmed entangled in Oregon crab gear from 2013 through 2020, two are believed to have involved gear originally set at less than 40 fathoms (in 2014 and 2015), and two involved gear originally set at greater than 40 fathoms (in 2019 and 2020). The gear set depth for the humpback whales entangled in Oregon crab gear in 2015 (involving derelict gear) and 2018 is unknown. Finally, the gear involved in the gray whale entangled in Oregon crab gear in 2018 was believed to have been originally set at either 36 or 41 fathoms.

Collaborative aerial and vessel-based survey off Oregon from February 2019 through May 2021 (see *Section 5.3.2.6*) have covered waters from zero to around 1,900 fathoms, with the majority (80%) of effort concentrated in waters 16 to 424 fathoms deep. Overall, 30% of the survey effort covered waters less than 40 fathoms. Surveys have observed humpback whales, on average, in 112 fathom deep waters (total range = 15-1,664 fathoms), with only 8% of individuals observed at less than 40 fathoms. Although this management measure is primarily designed to reduce co-occurrence with humpback whales, surveys have also observed blue whales, on average, in 66 fathom deep waters (total range = 28-482 fathoms), with 22% of individuals observed at less than 40 fathoms. Data described here are preliminary and do not fully account for survey effort and conditions, but generally indicate that a depth restriction, prohibiting gear outside of 40 fathoms, is likely to move gear out of the areas where both humpback and blue whales are most commonly observed.

The depth restriction also allows for any gear outside 40 fathoms after May 1 to be retrieved as derelict by any commercial fishing vessel.

20% pot limit reduction

The pot limit reduction is intended to reduce lines in the water, thereby reducing co-occurrence of entangling gear and covered species. Combining the pot limit reduction with the depth exclusion is also designed to mitigate potential fishery ground crowding or impacts to other marine life nearshore (e.g., gray whales) that might otherwise occur due to effort shift.

Analysis of reported fishing depth from logbooks revealed that the amount of fishing effort (pot-pulls) deeper than 40 fathoms in May has ranged from 3.7% to 9.6% in recent seasons (2013-14 through 2018-19), with the amount of gear fished in deeper water declining slightly through the end of the season (Figure 5-4). Therefore, the magnitude of the pot limit reduction is designed to avoid concentrating the gear which is typically set in deeper water during the late season, shoreward of the exclusion area.

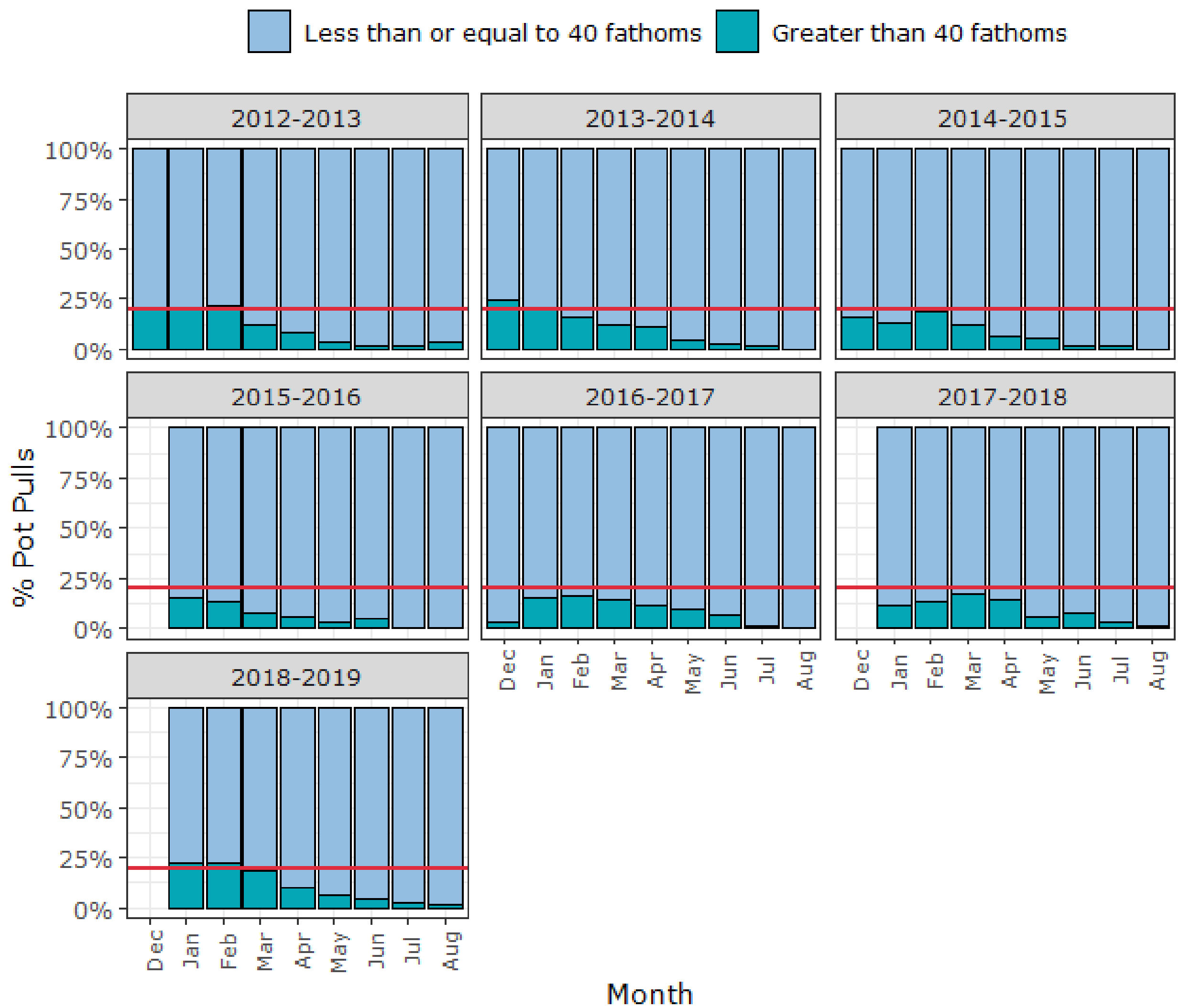

Figure 5-4. Monthly percentage of Oregon crab fishery effort (crab pot-pulls) inside and outside of 40 fathoms from the 2012-13 through 2018-19 seasons. The 20% pot limit reduction reduces pots by more than the average amount fished outside of 40 fathoms in the late-season during the baseline period (see red line representing 20% of pot-pulls for reference). This should eliminate potential increases in effort (fishing line density) in the open area brought about by the depth restriction. Data are summarized from ODFW commercial crab logbooks and represent percentages of pot-pulls.

Three-year sunset provision

These management measures include a three-year sunset date after which the set of rules will be vacated unless the OFWC elects to extend or modify them. During the sunset period, ODFW will evaluate the conservation benefit (i.e., reduction in gear to lessen co-occurrence of gear and whales) and economic impacts of each component. The sunset provision addresses industry concerns about permanent rulemaking with a high degree of uncertainty about potential fishery impacts and conservation effectiveness. At the September 2020 rulemaking meeting, the OFWC stated their intent that ODFW evaluate the effectiveness of these measures and provide recommendations to the OFWC that will provide equal and/or more conservation benefit to covered species as the original measures, prior to the expiration of the rules.

5.3.1.2 Elimination of standard replacement tag allowance

In September 2020, the OFWC adopted a rule amendment (OAR 635-005-0480) that eliminated the allowance for crab fishery permit holders to apply for standard replacement tags for up to 10% of their pot-tier limit, after the first 30 days of the season (ODFW, 2020b).

Since the implementation of pot limits in 2006, crab fishery permit holders were able to utilize provisions under OAR 635-005-0480 to apply for replacement of up to 10% of the tags initially issued, after the first 30 days of the season, to accommodate pot loss due to normal fishing conditions (e.g., cut-off gear, kelp, large swells, strong currents, etc.). From 2013 through 2020, an average of nearly 3,000 replacement tags (representing 27%, on average, of the maximum total allowable replacement tags that could have been issued) were issued each season, with the majority issued from January through March. Elimination of the standard replacement tag allowance removed permit holders' ability to obtain any replacement tags, except for loss due to extraordinary events (defined in OAR 635-005-0480) or catastrophic loss (defined in OAR 635-005-0240). From 2013 through 2020, there were only five instances where replacement tags (n=794 total) were issued due to catastrophic loss or extraordinary events, so the contribution of these remaining replacement tag issuance pathways to the overall number of vertical lines deployed off Oregon in the future is expected to be very low.

This measure reduces the risk of whale entanglement by reducing the amount of gear allowed to be deployed each crab season. This measure may also reduce derelict gear by increasing the incentive for participants to service, maintain, and avoid losing gear. Since replacement tags have historically been issued as early as one month after the start of the season, the risk reduction provided by this measure will also be realized earlier in the season compared to some other measures. An analysis of active line-days reduced by this measure indicates that, on average, the highest reduction will occur in March, but reductions will continue throughout the remainder of the season (See *Section 5.4.2.1*; Table 5-2).

5.3.1.3 Elimination of two-week post-season gear clean-up period

In September 2020, the OFWC adopted a rule amendment (OAR 635-005-0485) that eliminated the post-season gear clean-up period which historically allowed crabbers to leave unbaited gear with open release mechanisms in the water for up to 14 days following the closure of the ocean commercial season each year on August 14 (ODFW, 2020b). This provision was eliminated during the 2018-19 and 2019-20 crab seasons by temporary rule as an entanglement risk reduction measure.

Many crab vessels do not have the onboard capacity to remove all of their pots in a single trip. The clean-up period allowed vessels to make landings all the way to the end of the season, "store" their unbaited and opened pots in the ocean, and to use up to 14 days to remove remaining gear after the season ended. This measure disproportionately affects operators of smaller vessels, therefore, to mitigate the economic impacts, this measure includes a provision allowing another crab-permitted vessel to assist in the removal of gear during the last two weeks of the season under a one-time retrieval waiver issued by ODFW.

In conjunction with this measure, the OFWC also adopted a rule amendment (635-005-0490) that changed the starting date for allowing unlimited retrieval of derelict gear from August 31 to August 15 to coincide with the new date that any non-derelict gear must be removed from the water.

Elimination of this provision essentially reduces total line-days (i.e., provides a conservation benefit by reducing gear and potential co-occurrence) for the entire month of August, since late-season crabbers will have to begin removing gear from the ocean earlier (by up to two weeks) than they may have in years past (see *Section 5.4.2.1*).

5.3.1.4 Requirement for taut line best practice

In September 2020, the OFWC adopted a rule amendment (OAR 635-005-0485) that provides a regulatory approach for implementing one of the crab fishing best practices (OWEWG, 2018) to deploy gear in a fashion to maintain "taut lines". This practice is intended to minimize excess scope of fishing line in the water column that can occur when fishery participants move gear from deeper water (requiring lengthy scope) into shallower water and forgo efforts to shorten line before redeployment of gear (ODFW, 2020b). This measure was implemented by temporary rule for the end of the 2019-20 season (effective July 1, 2020).

ODFW does not consider irresponsible gear deployment to be a widespread practice within the fishery; however, this measure provides a regulatory expectation that fishery participants are accountable for responsible deployment of gear. The regulation is designed to maintain flexibility for the variety of ways that crab gear can be responsibly deployed, while ensuring that gross violations will be enforceable by OSP. For example, when crab gear is moved from deeper to shallower waters without shortening the line to account for the change in depth (an occurrence that has been observed and reported by other crabbers), it would likely be obvious that much more line is being used than necessary to account for tides, currents, and weather, and OSP will be able to take enforcement action.

5.3.1.5 Biotoxin management to prevent delay in peak harvest effort

In 2017, Oregon implemented regulations to allow commercial evisceration of crab when biotoxin accumulation warrants it and when management and industry confirm a benefit to employing this tool. After two seasons of implementing management measures in response to multiple events, a rule was adopted by the OFWC in 2019 to reduce the administrative burden of promulgating temporary rules for each event, by implementing auto-adoption of in-season crab fishery harvest restrictions (evisceration or closure) in each harvest area based on test results (OAR 635-005-0466).

These regulations allow ODFW to implement management decisions more efficiently, allow industry to respond quickly to management decisions, and continue to strengthen the protection of public health while minimizing fishery disruptions and economic impacts. The ability to start the season more reliably and avoid in-season disruptions also serves to prevent delays in peak harvest effort, which is anticipated to reduce the likelihood of interactions between covered species and crab gear later in the season. This will help to avoid situations like the one that occurred during the 2015-16 crab season in California when the central management area was delayed until late March and the northern management area did not open until late May due to elevated levels of domoic acid. Because peak harvest occurs shortly after season opening, the season delay resulted in peak harvest occurring during April, May, and June (CDFW, 2020), which coincided with the arrival of large whales off the California coast and the compression of whale foraging habitat brought on by restricted upwelling during the prevailing large marine heatwave (Santora *et al.*, 2020). This convergence of events caused increased co-occurrence of whales and fishing activity in nearshore areas and likely contributed to the record number of entanglements in California commercial crab gear in 2016 (see Figure 4-2).

5.3.1.6 Increased flexibility to minimize season opening delays

Discussions at the 2019 and 2020 Tri-State meetings centered on building more flexibility into the crab season opening protocols and coordination of whale entanglement risk reduction measures. As a result, two modifications to the Tri-State protocol (see *Section 2.2.4.1*) were agreed upon (one each in 2019 and 2020) that allow more flexibility with season opening dates and areas within the Tri-State region, as described below. These modifications were subsequently adopted into rule, by reference, by the OFWC (OAR 635-004-0465).

Ability to establish more than two areas with different opening dates

In September 2019, the OFWC incorporated into rule a modification to the Tri-State protocol that allows establishment of more than two separate area openings when low meat yield test results indicate that a portion of the Tri-State region does not have marketable crab but other areas do (ODFW, 2019a). Presumably, this ability will lead to earlier openings in smaller areas where crab quality has met criteria.

Areas are not delineated in the Tri-State protocol but are decided upon during the season opening decision process conducted collaboratively with industry and the other West Coast states. Quality criteria must be met at all sampling sites across an area to open. Previous iterations of the Tri-State protocol allowed only two separate area openings. The flexibility to strategically open discrete areas for harvest provided by this modification supplies a management tool for adapting to biotoxin and whale entanglement issues.

A second modification to the Tri-State protocol was concurrently incorporated into rule by the OFWC which extends the latest date for opening to February 1 for years when meat yield is still less than 23%. Prior to this change, the latest date for opening the fishery was January 15, and only when the meat yield was low (criteria defined in the protocol). This modification was designed to provide flexibility, but is not directly related to whale entanglement risk reduction. However, it is important to note that it includes specific language which only permits a delay until February 1 if there are no other concerns from managers or industry, such as elevated risk of whale entanglements or biotoxin events. This process is generally described in the Tri-State protocol with flexibility to allow Tri-State managers to determine a course of action based on the best available information at the time.

Reduction of meat yield criteria for season opening south of Cascade Head

In September 2020, the OFWC incorporated into rule another modification to the Tri-State Protocol that reduced the crab meat yield criteria south of Cascade Head from 25% (rounding allowed) to 24% (no rounding) (ODFW, 2020b).

As with the ability to establish more than two season opening areas, this change increases flexibility in the season opening protocol so that some areas may open earlier. Since the number of permits (and associated pots) declines over the season (Figure 5-2), an earlier season opening will lead to an earlier peak in pot usage, and therefore a decreased level of pots in the water in later months, when risk of covered species entanglements is higher.

5.3.1.7 In-season and post-season derelict gear retrieval

For over ten years, processes for in-season and post-season derelict gear retrieval have been established and refined in the crab fishery. Collectively, in-season and post-season derelict gear recovery efforts help to address several pressing issues such as gear conflicts, navigation hazards, and impacts to other species including ghost fishing and marine life entanglements. *Section 2.2.9* provides a complete description of the crab fishery management approach for addressing derelict gear.

In April 2012, the OFWC adopted a rule amendment (OAR 635-005-0055) to allow retention of crab from derelict gear recovered during the crab season by crab permitted vessels (ODFW, 2012b). This measure was implemented, in part, to incentivize recovery of derelict gear to reduce marine life entanglements. This was followed in August 2014, by new and amended rules (OAR 635-005-0491, 635-005-0480, and 635-005-0485) implementing the permitted post-season derelict gear recovery program (pursuant to HB 3262) (see *Section 2.2.9.3* for details). The justification for the program at that time included reducing the chances of marine mammal entanglements, in addition to reducing gear conflicts and navigation hazards (ODFW, 2014d),

ODFW is committed to maintaining these measures and others that facilitate in-season and post-season derelict gear recovery, while continuing to evaluate the effectiveness of existing measures and augment regulations where improvements can be made.

5.3.1.8 Fisher education and outreach

ODFW has been working since 2015 to engage with the crab industry and other stakeholders on the issue of marine life entanglement and efforts to reduce the crab fishery's potential impact on covered species. In addition to the formal outreach methods described below, ODFW staff have answered numerous calls, emails, and had in-person communications regarding various aspects of the state's entanglement management strategy, and have regularly attended Oregon Dungeness Crab Commission meetings to provide updates. ODFW also maintains a whale entanglement webpage with up-to-date information and relevant materials related to entanglement risk reduction.

Industry and advisory committee meetings

ODFW works with the Oregon Dungeness Crab Advisory Committee (ODCAC), a standing industry advisory body, to foster input on commercial crab management decisions. The group is comprised of a diverse group of harvesters and processors from all of the major crabbing ports in Oregon (see *Section 6.1.3*). In October 2019, this group was augmented to include members of the ODCC, crab associations, and industry members from the OWEWG to further advise ODFW on regulatory proposals to mitigate whale entanglements in crab gear. ODFW has consulted the ODCAC to continue to develop and solicit input on management measures, and has utilized this group to convey information to the broader crab industry. Meeting materials, summaries, and a current membership list are available on the ODFW whale entanglement webpage.

Since 2018, ODFW has hosted a series of commercial crab industry public meetings in October of each year, to discuss and gather input on key issues. At each of these meetings whale entanglement risk reduction has been a key topic. In addition to presentations and discussion on ODFWs response to the issue, NMFS whale entanglement experts and whale distribution study collaborators have also participated in sharing information at these meetings. Meeting materials are available on the ODFW whale entanglement webpage.

News and publications

Prior to the start of the 2017-18 crab season, the OWEWG (of which ODFW is a member) developed the first iteration of the Oregon Commercial Dungeness Crab Fishing Directive to Minimize Whale Entanglement Risk (hereafter referred to as the 'Best Practices Directive'), with additional updates made prior to the 2018-19 season (OWEWG, 2018). This Best Practices Directive has been widely distributed through the ODFW website, industry mailings, and in-person in recent seasons during hold inspections that occur just prior to the season opening.

Since 2007, ODFW has produced an annual newsletter for the commercial crab industry to share current information about the fishery, ongoing monitoring and research efforts, upcoming management changes, and current issues. In recent years, whale entanglement has been prominently featured to raise awareness within the industry and encourage input about ODFW's management strategy. Additionally, ODFW has mailed multiple industry notices to all commercial crab permit holders and crab buyers providing updates and information on whale entanglement mitigation efforts and processes. All past commercial crab newsletters and industry notices can be found on ODFW's commercial crab webpage.

Finally, a Frequently Asked Questions document was created by ODFW in February 2020 addressing a wide range of questions related to whale entanglement and assessment, conservation planning, and potential management options for the Oregon crab fishery.

Real-time reporting of whale aggregations

During spring and summer of 2020, ODFW utilized preliminary information from collaborative whale surveys off Oregon (see *Section 5.3.2.6*) to provide real-time reports of whale aggregations to industry members, along with voluntary requests that crabbers work to move gear into shallower water to reduce the likelihood of interactions with whales. This information was shared by ODFW with members of the ODCAC and by the ODCC with their list serves. ODFW plans to continue these real-time communications with the fleet while surveys are occurring in Oregon waters and investigate methods to efficiently broaden these outreach efforts. ODFW will also consider communicating relevant information on whale presence potential from other near-real-time data streams (e.g., WhaleWatch blue whale habitat suitability predictions) based on availability and applicability to the industry.

5.3.2 Informational and accountability measures

Accountability measures are intended to improve identification of entangling gear (as well as rule out cases when gear cannot be from the crab fishery) and help facilitate closer to real-time management of the fishery, while informational measures aim to fill critical information gaps. Informational and accountability measures include:

1. Requirement for registration of buoy color patterns;
2. Requirement for electronic fish tickets with harvest area designation for all commercial crab landings;
3. Buoy tag modification/coordination for improved identification;
4. Prohibition on the use of other West Coast fishery buoy line markings;
5. Requirement for additional late-season tag; and
6. Collaborative research to fill information gaps.

Additional accountability measures have been adopted in OARs by the OFWC in other fisheries to address marine life entanglement involving gear that cannot be attributed to a specific fishery origin. These include marking requirements for all commercial fixed gear buoys used in Oregon and on recreational crab buoys (effective January 1, 2020). These additional accountability measures will improve the ability to attribute entangling gear to each fishery to inform mitigation strategies.

5.3.2.1 Requirement for registration of buoy color patterns

In September 2019, the OFWC adopted a rule amendment (OAR 635-005-0480) that requires all commercial ocean and Columbia River crab buoy patterns to be registered with ODFW (effective at the start of the 2019-20 season), in addition to the existing requirement for registration of buoy brand numbers (ODFW, 2019a).

Vessels are required to use at least one buoy with the registered buoy color pattern on each piece of crab gear (pot or ring), which is standard industry practice. Registration involves submission of an electronic or printed photo of the buoy color pattern(s), with re-registration only required if the vessel changes buoy color patterns.

A NMFS review of entanglement records from 2013 to 2019, demonstrated that only 6% (n=4) of the 70 entanglements attributed to commercial Dungeness crab gear were identified as such without the presence of a buoy tag. This indicates that buoy tags have historically been the primary tool for identifying entanglements that involve the crab fishery. Over the same time period, buoys were reported or documented to be present in 60% (n=75) of confirmed entanglements that were not able to be identified to a specific fishery (NMFS, 2020g). Registration of buoy color patterns is intended to provide an additional identification tool for crab gear involved in marine life entanglements where buoy tags are lost, not visible, or not attributable.

5.3.2.2 Requirement for electronic fish tickets with harvest area designation for all commercial crab landings

In September 2019, the OFWC also adopted rule amendments (OAR 635-006-0001, 635-006-0210, and 635-006-0213) that require wholesale fish dealers and limited fish sellers to use electronic fish tickets (see *Section 2.2.7.1*) for all crab landings and submit entries by the end of the next business day after a landing is made (effective December 1, 2019) (ODFW, 2019a). The rules also require dealers to designate harvest area on the electronic fish tickets (see Figure 2-4 for harvest area map). Prior to implementation of these rules, both paper and electronic tickets were accepted for crab landings, required to be submitted within five working days, and a single harvest area coding represented the entire coast of Oregon and the Columbia River.

This measure is a useful monitoring tool for spatial management needs, including seafood market traceability (biotoxin management) and entanglement risk reduction. For biotoxins, it allows for improved efficiency and effectiveness of, and compliance with, recalls, embargoes, closures, and/or evisceration orders implemented due to biotoxin events by making near real-time data on harvest location for each fishing vessel and fish dealer available in a centralized ODFW database (also see *Section 5.3.1.5*). For entanglement risk reduction, it allows for near-real time harvest information on the spatiotemporal fishery footprint, though at a coarse scale. This could be used in the future to help inform co-occurrence of marine life with fishery activity for the purpose of potentially employing in-season spatial management responses if there is reason to believe that entanglement risk is elevated.

5.3.2.3 Buoy tag modification/coordination for improved identification

Each crab ring or pot used to commercially harvest crab is required to have a buoy tag attached to the main buoy (closest to the gear) identifying the owner or vessel from which it is operated (OAR 635-005-0480; Figure 2-2). Several recent non-regulatory changes have been made to modify the buoy tags used by the Oregon crab fishery and coordinate buoy tags between states to improve the likelihood that buoy tag information is useful in identifying entangling gear.

Beginning with the 2019-20 season, ODFW began issuing buoy tags with identifying information included on both sides of the tag to improve visibility of buoy tag information and aid identification of entangling gear. Prior to the 2019-20 season, buoy tags were single-sided which allowed for a potential situation where a buoy tag was flipped over so that information was not visible in photographs or videos taken during entanglement reporting or response.

From 2013 through 2019, 66 of the 70 whale entanglements attributed to commercial Dungeness crab gear were identified with a buoy tag. However, 20 of those cases may have involved identifying the tag only by the shape and/or color, rather than by tag/buoy number (NMFS, 2020g). This is in line with a 2018 review of forensic data collected from examining photographs and gear removed from 51 entangled whales, which determined that double-sided printing of buoy tags may have been helpful in identifying individual gear owners in 31% (n=16) of cases (PSMFC, 2018). Continued use of double-sided buoy tags is expected to increase the likelihood that buoy tag information is visible and useful in identifying gear so that it may be attributed to a specific fishery, and so that contact may be made with the gear owners in order to learn more about the gear configuration, set location, timing, etc.

Additionally, ODFW began issuing all primary buoy tags in a single color as opposed to using a pot-tier based color scheme (i.e., three separate colors) beginning with the 2020-21 season. This is intended to reduce similarities in color with other states and improve the likelihood that entangling gear can be either positively or negatively attributed to the Oregon crab fishery. Replacement buoy tags issued due to extraordinary events or catastrophic loss will remain a separate color to distinguish from primary buoy tags (see Figure 2-2).

Similarly, prior to the start of the 2020-21 season, ODFW worked with WDFW to ensure that distinctly different buoy tag shapes are being used by each state. This coordination resulted in Washington's Puget Sound commercial crab fishery switching to the use of an oval-shaped buoy tag, which is more easily distinguishable from the "house"-shaped buoy tag used by the Oregon crab fishery.

5.3.2.4 Prohibition on the use of other West Coast fishery buoy line markings

In September 2020, the OFWC adopted a rule amendment (OAR 635-005-0480) that prohibits use of buoy lines with markings that are required in another West Coast fishery (ODFW, 2020b).

As described in *Section 4.1.1*, each observed entangled whale is carefully documented, evaluated, and analyzed to glean information on the activity and geographic origin of the entangling gear. Despite this effort, over 50% of the confirmed entanglements in putative fishing gear that has been observed and/or recovered in recent years from West Coast whale entanglements has not been attributable to a specific fishery and/or state of origin (see Figure 4-1).

Accurate fishery and state of origin information is critical for designing targeted management measures that create effective change in fishing practices to protect covered species. One way to potentially improve accuracy of attribution rates is to require lines, not just buoys, to be marked in a way that identifies the specific fishery and/or state that it was used in. From 2013 to 2019, entanglement records indicate that lines without buoys were reported or documented to be present in 31% (n=39) of the 125 confirmed entanglements that were ultimately not able to be identified to a specific fishery (NMFS, 2020g). Marked line could be helpful when entanglements are observed with only a line and no buoys, tags, or pots to identify the source fishery, or if information from buoys or tags is inconclusive.

In January 2020, WDFW adopted a buoy line marking requirement for their coastal Dungeness crab fishery, effective at the start of the 2020-21 crab season. This was the first buoy line marking requirement for a fixed gear fishery on the West Coast. The WDFW regulation requires a red mark (12-inch minimum) at each end of buoy lines within one fathom of the main buoy and the crab pot. Oregon's prohibition on the use of buoy lines with marking that are required in another West Coast fishery provides a reciprocal regulation which is important for enhancing coordination of buoy line requirements across the West Coast and increasing the probability of accurate identification of any Washington gear (and other fisheries if they require line marking in the future) involved in future entanglement events. It also directly addresses the NMFS WCR PRD's recommended future work to prioritize expansion of fishery gear marking initiatives to be able to accurately identify the origins of entanglements (Saez *et al.*, 2021).

Section 5.3.3.2 describes ODFW's plan to continue working with industry, NMFS, and the other West Coast states to develop a detailed and coordinated strategy necessary to implement a meaningful line marking scheme in the Oregon crab fishery by the 2025-26 season.

5.3.2.5 Requirement for additional late-season tag

In September 2020, the OFWC adopted rule amendments (OAR 635-005-0480) that require crabbers that fish after May 1 each crab season to affix an additional late-season tag to each pot, along with the primary season tag which is already required.

The late-season tag will serve as the enforcement mechanism to implement the reduced pot limit (see *Section 5.3.1.1*) for each permit holder (i.e., only the reduced number of late-season tags will be available for purchase from ODFW by each permit holder). Lack of a late-season tag will also identify derelict gear from earlier in the season, and all gear without a late-season tag after May 1 will be allowed to be retrieved as derelict gear by any commercial fishing vessel. The presence or absence of late-season tags on entangling gear will provide additional information on the timing of future entanglements involving Oregon crab gear. In support of this accountability goal, late-season tags may not be deployed until two weeks prior to May 1.

5.3.2.6 Collaborative research to fill information gaps

In 2019, a collaborative research project was initiated between ODFW, Oregon State University (OSU), Cascadia Research Collective, and the U.S. Coast Guard. The ongoing project is jointly funded by the ODCC and a Section 6 Species Recovery grant under the ESA. Whale presence and absence data are being collected from monthly aerial surveys along standardized track lines to inform predictive distribution models describing species distributions relative to environmental conditions. Additionally, vessel-based photo-id and tissue sampling is being conducted to provide information on whale population structure. All data collected belong to the Geospatial Ecology of Marine Megafauna lab at OSU's Marine Mammal Institute, with broad rights to use and distribute provided to ODFW.

At the time of writing, the aerial surveys conducted through this research are funded through June 2021, with the full project (including model development) funded through June 2022, and the possibility for one additional year of model development covered through a no-cost grant extension due to COVID-19 impacts. ODFW is interested in seeking funding to conduct further observational surveys and has committed funding for one additional year (July 2021 through June 2022).

Preliminary results from this project are described throughout this CP, including in the context of covered species occurrence off Oregon (*Sections 3.2.1.5* and *3.2.2.5*), rationale for risk reduction measures (*Section 5.3.1.1*), and potential short-term adaptive management responses (*Section 5.6.1.3*). ODFW plans for utilizing the outcomes of this project for baseline and effectiveness monitoring are described in *Sections 5.4.1* and *5.4.2*, respectively.

The impetus for this project was a significant information gap identified early on by the OWEWG, which was convened in 2017. The OWEWG found that knowledge of seasonal whale distribution in Oregon waters is lacking and must be addressed to better understand the spatial and temporal patterns of whale entanglement risk in Oregon. By combining improved data on whale distribution with relatively high-resolution data on fishery effort from ODFW fishery logbooks, maps of entanglement risk can be developed and used to guide more targeted spatiotemporal management. This project represents one major effort by ODFW and various partners to address existing information gaps related to co-occurrence between whales and crab gear.

Moving forward, ODFW has committed to supporting collaborative research and opportunities for information gathering by convening and leading an advisory committee to evaluate and recommend research priorities at least every five years throughout the permit period (see Objective 2.3b and *Section 6.1.5* for implementation details). Working with this group, ODFW will maintain a list of research priorities which will be provided to NMFS during five-year progresses reports, along with a qualitative description of progress made towards filling critical information gaps (see *Section 5.7*).

5.3.3 Planned future measures

In addition to the risk reduction and accountability measures implemented in the crab fishery to date, ODFW is planning to recommend implementation of three additional measures (or packages of measures) in the crab fishery in the near future.

5.3.3.1 Maximum surface gear allowance

A maximum surface gear allowance is currently planned for implementation in the crab fishery. This regulation will restrict the amount of surface gear (i.e., buoys and lines used to mark and retrieve pots) permitted to be used by crab fishery participants on each pot, in order to reduce entanglement risk. Although a forensic understanding of the factors that lead to an animal becoming entangled is limited, it is generally accepted that slack line between buoys, knots, and splices where lines are joined are all places where an animal is more likely to become entangled.

By regulating the amount of surface gear, the number of entanglement points that a whale or sea turtle might encounter are reduced.

Potential impacts to the fishery from a maximum surface gear allowance include reduced visibility or retrievability of gear which could lead to increased pot loss. Additionally, there may be some time or cost involved with reconfiguring gear. At this time, implementation of a maximum surface gear allowance is largely dependent on solicitation of fleet input to develop reasonable and effective language that works to reduce entanglement risk, while still providing enough flexibility for industry to set up their gear to account for the wide variety of environmental conditions that may be encountered off Oregon. ODFW will work to solicit this input and pursue implementation of a maximum surface gear allowance by the start of the 2022-23 crab season.

5.3.3.2 Line marking

As described in *Section 5.3.2.4*, accurate fishery and state of origin information is critical for targeted fishery management that is protective of covered species. Requiring specific marking of buoy lines that identifies the specific fishery and/or state, is one method that has been suggested for potentially improving attribution rates.

There was significant discussion at the Tri-State meeting in May 2020 about the rationale and goals for buoy line marking regulations. The Committee generally agreed that goals for current and future line marking regulations include that they are: (1) identifiable and accurate, (2) visible (primarily in photographs), (3) reasonable and cost-effective, (4) coordinated across West Coast Dungeness crab fisheries and potentially other fixed gear fisheries, and (5) environmentally friendly.

Although Oregon industry members have generally supported the concept of line marking to help identify the fishery source for entanglements, there is little consensus on how best to implement buoy line marking in Oregon. Significant concerns have been raised about the risk of false positive and false negative gear attributions with line marking schemes proposed to date.

ODFW is committed to developing a detailed strategy that addresses these concerns and has the highest likelihood of providing meaningful information for gear identification. As a first step and in support of a coordinated West Coast approach, the OFWC adopted a prohibition of buoy line markings used in other West Coast fisheries in September 2020 (see *Section 5.3.2.4*). ODFW plans to continue working with industry, NMFS, and the other West Coast states to develop a line marking scheme that can be recommended for implementation in the Oregon crab fishery by the 2025-26 crab season.

5.3.3.3 Electronic monitoring

Along the West coast, there is a recognized need for near-real-time collection of spatially and temporally explicit information on fishery effort to strengthen crab traceability regulations, aid enforcement of season opening provisions, inform management decision-making related to marine life entanglements, and assess co-occurrence as a proxy for entanglement risk.

In 2019, an initial step towards establishing automated electronic data collection systems was taken through adoption of a requirement for electronic fish tickets with harvest area information for all commercial crab landings (see *Section 5.3.2.2*). To continue improving data collection, ODFW is committed to working with industry to test electronic monitoring (EM) systems for vessel tracking and developing procedures for how systems can be used to provide necessary fishery data by the 2026-27 crab season. There are various EM systems available on the market and testing of one or more EM systems within the fishery is a critical step for familiarizing fishery participants with the technology and defining data requirements, before requiring industry to invest in the equipment.

Additionally, ODFW will pursue development of an electronic logbook to replace the current paper version that is in use (see *Section 2.2.7.2*). The electronic system will be available for voluntary participation by the 2026-27 crab season and recommended to the OFWC for fleetwide implementation by the 2030-31 crab season. An electronic logbook system will greatly improve the quality, speed, and usability of data received by ODFW, while lessening the recordkeeping burden for fishery participants. ODFW has already begun taking steps to migrate past logbook data in preparation to receive EM data.

These combined efforts will provide substantial improvements to ODFW’s crab fishery monitoring, which is a critical aspect of understanding co-occurrence between the crab fishery and covered species.

5.4 Monitoring

The monitoring plan described in this section is designed to provide the necessary information to evaluate performance under the goals and objectives of this CP. The information needed to make performance determinations is collected through the specific monitoring actions described in this section, which can generally be divided into three main categories:

1) Baseline monitoring – to obtain baseline information;
2) Effectiveness monitoring – to support ongoing conservation decisions and determine progress towards meeting goals and objectives; and
3) Compliance monitoring – to evaluate compliance with CP and ITP terms and conditions.

The monitoring activities described in this section will inform multiple aspects of information needs.

5.4.1 Baseline monitoring

Baseline monitoring provides key information on the covered species that occur in the plan area which may be critical for management decision making during both CP development and implementation. ODFW is currently engaged in baseline monitoring to collect improved data on seasonal whale distribution in Oregon waters through the collaborative research project described in *Section 5.3.2.6*.

Preliminary data collected through this study have already been applied to management in designing initial risk reduction measures intended to decrease co-occurrence of whales and fishery effort. More specifically, the preliminary research results provided whale distribution data to inform the seasonal timing and bathymetry of the late-season depth restriction and pot limit reduction measures which began in May 2021 (see *Section 5.3.1.1*). This work is also expected to provide critical information that will be considered during the three-year evaluation period to evaluate effectiveness of the combined risk-reduction measures, and during subsequent progress report assessments and adaptive management decision-making (see *Sections 5.7* and *5.6*, respectively).

Additionally, ODFW has multiple data sources which are used to monitor fishery activity including fish tickets and commercial crab logbooks (see *Section 2.2.7*). Historical data from these sources provided the baseline information in *Section 5.4.2.1* (representing the 2012-13 through 2019-20 crab seasons) that will be used to assess effectiveness of entanglement risk reduction measures (i.e., reduction in line-days fished) in support of Objectives 1.1 and 1.2 (see *Section 5.2.2.1*).

5.4.2 Effectiveness monitoring

Effectiveness monitoring supports ongoing conservation decisions by helping to determine how successful conservation measures or actions are in meeting CP goals and objectives. The management actions described in *Section 5.3* have been implemented to reduce the risk of covered species entanglements and learn more from future entanglement events, based on the best available information from various sources at the time of implementation. Still, these decisions were made with some uncertainty in the appropriate management actions to achieve those objectives. Ongoing monitoring will help to:

- Improve detection of entangled animals in Oregon waters to determine whether management actions successfully reduce take of covered species incidental to the crab fishery;
- Collect covered species and fishery effort distribution information to assess co-occurrence and identify areas of elevated entanglement risk; and
- Provide information on fishery activity and performance to assess if management measures successfully achieve the intended results (i.e., risk reduction), and evaluate impacts to the economic performance of the crab industry.

In addition, effectiveness monitoring will provide ODFW with essential information to guide additional, alternative, or adaptive management actions over the duration of the ITP.

ODFW considered a wide range of monitoring activities and conducted an evaluation process to determine the key advantages, primary barriers to implementation, potential scale and cost, and feasibility of each in the near- and long-term. The result of this evaluation is a multi-pronged, phased strategy (Figure 5-5) that will augment the existing opportunistic entanglement reporting coordinated by NMFS (see *Section 4.1.1*).

The activities included in this CP's monitoring strategy can broadly be characterized as two tiers. The first tier includes activities that ODFW is committed to implementing; however, the target implementation date differs depending on readiness. These activities fall into two large categories – monitoring covered species and monitoring the fishery, which in combination provide the co-occurrence information that is the foundation of the primary conservation measures. These combined efforts will also provide data to inform assessments of covered species take and fishery impacts. The second tier includes activities that ODFW will support or convene partners to promote research, technological development, funding, etc. However, there are significant barriers to implementing the activities in the second tier that are outside of the direct control of ODFW (i.e., capacity, expertise, technological readiness, funding) and, therefore, are included as aspirational potential activities that ODFW cannot commit to implementing at this time.

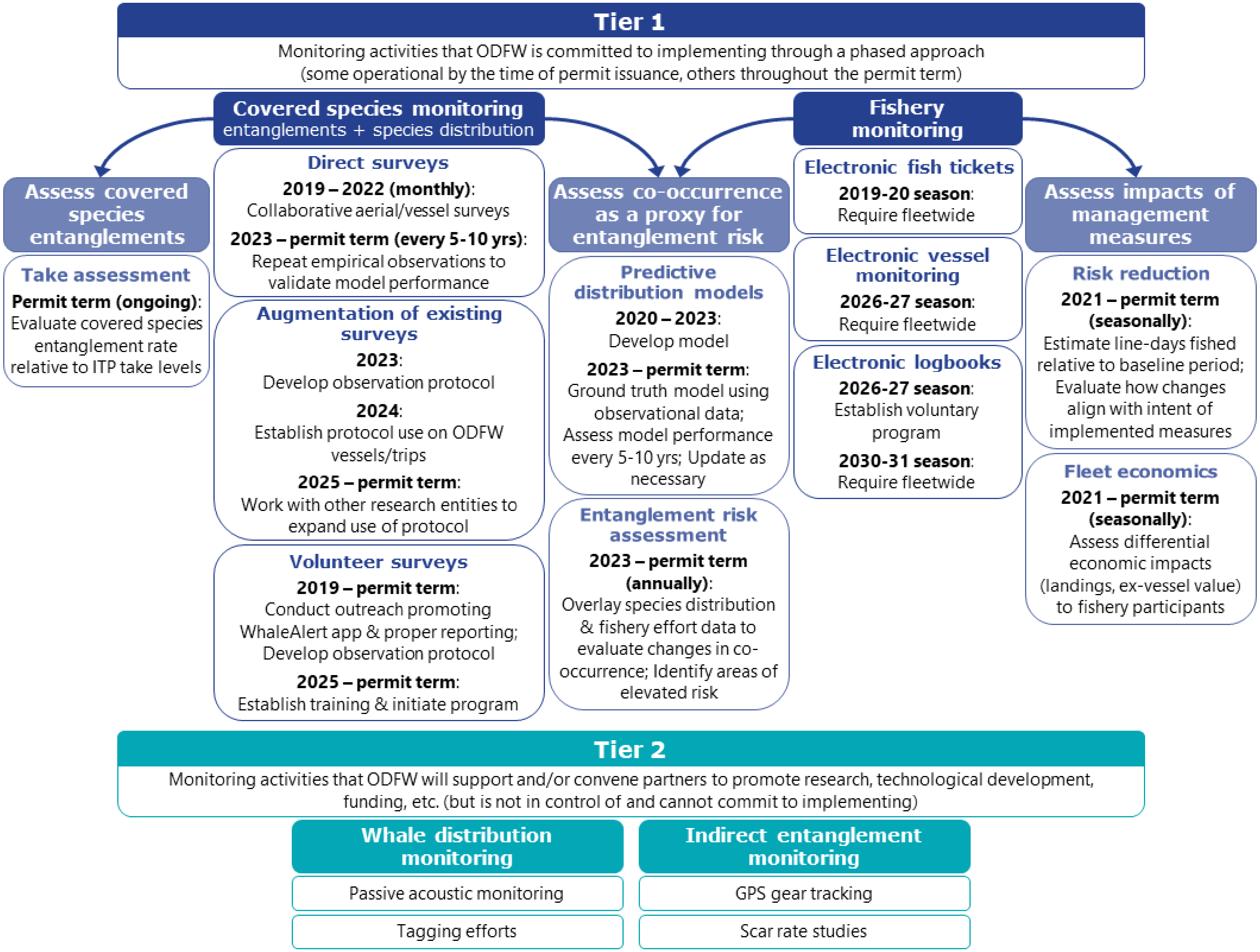

Figure 5-5. ODFW's two-tiered entanglement and co-occurrence monitoring strategy.

5.4.2.1 Tier 1 monitoring

ODFW's Tier 1 monitoring includes covered species and fishery monitoring activities that the agency is committed to implementing, some of which will be operational by the time of permit issuance, and others that may be implemented throughout the permit term.

For each category, ODFW has identified specific activities and relevant steps that will be taken over time to develop these efforts.

Covered species monitoring

The benefits provided by the covered species monitoring activities described in this section are two-fold. First, data will be collected on covered species distribution off Oregon that can be used to inform co-occurrence assessments and identify areas of elevated entanglement risk. Second, the systematic coverage provided by these activities will increase the likelihood that entangled animals off Oregon will be detected and reported.

Direct surveys

Section 5.3.2.6 describes an ongoing, collaborative research project that was initiated in 2019 to collect large whale presence and absence data from monthly aerial surveys along standardized track lines off Oregon. Concurrently, vessel-based photo-id and tissue sampling is being conducted to provide information on whale population structure. The preliminary results of this work have already proved instrumental in developing data-informed management measures that rely on an understanding of when and where large whale species are present off Oregon. The remainder of these surveys, funded by ODFW, will not only provide additional, highly trained "eyes on the water" for entanglement detection but will also collect the high-resolution whale distribution information needed to develop predictive species distribution models and assess co-occurrence as a proxy for entanglement risk (see below).

Currently, funding is committed to continuing surveys through June 2022; however, ODFW will work to repeat empirical observations of whale distribution at future timepoints, as recommended by the results of this study and as funding and resources allow. ODFW's intent is to repeat large-scale observation surveys every 5-10 years.

Augmentation of existing surveys

With the ODFW monitoring strategy focused on reducing co-occurrence of covered species and the crab fishery, direct at-sea observation hours will be of high value to management but, due to the rarity of entanglements, are exorbitantly expensive to obtain from dedicated entanglement observation surveys. However, the coastal waters off Oregon are busy with research surveys led by a number of entities, many of which are based out of Newport, Oregon. These projects, many of which are led by ODFW or include ODFW collaborators, provide opportunities for observing and reporting both free-swimming and entangled animals. The second component of ODFW's covered species monitoring will be to leverage these existing "eyes on the water" by adding an entanglement monitoring component to vessel trips. This work is expected to serve the primary goal of detecting entangled animals, while also providing observational species distribution information which will be added to or used to ground truth predictive species distribution models.

To begin this process, ODFW will develop a protocol for covered species observation by 2023 to collect key information including counts of entangled animals (along with proper reporting protocols), free-swimming animals, and instances where no animals are observed. The protocol will also track observation effort in time and space, and document the level of training of the observer, for later evaluation and weighing of information.

Over the following year, ODFW will establish use of the observation protocol, including training on the protocol and adding the protocol to ODFW at-sea research projects. *Section 7.2.1* provides some description of the various projects and diversity of expertise within the ODFW Marine Resources Program. These include the Marine Fisheries Research Project, Marine Mammal Project, and Marine Habitat Project, each of which spends considerable time at-sea for ongoing research programs, along with various limited-scale projects.

Once established in-house, ODFW will work to establish collaborations with other existing research entities to train their staff and incorporate the protocols in additional at-sea projects. The expansion will consider projects such as the biweekly research cruises along the Newport Hydrographic Line (NH line) off central Oregon, NOAA stock assessment surveys (e.g., bottom trawl, hake, acoustic-trawl), and the International Pacific Halibut Commission Fishery-Independent Setline Survey. However, implementation will be dependent on the willingness of potential collaborators to participate, frequency and design of existing projects, and the size of vessels and space for on-board observers, among other factors.

Volunteer surveys

The third component of ODFW's covered species monitoring will involve coordination of standardized reporting of on-the-water observations by Oregon coastal and ocean users.

ODFW has been and will continue working over the permit term to expand outreach and education efforts to increase the likelihood of an observed entanglement being reported, confirmed, and effectively responded to. As part of the ongoing survey activities described in *Section 5.3.2.6*, project partners have provided outreach and training to a variety of ocean users (e.g., charter fishing and whale watching operators, marine researchers, U.S. Coast Guard personnel, recreational and commercial fishers) regarding use of the Whale Alert app to record opportunistic sightings of whales in Oregon waters. Through this training, mariners have been encouraged to report sightings of healthy whales through the application, and specifically directed to the appropriate entanglement reporting hotline to report entangled marine mammals. ODFW will continue to coordinate outreach and encourage use of appropriate reporting channels with a broad range of user groups including coastal business owners, marine researchers, enforcement personnel, and recreational and commercial fishers. ODFW will specifically engage with crab industry participants to provide information on the entanglement issue and reporting through commercial crab annual newsletters, crab industry public meetings held each year in October, in-person communications during hold inspections prior to the season opener, and during periodic communications with crab industry advisors (i.e., ODCAC).

In addition to heightening awareness of the whale entanglement issue and promoting these existing ad hoc reporting channels (particularly the Whale Alert app), ODFW will design an observation protocol, analogous to that for researchers (described above), but targeting citizen science volunteers. Of particular interest are commercial, charter, and private vessels that frequently access waters outside of 27 fathoms, the current definition of humpback whale critical habitat (see *Section 4.3.1*), and outside of 40 fathoms, the current seasonal depth restriction implemented as a risk reduction measure in the crab fishery (see *Section 5.3.1.1*). ODFW will solicit volunteers from a targeted outreach campaign to groups that frequent offshore waters (key fisheries include albacore, salmon, halibut, pink shrimp, groundfish, and crab), provide training, and collect data to incorporate into other data streams for covered species observations. Training will provide information to on-the-water users about the importance of prompt reporting, maintaining a safe distance, staying with the animal, and pertinent information to gather when available (e.g., species, general condition, nature of distress, videos/photos of entangling gear).

This program will be in place by 2025 and will add to observations of covered species and entangled animals in time and space. Information will be collected on the total observation effort by volunteers, including trips where no animals were observed, and will be used to the degree possible in statistical expansion to understand detection rates and broader impacts of the fishery on covered species.

As with the incorporation of entanglement monitoring in existing projects, a volunteer program is expected to serve the primary goal of detecting entangled animals, while also providing observational whale distribution information which can be used to ground truth predictive species distribution models. Additionally, ODFW will be able to integrate and synthesize observations from volunteers with those collected through collaborative research efforts, to confirm patterns and assess the quality of data collected through each.

Fishery monitoring

Existing crab fishery effort data streams include electronic fish tickets and a paper logbook system (see *Section 2.2.7.2*) which provide valuable spatial and temporal information on catch and effort and are regularly used to describe fishery footprint and activity. At present, these data are informative, but require significant analysis each time an estimate of fishery footprint is desired. ODFW is planning to develop automated reporting tools that will facilitate routine and in-season evaluation of fishery footprint. Additionally, these data streams have key limitations (e.g., paper logbooks are limited by variable compliance rates and subject to backlogging).

Section 5.3.3.3 describes ODFW's plan to recommend implementation of electronic monitoring in the crab fishery, including required EM vessel tracking by the 2026-27 crab season concurrent with a voluntary electronic logbook system, and a fleetwide electronic logbook requirement by the 2030-31 crab season. This advancement will provide higher resolution data in near-real-time, greatly improving the usability of data by ODFW, particularly for in-season or adaptive management purposes. With automated reporting tools and improved data streams, ODFW's ability to describe changes in fishery effort and footprint in a timely manner will improve what is already a well-described fishery.

In the near-term, these combined efforts will provide ODFW with improved fishery effort data that can be used alongside species distribution predictive models to evaluate changes in co-occurrence and identify areas of elevated entanglement risk.

Assessment of co-occurrence as a proxy for entanglement risk

Co-occurrence monitoring includes a combination of methods to collect and compile both covered species distribution and fishing effort distribution data, which can be overlaid to identify areas of co-occurrence where and when elevated entanglement risk may be expected. The preceding sections describe efforts that are underway to collect both covered species distribution and fishery effort distribution data in Oregon and expected to produce the necessary information to assess co-occurrence in the near-term.

The final step of the whale distribution surveys described above will involve the development of predictive models describing species distributions relative to environmental conditions. At the time of writing, OSU researchers have completed several data processing steps and preliminary analyses to support development of these models by 2023. Additionally, ODFW has been briefed on several other species distribution modeling efforts being carried out by NMFS researchers that may contribute valuable information which could be used to compare model performance and/or contribute to co-occurrence assessments for Oregon.

Once reliable models are available, ODFW will identify and compare the best available co-occurrence and fishery effort information on an annual basis, to evaluate the level of co-occurrence over time as a measure of management effectiveness and to identify areas and times of elevated entanglement risk. Co-occurrence assessments will also be considered to inform precautionary fleet advisories in real-time (see *Section 5.6.1.4*) and assess the need for adaptive adjustments.

Assessment of management measure impacts

In addition to the co-occurrence and risk assessment work described above, fishery monitoring data will be used to assess the impacts of the conservation measures in this CP. This will include assessing the conservation benefit provided by risk reduction measures, as measured by reduction in line-days, to determine whether they successfully achieve the intended results. Additionally, impacts of measures on the economic performance of the crab fishery will be evaluated.

Risk reduction

In order to determine whether management measures are effective at reducing the number of vertical lines off Oregon that pose an entanglement risk to covered species, it is necessary to monitor for potential changes in fishery behavior or activity that may result. As described in *Section 2.2.7*, ODFW has multiple data sources (e.g., fish tickets, logbooks) which provide baseline information on fishery activity. ODFW will continue to utilize these data streams moving forward, or improved data streams that result from electronic monitoring of the fishery (see *Section 5.3.3.3*), to identify changes in fishery activity (effort and/or behavior). Specifically, ODFW will closely monitor the active line-days fished throughout the crab season, and during times when covered species are present off Oregon in higher abundance, to determine the realized conservation benefit (i.e., reduction in line-days) following implementation of certain management measures during the 2020-21 season (e.g., 20% pot limit reduction after May 1, elimination of standard replacement tags, elimination of two-week post-season gear clean-up period). This will be compared to baseline active line-day estimates to evaluate how changes align with the intent (or anticipated reduction) of implemented management measures, and reported in regular progress reports as described in *Section 5.7*.

Line-day estimation methods

Entanglement risk posed by the number of vertical lines in the water during the crab season is explored through use of a line-day metric, representing a single vertical line actively deployed for one day. The line-day metric was used during development of the risk reduction measures in *Section 5.3.1* to explore historical levels and anticipated reduction in line-days under various risk reduction scenarios. It will also be used to evaluate performance in relation to several objectives. While the line-day metric is a useful tool for investigating the relative level of entanglement risk in response to different management scenarios, it includes a number of inherent assumptions which are detailed below, along with the methods used to obtain different estimates. These methods were developed by ODFW and represent the best available estimates at this time. ODFW will continue to re-evaluate the line-day estimation methods and make improvements where possible. Any changes to estimation methods will be described along with the estimates provided to NMFS in regular progress reports (see *Section 5.7*).

Vertical line and line-day estimation

Utilizing fish ticket data, the number of active permits (i.e., permits that make at least one landing into Oregon) by half-month periods throughout the crab season was obtained. A pot or vertical line estimate (by regulation, each pot is currently attached to surface buoy(s) by a single vertical line) was made by multiplying the number of active permits by their associated pot limit (200, 300, or 500 pots) for each half-month period. Vertical line estimates were then converted to line-day estimates by multiplying the number of vertical lines by the number of days (that the season was open) in a given half-month period.

Assumptions:

- Each permitholder is fishing their full pot allocation. This likely results in an overestimate of line-days since not all crabbers fish their full pot limit throughout the entire season.
- Each piece of gear is deployed for the entire half-month period. This likely results in an overestimate of line-days.

Caveats:

- A small number of multi-state permitted vessels (see *Section 2.2.5.2*) are not accounted that did not make a landing into Oregon (but may have been fishing off Oregon and landed all crab into another state) in a given season during the baseline period. This likely results in an underestimate of line-days.

Historical baseline

The historical baseline includes average line-day estimates for the 2012-13 through 2019-20 crab seasons, except for the August estimate which includes only 2012-13 through 2017-18. The period since 2013 represents the "modern" era of entanglement reporting and documentation, and the period used to assess the West Coast and Oregon entanglement record in this CP (see *Sections 4.1.1* and *4.1.2*). In order to provide a baseline representing conditions prior to implementation of any CP conservation measures, the August estimate does not include the 2018-19 and 2019-20 seasons during which the two-week post-season gear clean-up period was eliminated by temporary rule. Additionally, to account for gear expected to be in the water during the gear clean-up period, a line-days estimate was included to account for the stacking out of gear from August 15 – 28. This estimate was made based off the average line-days for the August 1 – 14 period, assuming that a constant amount of gear was removed from the water each day for the next two weeks until no gear remained.

Assumption:

- Gear is removed from the ocean at a constant rate throughout the two-week post-season gear clean-up period.

Caveats:

- The baseline period includes seasons with various season opening structures, with most seasons experiencing a delayed or split opening due to low meat yield, elevated domoic acid detected in the viscera of crab, or a combination of both (Table 5-1). The various delays during the baseline period are evident in the low average line-day estimates for December and, to a lesser degree, January. While these estimates are representative of fishing activity during the baseline period, it is important to note that the crab fishery is most active at the start of the season with the vast majority of crab landed during the first eight weeks. If future crab seasons open on December 1 (i.e., no delay), it is expected that line-day estimates would be highest in December.
- The historical baseline estimates do not include any gear placed in the water during the current 73-hour gear setting period in place at the start of the crab season. This period is excluded for several reasons. First, the duration of the gear setting period has changed over time, including during the baseline period. Additionally, the time scale is set in hours, rather than full days which does not translate to the line-day estimation methods easily. Finally, and perhaps most importantly, ODFW does not have data on how this gear-setting period is used by the fleet so estimates or assumptions about the level of gear in the water during this time would be largely

uninformed. This exclusion may result in a slight underestimate of line-days in the month that the season opens.

- Line-day estimates for the 2019-20 season may have been impacted by disruptions in fishing activity related to the COVID-19 pandemic; however, a major decline in crab catch and effort relative to past seasons was not observed.

Table 5-1. Season opening structure during the historical baseline period (2012-13 through 2019-20 seasons). Most seasons experienced a delayed or split opening due to low meat yield, elevated domoic acid levels in crab viscera, or a combination of both.

Crab season	Regulatory opening date	Fishing zone	Reason for delay
2012-13	December 31	Coastwide	Low meat yield
2013-14	December 16	Coastwide	Low meat yield
2014-15	December 1	Coastwide	
2015-16	January 4	Coastwide	Elevated domoic acid
2016-17	December 18 January 1	South of Cape Blanco North of Cape Blanco	Elevated domoic acid Elevated domoic acid
2017-18	January 15 February 7	North of Cape Blanco South of Cape Blanco	Low meat yield Low meat yield + elevated domoic acid
2018-19	January 4 February 1	North of Cape Arago South of Cape Arago	Low meat yield Low meat yield + elevated domoic acid
2019-20	December 31	Coastwide	Low meat yield

Anticipated reduction due to late-season 20% pot limit reduction

To estimate the anticipated reduction due to the late-season 20% pot limit reduction (see *Section 5.3.1.1*), the average line-day estimates used to inform the historical baseline were used. The anticipated reduction represents 20% of the line-days estimated from May 1 (implementation of the measure) through the end of the crab season, including the two-week post-season gear clean-up period.

Assumption:

- The pot limit reduction will not affect fishery behavior, or put differently, fishery participants will remove 20% of their gear but continue deploying the other 80% for as long as they typically fish.

Caveat:

- Fishery participants may change their behavior in other ways in response to this measure (e.g., removing all gear after May 1, continuing to fish longer into the season).
- This estimate does not account for the potential impacts of the 40-fathom depth restriction, implemented in combination with the pot limit reduction.
- This reduction is expected to be realized during the 2020-21 through 2022-23 seasons. After that time, the rule will expire and ODFW will provide additional

recommendations to the OFWC to maintain or modify the measure, which will have an undetermined impact on line-days after May 1.

Anticipated reduction due to elimination of the post-season gear clean-up period

As described above, an estimate for the number of vertical lines in the water while gear is being stacked out during the two-week post-season gear clean-up period is accounted for in the historical baseline estimates. To estimate the anticipated reduction due to the elimination of that period (see *Section 5.3.1.3*), a line-days estimate was obtained for the month of August, assuming that without the post-season gear clean-up period in place, fishery participants would begin stacking out gear two weeks prior to the end of the season and continue at a constant rate through the season closure on August 14. The amount of gear estimated to be in the water at the start of August (and the amount removed each day), was based on the baseline number of pots in the water during the first half of August, reduced by 20% to account for the pot limit reduction in effect at this point in the season. The anticipated reduction in line-days represents the difference between this estimate and the August historical baseline (reduced by 20%).

Assumptions:

- Without a post-season clean-up period in place, fishery participants will begin stacking out gear on August 1, two weeks prior to the season closure.
- Gear will be removed from the ocean at a constant daily rate from August 1 – 14.

Anticipated reduction due to elimination of the standard replacement tag allowance

To estimate the anticipated reduction due to the elimination of the standard replacement tag allowance (see *Section 5.3.1.2*), the number of replacement tags and date of issuance, by season, was obtained from a buoy tag tracking database. For each vessel that requested replacement tags, a last landing date was determined from fish ticket data. The total number of replacement tags issued were assigned to each vessel by month from the month of issuance to the month of last landing. Replacement tags were then summed across vessels by month to estimate the total replacement tags (i.e., total number of vertical lines on pots using replacement tags) by month for each season during the baseline period. These vertical line estimates were then converted to line-day estimates by multiplying the number of vertical lines by the number of days in the month.

Since a total elimination of the standard replacement tag allowance was implemented, these historical line-day estimates (with the allowance in place) are equal to the anticipated reduction moving forward.

Assumptions:

- Each vessel deploys all replacement tags that are issued during the month of issuance through the month of last landing. This likely results in an overestimate of line-days.

Caveats:

- The estimated line-day reduction does not factor in the 20% pot limit reduction after May 1.

Line-day estimates

Table 5-2 provides estimates of the average monthly active line-days over the historical baseline period (2012-13 through 2019-20 seasons) and the anticipated reduction in average line-days from various risk reduction measures implemented during the 2020-21 crab season. Estimates were made according to the methods and assumptions described above.

Table 5-2. Average monthly active line-day estimates for the historical baseline period (2012-13 through 2019-20 seasons) and anticipated reductions in average active line-days beginning in the 2020-21 season due to implementation of various risk reduction measures. Data are from ODFW fish tickets. Line-day estimation methods, key assumptions, and caveats are detailed in *Section 5.4.2.1*.

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Season total
Historical baseline (average line-days 2012-13 – 2019-20)	599,925	2,651,713	2,629,338	2,304,900	1,595,438	1,196,500	732,375	518,913	310,236	**12,539,336**
Anticipated reduction in average line-days (beginning 2020-21)										
Due to late-season 20% pot limit reduction	0	0	0	0	0	-239,300	-146,475	-103,783	-62,052	**-551,610**
Due to elimination of post-season gear clean-up period	0	0	0	0	0	0	0	0	-169,493	**-169,493**
Due to elimination of standard replacement tag allowance	-15	-24,006	-71,677	-79,031	-56,370	-43,385	-24,143	-15,186	-4,585	**-318,396**
Combined reduction, relative to baseline (%)	<-0.1%	-0.9%	-2.7%	-3.4%	-3.5%	-23.6%	-23.3%	-22.9%	-76.1%	**-8.3%**

Baseline late-season line-days outside of 40 fathoms

The anticipated impacts from implementation of the 40-fathom depth restriction cannot be treated as a direct reduction in line-days relative to the overall baseline, because it is likely that some portion of the fishing effort that has historically occurred outside of 40 fathoms may shift inside 40 fathoms rather than being eliminated. The potential for gear crowding that could result from this measure alone is the primary reason for combining the depth restriction with a pot limit reduction.

Instead, a separate baseline estimate has been calculated for the line-days that occurred outside of 40 fathoms from May 1 through the end of the season over the baseline period. The depth restriction will specifically reduce these line-days, rather than the overall level. In practice, the depth restriction is expected to eliminate all active line-days outside of 40 fathoms during the late-season in the near-term; however, Objective 1.1b is drafted as a reduction of at least 50% to account for potential adaptive management actions (e.g., adjustment of depth restriction based on new information, authorization of duplexing/longlining, pop-up gear) that could result in some line-days outside of 40 fathoms in the future.

Baseline line-days outside of 40 fathoms from May through the end of the season were estimated by applying the proportion of late-season pot-pulls outside of 40 fathoms (from fisher-reported depth information in crab logbooks) to the average late-season line-days (from ODFW fish tickets). The baseline period represents the 2012-13 through 2018-19 seasons as logbook data from the 2019-20 season are not yet available for analysis.

To determine the proportion that should be applied, pot-pulls from logbooks were divided into depth bins (i.e., fisher-reported depth ≤40 fathoms and >40 fathoms). The average percentage of late-season pot-pulls outside of 40 fathoms across the baseline period was calculated by summing all pot-pulls outside 40 fathoms after May 1 from all baseline seasons, and dividing that by the total pot-pulls at any depth over the same months and seasons. To calculate the average late-season line-days outside of 40 fathoms, the pot-pulls proportion was applied to the average line-days fished from May 1 through the end of the season over the same period (see methods above). This value is provided in Table 5-3, along with the target for future seasons representing a reduction of at least 50% from the baseline level.

Fleet economic impacts

The monitoring efforts described above will provide critical information about the effectiveness of CP conservation measures in supporting the conservation of covered species. In addition to those efforts, ODFW will monitor the economic impacts of those measures on the crab industry in support of the overarching vision, goals, and objectives described in *Section 5.2*. This will largely involve monitoring landings and ex-vessel value throughout the season, to determine how each is impacted by the management measures implemented to date.

The management measures described in this CP are likely to have differential economic impacts on different business plans (i.e., different vessel sizes, classes, and/or pot tiers, during different times of the year and/or servicing different markets) within the crab fishery. For example, measures which restrict activity in the late-season may have a larger impact on smaller vessels that fish throughout the spring and summer, as opposed to larger vessels which may complete their crab season earlier in the year before shifting to other fisheries. Therefore, a primary goal of ODFW's economic monitoring will be to assess those differential impacts and inform the adaptive management decisions made throughout the duration of the permit.

5.4.2.2 Tier 2 monitoring

ODFW's Tier 2 monitoring includes activities that ODFW will support or convene partners to promote research, technological development, funding, etc. However, there are significant barriers to implementing the activities in the second tier that are outside of the direct control of ODFW (i.e., capacity, expertise, technological readiness, funding) and, therefore, are included as aspirational potential activities that ODFW cannot commit to implementing at this time.

Indirect monitoring to detect entanglements

Two potential methods that have been considered for indirect monitoring for entangled animals include GPS gear tracking and the use of scar studies to estimate entanglement rates.

GPS gear tracking would involve monitoring the GPS location of deployed crab pots in order to detect crab pot movement that resembles whale track lines. While technology does exist to be able to monitor gear location, it is currently cost prohibitive and not practical for fleetwide implementation. Additionally, a machine-learning algorithm for detecting movement patterns would need to be developed and able to overcome the risk of false detections due to gear movement from other factors (e.g., kelp, vessel traffic, weather).

ODFW views most of the barriers to implementation of GPS gear tracking as technological or economic in nature, rather than being due to management barriers. For this reason, ODFW is not currently able to estimate a potential implementation timeline, or determine the potential implementation scale (i.e., statistical expansion based off a sample of buoys versus tracking of every buoy). However, ODFW does see value in this monitoring concept and will support research and gear development efforts.

Another potential indirect monitoring technique would be to establish a baseline understanding of entanglement scar rates off Oregon, then continue monitoring for new scar rates or freshness of scar rates to estimate new scar accumulation over time (i.e., entanglement rates). This method can be useful for assessing how many entanglements go unreported and are survived (at least initially), but not necessarily for determining how many go unreported and are not survived. Additionally, the information may provide a better understanding of population-level entanglement impacts, but does not help to determine the proportion of unobserved entanglements that can be attributed to a specific state, or even fisheries along the West Coast.

Scar rate studies would be most effective if done in collaboration across the West Coast and with dedicated partners to provide high-quality images throughout covered species' ranges. A project at this scale would require significant research and development that is not achievable in the near-term. However, ODFW will support research on this topic and engage with the CP advisory committee focused on evaluating and recommending different research priorities (see *Section 6.1.5*).

Whale distribution monitoring to support co-occurrence work

Several other methods have been proposed for monitoring whale distribution off Oregon, and the broader West Coast, including passive acoustic monitoring and tagging efforts. Better information on whale distribution would contribute to assessments of co-occurrence which serves as a proxy for entanglement risk.

Passive acoustic monitoring is a well-established method for monitoring whale populations based on species-specific vocalizations. There are a number of variables that contribute to the efficacy of acoustic monitoring work including the detection range (which is dependent on properties of the water column like temperature, depth, other sound sources), in-water infrastructure, and whether hydrophones are cabled (which presents a tradeoff between cost and delay in data transmission). This method would also require some understanding about the level of vocalization (i.e., call rates) of the whale populations being studied, in order to extrapolate acoustic detections and make inferences about whale densities in the area. Due to funding constraints, acoustic instruments across the coast may not be feasible, but ODFW has considered that a gateway approach to track migrations into and out of certain areas may be reasonable. If implemented, this type of approach could be used to trigger additional monitoring and/or adaptive management measures.

Whale tagging efforts provide another potential method for monitoring a population's movement patterns. However, there are a number of challenges and costs associated with the deployment of satellite tags on whales. Many tags last only a few months, so sample sizes from this type of work would likely be small. To that end, it is unlikely that tagging would provide usable, fine-scale species distribution information, but it could provide a better understanding of DPS behavior and migrations. It could also be used to monitor where animals go when they leave Oregon waters to inform detectability of whales tagged off Oregon as they move to other locations along the coast. Finally, tagging data would provide further validation of predictive species distribution model performance.

Ultimately, ODFW recognizes that these types of monitoring require significant research and development, and the agency will need to work with subject matter experts to get a better understanding of the potential scale, cost, and timeline. Accordingly, these methods are considered long-term monitoring options and the agency will encourage consideration by the CP advisory committee convened to evaluate and recommend different research priorities (see *Section 6.1.5*).

5.4.3 Compliance monitoring

Compliance monitoring tracks an ITP permit holder's compliance with the requirements specified in the CP and the terms and conditions of the ITP. This includes monitoring of the covered activity, implementation of the conservation program as described in the CP, and the extent of take for each covered species incidental to the covered activity. ODFW will provide

NMFS with the information necessary to monitor and enforce permit compliance through the specific reporting requirements detailed in *Section 5.7*.

5.5 Performance and success criteria

Information gathered from the various effectiveness monitoring efforts described above will provide data and/or information that will be analyzed with reference to performance and success criteria in order to track progress towards meeting the biological objectives in *Section 5.2.2*.

ODFW has developed performance and success criteria, based on active line-day estimates, to directly measure progress towards meeting Objectives 1.1 and 1.2 (Table 5-3). ODFW will use these criteria for evaluation beginning with the 2020-21 season when the primary risk reduction measures were first implemented. Data used to assess these criteria will come from fishery monitoring and results will be provided to NMFS in regular progress reports according to the reporting requirements outlined in *Section 5.7*.

Table 5-3. Performance and success criteria for determining progress towards achieving biological Objectives 1.1 and 1.2a. All success criteria will be measured relative to baseline levels (from 2012-13 through 2019-20), except for Objective 1.1b where baseline levels do not include 2019-20 since logbook data are not yet available for analysis.

Objective	Performance criteria	Success criteria	Baseline level	Reduction needed	Reduction anticipated
1.1a	Average active line-days fished from May 1 through the end of the season	20% reduction by 2025	2,758,024	-551,605	-808,401[a]
1.1b	Average active line-days fished outside 40 fathoms from May 1 through the end of the season	≥50%[b] reduction by 2025	122,452	-61,226	-122,452[a]
1.2a	Average active line-days fished across the season	5% reduction by 2025	12,539,336	-626,967	-1,039,498

[a]The reduction anticipated for Objective 1.1 is based on risk reduction measures that have been implemented through the 2022-23 crab season (see *Section 5.3.1.1*). Prior to the expiration of those rules, ODFW will evaluate the effectiveness of those measures and provide recommendations to the OFWC that will provide equal and/or more conservation benefit to the covered species as the original measures. This could result in a change to the reduction anticipated.

[b]The depth restriction that is currently implemented is expected to eliminate all active line-days outside of 40 fathoms during the late-season in the near-term; however, Objective 1.1b is drafted as a reduction of ≥50% to account for potential adaptive management actions that could result in some line-days outside of 40 fathoms in the future.

For the remaining objectives, performance will be described in regular progress reports to inform progress towards each objective component. Specific information that will be provided, at a minimum, to evaluate progress towards achieving objectives is detailed in Table 5-4.

Table 5-4. Performance criteria for determining progress towards achieving biological Objectives 1.2b, 1.3, 1.4, 2.1, 2.2, and 2.3.

Objective(s)	Performance criteria
1.2b	• Amount of gear retrieved through in-season derelict gear retrieval efforts, as well as amount and spatial distribution of gear collected during the post-season derelict gear recovery program • Evaluation of the effectiveness of derelict gear recovery efforts • New or amended regulations implemented in the crab fishery to augment derelict gear recovery programs, as available or appropriate
1.3a	• ODFW outreach efforts regarding implementation of best practices, awareness of the entanglement issue, and/or entanglement reporting (e.g., Whale Alert app) and response
1.3b	• Convening of CP advisory committee to evaluate and recommend gear modifications
1.3c	• New or amended regulations implemented in the crab fishery to improve gear configuration and/or design, as available or appropriate
1.4a	• Convening of CP advisory committee to evaluate and recommend adaptations to the overall management strategy
1.4b	• New or amended regulations implemented in the crab fishery to further reduce entanglement risk and/or minimize impacts to the crab fishery, as available or appropriate
2.1a, 2.1c	• New or amended gear marking regulations implemented in the crab fishery, as available or appropriate
2.1b	• Convening of CP advisory committee to evaluate and recommend further gear marking modifications
2.2a	• Progress towards EM vessel tracking and electronic logbook development and implementation efforts
2.3a	• Convening of CP advisory committee to evaluate and recommend research priorities
2.3b	• Progress towards obtaining funding and/or research collaborations to fill critical information gaps

5.6 Adaptive management strategy

Adaptive management is a fundamental element of this CP which provides a framework for achieving the goals and objectives identified in *Section 5.2* through a range of possible alternative or adjusted strategies. In this way, adaptive management is a tool to address uncertainty in the conservation of the covered species which stems from limited information about the ecology of the species or their habitat, as well as, uncertainty in the effectiveness of specific management approaches.

Adaptive management is a cyclical process which involves an assessment of the problem, development and implementation of a management strategy (*Section 5.3*), monitoring to evaluate effectiveness (*Sections 5.4* and *5.5*), and adjustment of the management strategy, as necessary. This is followed by reassessment of the problem and will often require continuation of the subsequent steps in order to further refine the management approach. While this cycle of monitoring, evaluation, and adjustment will improve understanding about the effectiveness of the implemented measures, it is also likely that updated ecological knowledge of the species may lead to additional adjustments, alteration, or replacement of certain measures.

The adaptive management strategy developed for this CP includes two categories of management actions which may be considered throughout the permit duration. First, there are short-term adaptive management responses that are ready to implement in response to an indication that entanglement risk is elevated. Second, there are future potential measures that require some level of additional development time, which may be considered in addition to, or in place of, existing measures in the future. Future potential measures may also include a more stringent or relaxed version of the conservation measures that are currently in place.

Both categories of management actions are described in the subsequent sections along with a description of the consultation process that will be used to streamline adaptive management decision making.

5.6.1 Short-term adaptive management response to elevated entanglement risk

In the short-term, adaptive management responses that are ready to implement largely involve adjustments to the primary risk reduction measures described in *Section 5.3.1.1*. The actions described in this section may be implemented in-season or in a future season in response to an indicator that entanglement risk is elevated, following a thorough consultation process to determine the most appropriate action.

5.6.1.1 Indicators of elevated entanglement risk

Currently, confirmed entanglements are the most appropriate indicators of elevated risk and will be used as a trigger to initiate an adaptive management consultation process (see *Section 5.6.1.2*). Consultation to determine a management response will occur if confirmed entanglements involving Oregon crab gear meet or exceed the anticipated take levels described in Table 4-3, which are:

- Humpback whales – 2 animals per year
- Blue whales – 1 animal every five years
- Leatherback sea turtles – 1 animal every ten years

In practice, this means that a consultation process will begin if two humpback whales, one blue whale, or one leatherback turtle are entangled in any year. For blue whales and leatherback sea turtles, the anticipated take level is defined over multiple years, and so strong consideration will be given during the consultation process (see below) to the events surrounding the entanglement and whether elevated risk is expected to continue in future seasons (e.g., have ocean conditions changed indicating that entanglement risk for those species will remain elevated in the future?). If so, a management response will likely be implemented that is expected to reduce risk over a multi-year period. Additionally, as described below, the consultation process will also consider multi-year patterns of entanglements (i.e., average entanglements over time) that may warrant a longer lasting or more restrictive response than an isolated entanglement event.

In addition to confirmed entanglements, other factors may indicate elevated entanglement risk including presence of covered species in high abundance off Oregon, fleet dynamics, and changes in ocean or forage conditions. At this time, ODFW has not identified reliable, real-time data streams which would provide the necessary information to develop indicators based on these factors; however, there are several projects that are currently in development that might provide useful information in the future when publicly available. For example, the habitat compression index indicator through the California Current Integrated Ecosystem Assessment may be considered for use once available coastwide and paired with meaningful management thresholds. Moving forward, ODFW will consider data streams developed in the future as potential additional indicators that may be used as triggers to improve the formal adaptive management consultation process. ODFW will consult with NMFS to discuss any new indicators being considered for application. In the meantime, ODFW will continue to rely on the best available information on any factors that indicate elevated entanglement risk during the consultation process to design an appropriate response (see *Section 5.6.1.2*), and to inform precautionary actions (see *Section 5.6.1.4*).

5.6.1.2 Adaptive management consultation process

If confirmed entanglements indicate that an adaptive management response should be considered, ODFW will initiate a consultation process with NMFS, within two weeks of an indicator threshold being met, to determine the best management response given the information available at that time (see *Section 5.6.1.3* for a menu of potential responses). ODFW will seek input from existing advisory groups with first-hand knowledge and expertise (e.g., industry advisors, marine researchers/biologists), to ensure that the selected management response is reasonably supported by the best available science and to ensure transparency in the selection process. Factors that will be considered include:

Management measure effectiveness (or conservation benefit)

Primary consideration will be given to the expected effectiveness of a given response at reducing impacts of the crab fishery on covered species. Management measure effectiveness will be highly dependent on evaluation of the circumstances surrounding any confirmed entanglements that trigger a response.

Economic impact to the fishery

As described in *Section 5.4.2.1*, the economic impact of management actions will change depending on the progression of the fishing season and will not be equal across fishery participants. There may be situations where multiple management responses are expected to provide a similar conservation benefit to covered species and, in those cases, economic impacts will be a primary consideration in determining a final response.

Data availability

The availability of data will be considered when implementing a management response to determine the likelihood that current conditions (e.g., fleet activity, covered species abundance and distribution) are well understood. If data are believed to be limited, a more restrictive management response may be warranted as a precautionary approach. Whereas, a less restrictive response may be appropriate when data are readily available. Additionally, the availability of data for monitoring and evaluating effectiveness will be considered when the conservation benefit and economic impact is not expected to differ among possible responses.

Historical information on species distribution, migration, and habitat use

Entanglement risk varies throughout the year depending on the progression of the crab fishery and covered species migration throughout the area. Historical information on covered species distribution and migration patterns will be an important consideration as it relates to seasonal entanglement risk and the need for a more or less restrictive response.

Fishing season dynamics

Similarly, the distribution of fishing effort, amount of gear deployed, and progression of the fishing season all impact seasonal entanglement risk and, as such, will be important considerations for determining a response. When possible, information on fishing activity from the current season will be used to inform management. However, historical information or predictive models (when available) may be useful for considering how fishing activity and, thereby, entanglement risk is expected to change over time.

Ocean and/or forage conditions

The relationship between ocean conditions, the distribution and abundance of forage, and the timing and location of covered species off Oregon will be an important consideration for understanding entanglement risk and determining appropriate management responses. At this time, quantitative information on the relationship between ocean conditions and covered species presence in Oregon is not sufficient to be informative for management; however, ongoing research efforts are working to create predictive tools which may be useful in the future. These tools will be utilized during the management response selection process when available. Until that time, general understanding about the potential impacts of ocean conditions will be considered if supported by the best available scientific information.

Patterns of confirmed entanglements

In addition to evaluation of the specific circumstances surrounding any entanglements that occur, consideration will be given to patterns or rates of entanglements. For example, patterns in the timing of entanglements over several season may indicate that a temporal adjustment to management measures is most appropriate, whereas, repeated entanglements in shallower waters may trigger a bathymetric response.

Marine life concentrations

Near-real-time information on marine life concentrations may enable more targeted spatiotemporal management responses. ODFW has been briefed on several species distribution models currently under development by NMFS researchers that would provide humpback and blue whale habitat suitability and/or density predictions off Oregon which could be used to inform potential management responses. Additionally, species distribution models for Oregon are currently under development through collaboration between ODFW, OSU, the U.S. Coast Guard, and other partners (see *Section 5.3.2.6*).

At this time, ODFW has not identified a reliable data stream or appropriate management thresholds from this work that can be used to consider marine life concentrations as a real-time indicator of elevated entanglement risk to trigger adaptive management. However, ODFW will continue to support research efforts and utilize available data streams on marine life concentrations during the management response selection process, when available.

5.6.1.3 Potential adaptive management regulatory responses

In September 2020, the OFWC adopted a series of rules which reduces each commercial Dungeness crab permit holders' pot limit by 20%, in combination with a 40-fathom depth restriction, effective May 1 during the 2020-21, 2021-22, and 2022-23 crab seasons (see *Section 5.3.1.1*). Three of the four potential short-term management responses described in this section involve adjustments to these rules which are expected to provide an additional conservation benefit should the measure not be effective at achieving the goals and objectives of this CP. It is important to note that measures are not necessarily independent of each other and could be implemented in combination, if appropriate. For example, a combined adjustment to the pot limit reduction percentage and depth restriction may be recommended in some instances to provide a conservation benefit to covered species, while avoiding unintended gear crowding in open areas.

Depending on the specific circumstances, each response may be implemented in-season or in a future season, following a thorough consultation process (as described above). Implementation may require regulatory change which could be achieved through either a temporary or permanent rulemaking process. Under ORS 183.335(5), ODFW has the ability to file a temporary rule in appropriate circumstances, without advance notice or public comment. Temporary rules are considered by the OFWC after filing, and can be adopted, modified, or rescinded at that time. Temporary rules can remain in effect for up to 180 days, once adopted. Permanent rulemaking requires ODFW to provide a notice of proposed rulemaking with an opportunity for public comment, prior to adoption by the OFWC at a public hearing. The temporary rulemaking process is the most likely mechanism for taking management action in-season, while any substantial or lasting changes to the management strategy would be accomplished through permanent rulemaking.

Adjust the implementation date of late-season pot limit reduction and depth restriction

One potential adaptive management response would be to adjust the implementation date to occur prior to May 1, in order to provide a conservation benefit (i.e., reduced vertical lines and elimination of gear outside 40 fathoms) earlier in the season. Preliminary data from aerial whale surveys off Oregon through May 2021 include humpback whale observations during every month except January, with the majority (80%) observed between May and November. Blue whales have also been observed off Oregon during every month except for December, with the majority observed between July and November (see *Section 5.3.1.1*).

An earlier implementation date is likely to further reduce gear when both humpback and blue whales are present off Oregon. The collection of more fine-scale whale distribution data off Oregon from continuation of aerial surveys through at least June 2022 (see *Section 5.3.2.6*), will provide a better understanding of the potential benefit provided by a temporal adjustment to this rule. In terms of impacts to the fishery, this response is expected to result in reduced economic revenue, particularly to late-season participants in the fishery, and limit access to deeper fishing grounds which may have differential impacts on industry members depending on where they fish. Additionally, limiting harvest during months when weather can be poor, has the potential to create additional safety concerns for harvesters trying to maintain profitability with restricted access.

Adjust the percentage of late-season pot limit reduction

Another potential management response would be to increase the percentage of the late-season pot limit reduction described above, in order to provide an additional conservation benefit (i.e., greater reduction of vertical lines in the water) after May 1. As with the response described above, an adjustment of the pot limit reduction is expected to result in reduced economic revenue, particularly to late-season participants in the fishery.

Adjust the depth restriction

Adjustment of the depth restriction closer to shore could also be an appropriate adaptive management response, in order to further minimize or eliminate vertical lines in primary humpback habitat, as currently defined or refined by future research results. Humpback whale critical habitat has been designated off Oregon with an inshore boundary of ~27 fathoms (NMFS, 2021a). Although preliminary results from aerial and vessel-based surveys off Oregon through May 2021 indicate that the majority (80%) of humpback whales are observed in waters 42 to 202 fathoms deep, a small portion (8%) of individuals have been observed in less than 40 fathoms (see *Sections 3.2.1.5* and *5.3.1.1*). An adjustment of the depth restriction closer to shore may further reduce gear in humpback whale habitat, though it will also limit access to additional fishing grounds for fishery participants after May 1.

This response would also provide a conservation benefit for blue whales that have been observed off Oregon most commonly in waters 34 to 123 fathoms deep, with 22% of individuals observed at less than 40 fathoms. Although not a covered species under this CP, gray whales are distributed closer to shore than humpback and blue whales, and entanglement risk for this common Oregon species is also a consideration. Depth restriction alone might be of concern in concentrating crab gear in primary gray whale habitat but, as combined with gear reduction, is designed to mitigate impacts to gray whales.

Implement earlier season closure

Lastly, although not part of the original regulatory package to reduce risk, an extreme management response could be to close the season early (prior to August 14) in order to eliminate gear later in the season when covered species are known to be more abundant off Oregon. This response has the potential to provide the greatest conservation benefit, but also result in the greatest disruption to the fishery and reduction in economic revenue relative to other options. However, the effectiveness and impact to the fishery are both dependent on the chosen implementation date.

5.6.1.4 Precautionary fleet advisory

The responses described above each represent a regulatory approach to ensure that additional entanglements do not occur. Additionally, precautionary action may be taken in the form of a fleet advisory to encourage voluntary efforts to adjust fishing behavior (e.g., moving gear out of deeper waters) if entanglement risk is elevated or expected to become elevated. While the management responses above may be triggered by confirmed entanglements, a fleet advisory may be issued in response to various information sources which indicate elevated risk (e.g., presence of covered species in high abundance off Oregon, fleet dynamics, changes in ocean or forage conditions). A fleet advisory has the potential to minimize or eliminate gear in a specific area, but is dependent on some reliable, real-time information that risk is elevated and should consider the potential consequences of shifting effort. The effectiveness of a fleet advisory is dependent on voluntary participation, but may be a useful tool which can be implemented quickly when a more restrictive management response is not warranted.

5.6.2 Future potential measures

There are other conceptual adaptive management tools that could be developed and implemented in the future, if successful. These options may serve as additional or alternative risk reduction measures, if the existing management measures are not effective at achieving the objectives of this CP. Additionally, the development of alternative measures provides an opportunity to minimize impacts to the crab fishery, if there is a future option that is at least as protective of covered species as the existing measures, but less disruptive to the fishery.

The majority of these options are less suited to an in-season response, although several could be used in that way once they are adequately developed. There is also potential for some of the following measures to be used in combination under certain circumstances.

Due to limited staff resources, ODFW is not able to pursue all of the various potential measures simultaneously. ODFW has prioritized potential measures to focus on for immediate development based on two criteria: (1) readiness for development, and (2) crab industry support for development (which may not be equivalent to industry support for implementation). Readiness for development scores represent ODFW staff estimation of workload needed to develop, funding or technological limitations, necessary level of coordination with other entities, and other factors. Industry support for development scores represent ODFW staff assignment of industry support based on input received at the 2020 industry public meetings, and ad hoc conversations between ODFW and industry members. This prioritization is detailed in Table 5-5 and highlighted by the order in which the future potential measures are described in this section.

Table 5-5. Prioritized list of future potential measures for evaluation and potential development and implementation. Measures could be used in addition to, or in place of, existing management measures to reduce the risk of covered species entanglement in Oregon crab gear.

	Potential measures	Readiness for development	Industry support for development	Primary barriers to implementation
5.6.2.1	Authorization of longlining/duplexing	Medium	High	Gear conflict concerns; enforcement concerns; uncertainty about impacts
5.6.2.2	Full season pot limit reduction	High	Low	Limited fleet support for implementation
5.6.2.3	Permit stacking	Medium	Medium	Requires development of an effective stacking plan; concerns about reactivation of latent permits
5.6.2.4	License buyback	Low	High	Funding mechanism has not been identified/secured; concerns about reactivation of latent permits
5.6.2.5	Hot spot closures	Low	Unknown	Requires real-time data; concerns about "curtain" effect
5.6.2.6	Late-season limited entry program	Medium	Low	Requires development of an effective LE program
5.6.2.7	Tri-State coastwide pot limit	Low	Unknown	Requires buy-in from CA and WA; requires development of an effective pot limit program
5.6.2.8	Implementation of "weak links"	Low	Low	Requires gear testing; requires evaluation of effectiveness with humpback whales; derelict gear concerns
5.6.2.9	Implementation of "pop-up" gear	Low	Low	Technology is not ready (reliability, affordability, effectiveness); requires extensive gear testing

ODFW plans to take the necessary steps to evaluate and develop the first two potential measures (authorization of longlining/duplexing and a full-season pot limit reduction) by the end of the 2022-23 crab season, which aligns with the three-year sunset date for the combined pot limit reduction and depth restriction implemented in May 2021 (see *Section 5.3.1.1*). Information generated from development of these measures will be considered during the three-year evaluation and in generating recommendations to provide to the OFWC at that time.

Additionally, ODFW will continue to refine a development timeline for the remaining potential measures within five years of permit issuance. Details of this development timeline will be included in the first progress report submitted to NMFS under the reporting requirements in *Section 5.7*.

5.6.2.1 Authorization of longlining/duplexing

A longline gear configuration involves stringing crab pots together with groundline marked at each end by a surface buoy(s) attached to a vertical line. Longlining is currently prohibited in the crab fishery as a result of a series of actions by the OFWC in the mid-1990s to address concerns about overcapitalization and incidence of gear conflicts with other users (e.g., single crab pots, trawl gear). Today, every crab pot is required to be marked by an individual buoy and crab pots are prohibited from being attached to one another by a groundline or any other means, which aids enforcement of the pot limit program.

Authorization of longlining or duplexing (i.e., two crab pots connected to a single vertical line) has been proposed as a potential mechanism for significantly reducing the number of vertical lines, while still allowing a higher number of pots to be fished. At this time, potential gear conflicts and enforcement of pot limits remain the primary barriers to implementation. However, while the current prohibition on longlining ensures that crab and other fishers know the location of gear and can avoid gear setting conflicts, the authorization of longlining may also reduce conflicts stemming from the sheer number of single lines present (e.g., conflicts with commercial and recreational salmon trollers).

Additionally, there are several information gaps related to longlining/duplexing which may have implications for entanglement incidence and severity. First, there is limited information about the entanglement risk posed by different groundline types, particularly for bottom feeding whale species (e.g., gray whales). Also, it is not known how longlining or duplexing might affect the severity and number of unreported entanglements if a whale becomes entangled with multiple pots which constrain their ability to move.

The challenges associated with authorization of longlining/duplexing may be partially addressed through a more targeted implementation approach. For example, implementation only in deeper water (e.g., outside 40 fathoms) and/or in the late-season (e.g., after May 1). If properly developed, longlining/duplexing could also potentially be implemented as an in-season adaptive response to elevated entanglement risk.

5.6.2.2 Full season pot limit reduction

A full season pot limit reduction is a potential measure that would reduce vertical lines throughout the entire season and provide a conservation benefit beginning at the start of the season. Early in the season, covered species are less abundant but can still be present off Oregon when substantially more gear is deployed.

This measure would affect all permit holders and has the potential to affect the distribution of catch and revenue across the season and among participants. For example, with a reduced pot limit, some participants that typically exit the fishery early may choose to participate longer or opt to forego some revenue. However, the level of pot limit reduction that may significantly impact catch and revenue is not known at this time. An assessment of catch and revenue following the implementation of pot limits in 2006 indicates that the annual pounds landed did not decline and that ex-vessel value has increased to record levels since that time. Additionally, an analysis of landings and earnings suggests that the distribution among participants also did not significantly change (ODFW, 2009).

While there is a small segment of the crab industry that support full season pot limit reduction, limited fleet support due to the potential impacts to the fishery remains the primary barrier to implementation at this time. A full season pot limit reduction may become a more viable option, if ongoing monitoring efforts indicate that gear deployed during the early season presents a greater entanglement threat to covered species than currently believed.

5.6.2.3 Permit stacking

Under current regulations, only one crab permit (with a single pot limit) can be attached to an individual vessel. Permit stacking is a potential future measure which would allow multiple permits to be assigned to the same vessel to achieve a higher combined pot limit, with some discount applied which reduces the overall number of pots fished. For example, two 500 pot permits on a single vessel may stack to allow for a discounted 750 total pots to be fished. The specific details of any future permit stacking plan would need to be carefully developed with industry input to create incentives that support the goal of gear reduction.

While there is a portion of the crab industry that supports the concept of permit stacking, there is concern among others regarding consolidation that restructures the fishery toward larger operations (i.e., vessels, companies, processors). Additionally, the design of a permit stacking plan would have to address concerns about the potential reactivation of latent permits (i.e., some portion of vessel permits which do not actively make landings into Oregon every year) (see *Section 2.2.5.2*). At this time, the challenge of designing a program that simultaneously meets conservation goals and addresses industry concerns remains a primary barrier to implementation.

5.6.2.4 License buyback

A license buyback program would permanently reduce the total amount of gear allowed in the fishery by eliminating permits through a voluntary buyback option. A buyback may impact the fishery by reducing opportunities for new entrants due to the reduced availability and increased cost of the more limited number of permits (i.e., fleet consolidation). Additionally, as with a permit stacking measure, a license buyback may raise concerns about the potential reactivation of latent permits (see *Section 2.2.5.2*) and consolidation towards larger operations.

At this time, the primary barrier to implementing a license buyback is the need to identify an adequate funding mechanism that enables the purchase of enough permits to meaningfully reduce risk.

5.6.2.5 Hot spot closures

Hot spot closures (or zonal closures) are a potential measure for reducing entanglement risk through the targeted removal of gear from areas of higher covered species abundance. The impact of hot spot closures on crab fishery participants are variable and dependent on when and where individuals are deploying gear.

The primary barrier to hot spot closures in Oregon is the expense of collecting ongoing, real-time information on the distribution of covered species. At this time, funding has been secured for whale surveys off Oregon through June 2022 (see *Section 5.3.2.6*); however, a long-term funding mechanism has not been identified.

An additional concern related to hot spot closures is the potential of creating a “curtain” effect where gear is concentrated around the perimeter of a closed area. This phenomenon has been observed in logbook data that indicate crab fishing concentrated around the perimeter of marine reserve sites at certain times off Oregon (ODFW, unpublished data). A dense aggregation of gear around a hot spot could greatly increase entanglement risk when animals pass through to move in or out of the area. This is different from current regulations that include a depth restriction (see *Section 5.3.1.1*), in that a hot spot closure would include a defined area based on real-time marine life concentrations that could potentially be boxed in with a curtain of gear that animals would have to pass through, rather than a north-south line that whales are not expected to move across in high abundance based on historical species distribution patterns.

5.6.2.6 Late-season limited entry program

A late-season limited entry program is a potential future measure which would ensure that an increase in entanglement risk is avoided by capping potential effort in the late-season when covered species are more abundant off Oregon. Participation in a late-season limited entry program would be restricted to only those crabbers or vessels with a history of participating in the late-season. As it is currently being considered, this measure would prevent an increase in entanglement risk but would not necessarily reduce risk, unless it was specifically designed to do so.

A control date of August 14, 2018 was adopted by the OFWC in September 2019 for participation in a potential late-season limited entry program (ODFW, 2019a). In effect, this ensures that only landings prior to that date will be considered in qualifying criteria during development of any future limit on participation in the late-season. The action to establish a control date was taken as a signal to industry that fishing activity after that date would not be considered in qualifying criteria, in order to reduce the motivation for a "prospecting" response.

The development and details of a potential limited entry program are contentious, as such a program inevitably creates winners and losers in terms of who obtains a late-season permit. At this time, the primary barrier to implementation is the wide range of options that would need to be considered and decided upon in order to design an effective program.

5.6.2.7 Tri-State coastwide pot limit

A Tri-State (or bi-state) pot limit is a potential mechanism for reducing gear coastwide, and particularly in border areas (e.g., the Columbia River) where excessive gear and crowding concerns from dual-permitted vessels exist. This type of program would involve a limit on the total number of pots that can be fished on the West Coast, regardless of how many pots a permit holder is authorized to use in a particular state. Similar to permit stacking, a dual permit holder with a 500 pot limit in Oregon and a 500 pot limit in Washington might be limited to a total of 750 pots, for example, if they chose to fish in both states within a crab season.

Impacts to the fishery would be limited to vessels permitted in two or all three West Coast states and would likely impact the distribution of catch and revenue geographically and among participants. Importantly, a Tri-State or bi-state pot limit would require substantial coordination and agreement from the other West Coast states which may be a challenge due to the diversity of perspectives and business plans within the coastwide fishery.

5.6.2.8 Implementation of "weak links"

"Weak links" or breakaway lines are fishing gear modifications designed to create a point in a line that breaks under a lower stress load than the rest of the line. In doing so, weak links can reduce the severity of entanglements (e.g., serious injury and mortality) by reducing weight on the line or helping entangled animals self-release from gear. However, weak links also make it possible for gear to break off for other reasons which may result in more lost pots or pots that are difficult to retrieve. For example, the unconsolidated sediments (e.g., sand, mud, or a mixture) which are common substrate along the U.S. West Coast pose a high risk of pots getting stuck on the seafloor. This was shown to be a challenge during WDFW testing of two breakaway devices (yale sleeves and breakaway swivel links) in 2019 which demonstrated that the force applied during retrieval of gear equipped with yale sleeves commonly exceeded the breaking strength of the device resulting in pot loss. The same testing yielded more promising results for breakaway swivel links which are attached to the gear in such a way that the same force is not applied to the device during retrieval.

Weak links could be a fairly inexpensive gear modification option; however, implementation would likely require crabbers to modify operations to adapt to running different gear which may result in lost time or revenue. Additionally, while weak links are widely used on the U.S. East Coast, their effectiveness there is still in question (Werner and McLellan-Press, 2016) and the feasibility of their use with the West Coast Dungeness crab fishery is even less certain. Humpback whales have less girth and strength than right whales (Knowlton *et al.*, 2015), which may affect the ability of humpback whales to exert enough force to break the weak link as intended. More information is needed to optimize tradeoffs between weak links that breaks too easily contributing to pot loss, and ones that does not break under the force exerted by humpback whales. Further testing is also needed to ensure a design that can be reliably retrieved under the ocean conditions present on the West Coast to avoid contributing to derelict gear. These challenges present the largest barriers to implementation of weak links at this time.

5.6.2.9 Implementation of "pop-up" gear

"Pop-up", "ropeless", or "on demand" gear has the potential to minimize or eliminate vertical lines through crab pot technology which secures the vertical line and buoy to the crab pot on the ocean floor until the pot is ready to be retrieved at which time the buoy and line is released up to the surface. Currently, pop-up gear is very expensive and would require fishery participants to invest in new gear, in addition to, the lost time and revenue associated with initially adapting to running different gear. The absence of a reliable, affordable, and effective option and the need for substantial gear testing present the largest challenges for implementation at this time. While implementation of pop-up gear on its own has limited fleet support at this time, there may be more interest in a combined approach where pop-up gear could be used in conjunction with longlined gear.

ODFW currently has the ability to authorize testing of otherwise illegal gear configurations, such as pop-up gear, through an Experimental Gear Permit (EGP) authorized under OAR 635-006-0020. The application process is largely informal and typically initiated by an applicant making a request to ODFW. ODFW then works with the applicant to determine if the gear is likely to be successful in meeting ODFW's goals for the fishery and conservation of species and habitats, and specify terms and conditions for permit issuance. Terms and conditions may include detailed specification of the permitted gear, limits on the amount of gear, spatial and temporal restrictions, and data collection by the applicant and/or ODFW. Permit duration is negotiable, but permits are typically annual. There is a nominal $30 fee for each EGP issued. Gear testing under an EGP must comply with all other commercial fishing regulations such as closed seasons and license and permit requirements. ODFW can authorize such testing for research purposes outside of season, under a Scientific Take Permit, which requires a more formal application and review process.

5.7 Reporting

ODFW will submit a progress report to NMFS regarding implementation of this CP every five years following permit issuance, with additional updates and coordination upon request by NMFS. Progress reports will include updates on performance and success criteria (see *Section 5.5*) over the previous five crab seasons, or since the last progress report was submitted. At a minimum, reports will contain the following information:

- Number of confirmed humpback whale, blue whale, and leatherback sea turtle entanglements in Oregon crab gear during each of the previous five seasons, relative to the anticipated take levels described in Table 4-3;
- Outcomes of annual co-occurrence assessments (once reliable models are available) and ongoing assessments of economic impacts of management measures on the crab industry as described in *Section 5.4.2.1*
- Line-days estimates to assess performance against criteria in Table 5-3;
- Descriptive information to assess performance against criteria in Table 5-4;
- Outcomes of any adaptive management consultation processes, including a description of the indicator of elevated risk, management responses considered, and rationale for the selected response as described in *Section 5.6.1*; and
- Progress and/or plans for development of future potential measures in *Section 5.6.2*.

Reports will be transmitted via email to WCR PRD staff and other employees, as directed by NMFS. Either ODFW or NMFS may request a meeting to discuss the report. Reports will also be made publicly available on ODFW's whale entanglement webpage.

5.7.1 Three-year evaluation report

Additionally, ODFW will submit a brief report at the end of the three-year evaluation period to evaluate the effectiveness of the combined late-season pot limit reduction and depth restriction first implemented in May 2021 (see *Section 5.3.1.1*). At a minimum, this report will include:

- Average active line-days fished in the late-season (May 1 through the end of the season) during each season following implementation of the measure;
- Average active line-days fished inside and outside of 40 fathoms during each month of the crab season following implementation of the measure;
- Relevant spatial or temporal information on whale distribution and co-occurrence with the crab fishery from work described in *Section 5.3.2.6*;
- Enforcement efforts or actions taken to ensure compliance with the measure;
- Relevant information gained from economic monitoring of crab fishery impacts following implementation of the measure; and
- An update on planning efforts and/or action taken to provide additional recommendations (e.g., continuation or modification of rule) to the OFWC prior to expiration of the rule.

This report will also be transmitted via email to WCR PRD staff and other employees, as directed by NMFS, and will be made publicly available on ODFW's whale entanglement webpage.

Section 6 Plan Implementation

6.1 Coordination and key partners

Successful implementation of this CP will require ongoing coordination between ODFW and various other partners and stakeholders described below. Partners will be consulted during two distinct phases. First, partners will be consulted during the issuance determination phase after the CP has been submitted to NMFS but before a determination is made to consider any modifications to the CP or ITP application that are needed based on input provided by NMFS. Partners will also be consulted throughout the permit term to facilitate coordination among the West Coast states, provide expertise to CP advisory committees, contribute to management decision-making, and carry out implementation of the CP.

6.1.1 National Marine Fisheries Service

ODFW has regularly consulted with NMFS staff from the WCR PRD on development of this CP, both one-on-one and through the Tri-State Committee, and will continue to collaborate throughout the ITP application and CP implementation processes. Following ITP issuance, ODFW as the permittee will be responsible for implementation of this CP. NMFS' role will be to verify that the terms and conditions of the ITP and accompanying CP are being fulfilled, via ongoing discussions and periodic reporting.

Additionally, as described in *Sections 5.6.1.2* and *5.6.1.3*, in the event that an entanglement trigger is reached and an adaptive management response is warranted, ODFW will initiate a consultation process with NMFS and other key partners to determine the best management response given the information available at that time.

6.1.2 Tri-State Committee

The Tri-State Committee, a permanent and routine component of West Coast Dungeness crab management since 1990, serves as a forum for regular coordination between state fishery managers and crab industry members from Washington, Oregon, and California to collaborate on fishery season structure and other issues facing the crab fishery, including conservation planning efforts in each state. WDFW and CDFW are currently preparing separate but analogous CPs for Washington and California, respectively, and have declared their intent to submit ITP applications to provide coverage for their respective commercial Dungeness crab fisheries. While the differences in each state's regulatory environment and fishery operations will be reflected in each CP, coordination has already occurred among the states and with NMFS involvement to align risk reduction measures and other key informational components, such as monitoring.

A consistent management approach among the states, in some circumstances, has the potential to provide additional entanglement risk reduction and improved data collection. To this end, ODFW will continue routine communication and data sharing with the other states and NMFS, in addition to regular participation in the Tri-State Committee.

6.1.3 Oregon Dungeness Crab Advisory Committee

ODFW works with ODCAC, a standing industry advisory body, to foster industry input on commercial crab management decisions. The group is comprised of harvesters and processors from all of the major crabbing ports in Oregon and was augmented in 2019 to include members of the ODCC, crab associations, and industry members from the OWEWG to further advise ODFW on management measures to address marine life entanglements. A small subset of ODCAC also represents industry at Tri-State Committee meetings.

ODCAC will be a key partner for ODFW during implementation of this CP by serving as an important conduit of information to the broader crab industry and providing industry expertise that is necessary for effectiveness monitoring, development of additional or alternative management measures, gear innovation, and evaluation of fishery impacts. ODFW is committed to maintaining this group for the duration of the requested ITP in order to continue carrying out these important functions. Additionally, a subset of ODCAC may be asked to participate in the various advisory committees described in *Section 6.1.5*.

6.1.4 Oregon Whale Entanglement Working Group

The OWEWG was convened by Oregon Sea Grant beginning in May 2017 with the primary goal of developing short- and long-term options for reducing the risk of whale entanglements in Dungeness crab and other fixed gear to ensure thriving and resilient fisheries in Oregon and along the entire West Coast. The group consists of representatives from Oregon's commercial fixed gear fishing fleet (crab and sablefish), a recreational crabber, a whale disentanglement specialist, a fishing gear expert, an OSU marine mammal expert, non-governmental organizations, the ODCC, and ODFW. For over two years, the OWEWG held regular meetings open to the public, which provided an important avenue for ODFW to gather public input regarding the fishery and best practices. In addition to serving as a forum for collaboration, the OWEWG produced a voluntary best fishing practices directive and developed preliminary recommendations focused on improving information about entanglements and management options to reduce risk, which formed the basis of many of the conservation measures described in *Section 5.3*.

The OWEWG is not currently meeting on a regular basis but may be convened on an ad hoc basis to address specific whale entanglement issues and continues to serve as a hub for communication and idea sharing. For example, the group was convened at the request of ODFW in January 2021 to solicit input and generate ideas related to the monitoring program in this CP. In this capacity, OWEWG will remain a key partner for ODFW during implementation of this CP and a subset of the working group may be asked to participate in the various advisory committees described in *Section 6.1.5*.

6.1.5 CP advisory committees

As detailed in *Section 5.2.2*, ODFW commits to convening and leading four advisory committees to fulfill several key objectives at least every five years throughout the permit period. Specific advisory committees will meet in order to evaluate and recommend the following:

- Gear modifications as they are demonstrated to be feasible for fishery operations and beneficial to covered species conservation off Oregon;
- Adaptations to the overall management strategy (including improvements and alternatives) that are at least as protective of covered species as the existing measures, to further reduce entanglement risk while supporting ODFW's ability to make targeted decisions that minimize impacts to the crab fishery;
- Further gear marking modifications to improve identification of gear involved in entanglement reports; and
- Research priorities to fill critical management information and research gaps for Dungeness crab, covered species, fishery gear, and management measures.

These advisory committees are likely to include participation by a subset of ODCAC and/or OWEWG, along with subject matter experts (e.g., marine mammal, fishery, disentanglement, gear), to ensure that recommendations are made based on the best available information at that time. In some cases, advisory committee discussions may also benefit from the involvement of Tri-State and NMFS partners. While each of the four committee meetings will be held separately, strong overlap in participation is expected.

A summary of ideas or recommendations generated from advisory committee processes will be included in progress reports submitted to NMFS every five years (see *Section 5.7*).

6.1.6 Oregon Fish and Wildlife Commission

The OFWC consists of seven commissioners who are charged with setting policies and developing general state programs that provide for the productive and sustainable utilization of fish and wildlife resources by all user groups. The OFWC adopts rules and regulations (OARs) related to recreational and commercial seasons, gear, and operations, including those conservation measures described in *Section 5.3* which have been adopted into rule to reduce entanglement risk and provide critical information about marine life entanglements. The OFWC will also contribute to the CP development process by approving the plan approach.

The OFWC will continue to be involved during implementation of this CP by considering ODFW staff recommendations and establishing additional or alternative regulations, as needed, that contribute to the fulfillment of this CP's objectives. All meetings of the OFWC are open to the public and therefore serve as an important conduit of information and opportunity for public comment.

6.1.7 Oregon State Police

Enforcement of fish and wildlife regulations (including state statute and rules, and federal statute and rule) in Oregon is primarily the responsibility of the OSP Fish and Wildlife Division, which includes a Marine Fisheries Team that is responsible for coastwide enforcement of commercial and recreational fishing regulations. As such, OSP Fish and Wildlife officers will enforce compliance with management measures implemented under this CP. Prior to regulations being adopted by the OFWC, ODFW consults with OSP on regulation development, language, and enforcement concerns. Therefore, all regulations that are currently in place have the support of OSP for implementation.

Additionally, personnel from ODFW and OSP meeting annually (or as needed) to discuss priority issues and objectives, and develop cooperative enforcement plans (CEPs) that ensure enforcement efforts are in line with ODFW's management priorities and goals. These meetings provide an opportunity to identify any enforcement challenges and develop an approach to address them.

6.2 Permit amendments, suspension, and renewals

Given the 20-year duration of the requested ITP, consideration should be given to the potential for changes to the CP or ITP, in accordance with the statutory and regulatory provisions of ESA and NEPA that govern changes to operations and documents.

6.2.1 Amendments

Each revision of the CP, section 7, or NEPA will not necessarily result in amendment of the ITP. The need to amend the ITP depends on the nature of the CP changes, how those changes need to be reflected in the ITP, and whether they would trigger additional section 7 or NEPA review. Either ODFW or NMFS can initiate amendments, but NMFS is responsible for determining the level of review needed to satisfy ESA requirements.

6.2.1.1 Minor amendments

Minor amendments are changes that do not affect the scope of the CP's impact and conservation strategy, change amount of take, add new species, and/or significantly change the boundaries of the CP. Minor amendment of this CP or the accompanying ITP may be accomplished through consultation between ODFW and NMFS without any notice to the public or comment period. Examples of minor amendments include:

- Clarification to address small errors, omissions, or language that may be too general or too specific for practical application;
- Correction of typographical, spelling, grammatical, or similar editing errors;
- Minor corrections in boundary descriptions or insignificant mapping errors;
- Correction of information or data that deviate from the references cited, provided the intended meaning of the amended text is not changed; and
- Minor modifications to monitoring, reporting, or analytical protocols.

ODFW or NMFS may initiate a minor amendment by providing the other agency with a written statement describing the reason for the amendment, its effect on CP implementation, and its impact on covered species. A minor amendment shall become effective after 45 days of such transmission, unless objected to by the other agency. ODFW will provide details of any modifications with the crab industry and public through appropriate communication streams (e.g., ODFW's whale entanglement webpage, industry notice, press release).

6.2.1.2 Major amendments

Major amendments to the CP and ITP are changes that do affect the scope of the CP and conservation strategy, increase the amount of take, add new species, and/or significantly change the boundaries of the CP. Major amendments often require amendments to NMFS' decision documents, including the NEPA document, the biological opinion, and findings and recommendations document. Major amendments will also often require additional public review and comment. Examples of major amendments include:

- Addition of new species, either listed or unlisted;
- Increased level or different form of take for covered species;
- Changes to funding that affect the ability of ODFW to implement the CP;
- Changes to covered activities not previously addressed;
- Changes to the covered area; and
- Significant changes to the conservation strategy, including changes to the conservation measures.

Prior to submitting a major amendment request to NMFS for approval, ODFW shall provide notice to the crab industry and public through appropriate communication streams (e.g., ODFW's whale entanglement webpage, industry notice, press release) to allow opportunity for public comment. Similarly, if a major amendment is initiated by NMFS, ODFW shall immediately provide notice to the crab industry and public, including details about known or anticipated opportunities for public comment that will follow.

6.2.2 Suspension/revocation

NMFS may suspend or revoke the ITP if ODFW fails to implement the CP in accordance with the terms and conditions of the ITP, or if suspension or revocation is otherwise required by law. Suspension or revocation of the section 10(a)(1)(B) permit, in whole or in part, by NMFS shall be in accordance with 50 CFR § 13.27-29, 17.32(b)(8).

6.2.3 Permit renewal

Upon expiration, the section 10(a)(1)(B) permit may be renewed without the issuance of a new permit, provided that the permit is renewable, and that biological circumstances and other pertinent factors affecting covered species are not significantly different than those described in the original CP. To renew the permit, ODFW shall submit to NMFS, in writing:

- A request to renew the permit;
- Reference to the original permit number;
- Certification that all statements and information provided in the original CP and permit application, together with any approved CP amendments, are still true and correct, and inclusion of a list of changes;
- A description of any take that has occurred under the existing permit; and
- A description of what activities under the original permit the renewal is intended to cover.

If NMFS concurs with the information provided in the request, it shall renew the permit consistent with permit renewal procedures required by 50 CFR § 13.22. If ODFW files a renewal request and the request is on file with the NMFS office at least 30 days prior to the permit's expiration, the permit shall remain valid while the renewal is being processed, provided the existing permit is renewable. However, ODFW may not take listed species beyond the quantity authorized by the original permit or change the scope of the CP. If ODFW fails to file a renewal request within 30 days prior to permit expiration, the permit shall become invalid upon expiration. ODFW must have complied with all reporting requirements to qualify for a permit renewal.

6.3 Changed circumstances

Section 10 regulations (69 *Federal Register* 71723, December 10, 2004 as codified in 50 CFR § 17.22(b)(2) and 17.32(b)(2)) require that a CP specify the procedures to be used for dealing with changed and unforeseen circumstances that may arise during the implementation of the CP. In addition, the CP No Surprises Rule (50 CFR § 17.22(b)(5) and 17.32(b)(5)) describes the obligations of the permittee and NMFS. The purpose of the No Surprises Rule is to provide assurance to the entities participating in conservation planning under the ESA that no additional restrictions or funding will be required for species adequately covered by a properly implemented CP, in light of unforeseen circumstances, without the consent of the permittee.

Changed circumstances are defined in 50 CFR § 17.3 as changes in circumstances affecting a species or geographic area covered by a CP that can reasonably be anticipated by plan developers and NMFS and for which contingency plans can be prepared (e.g., the new listing of species, a fire, or other natural catastrophic event in areas prone to such event).

If additional conservation measures are deemed necessary to respond to changed circumstances and these additional measures have already been provided for in this CP's operating conservation program (e.g., the conservation management activities or measures expressly agreed to in this CP), then ODFW will implement those measures as specified. However, if additional conservation measures are deemed necessary to respond to changed circumstances and such measures have not been provided for in this plan's operating conservation program, NMFS will not require these additional measures absent the consent of ODFW, provided that this CP is being "properly implemented" (properly implemented means the commitments and the provisions of this CP have been or are fully implemented).

The following subsections describe reasonably foreseeable changes in circumstances that may affect the species or plan area covered by this CP.

6.3.1 Newly listed species

If a new species that is not covered by this CP, but that may be affected by activities covered by this CP, is listed under the ESA during the term of the section 10(a)(1)(B) permit, the permit will be reevaluated by NMFS. ODFW will collaborate with NMFS and key partners, when appropriate, to reevaluate the CP conservation strategy and jointly determine how the CP covered activities may be modified, as necessary, to ensure that the activities covered under this CP are not likely to jeopardize or result in the take of the newly listed species or adverse modification of any newly designated critical habitat. ODFW shall implement the modifications to the CP covered activities jointly identified by NMFS and ODFW as necessary to avoid the likelihood of jeopardy to or take of the newly listed species or adverse modification of newly designated critical habitat. ODFW shall continue to implement such modifications until such time as ODFW has applied for and NMFS has approved an amendment of the section 10(a)(1)(B) permit, in accordance with applicable statutory and regulatory requirements, to cover the newly listed species or until NMFS notifies ODFW in writing that the modifications to the CP covered activities are no longer required to avoid the likelihood of jeopardy of the newly listed species or adverse modification of newly designated critical habitat.

6.3.2 Delisting of covered species

If a species that is covered by this CP is delisted under the ESA during the term of the section 10(a)(1)(B) permit, coverage of that species under this CP will cease, effective at the time that NMFS' decision is published in the *Federal Register*. At this time, any exceedance of the take allowances for the delisted species will not constitute a violation of ESA requirements; however, ODFW will continue to report on fishery impacts to the delisted species (in accordance with the reporting protocol in *Section 5.7*) for the term of the permit. At the time of delisting, all conservation measures included in the conservation strategy will remain in effect; however, ODFW will collaborate with NMFS and key partners, when appropriate, to reevaluate each measure and jointly determine if changes may be made to lessen impacts to the crab fishery while maintaining the protections in place for the remaining covered species. If modifications to the conservation strategy are warranted, ODFW shall continue to implement the original conservation strategy until such time as ODFW has applied for and NMFS has approved an amendment of the section 10(a)(1)(b) permit, in accordance with applicable statutory and regulatory requirements.

If ODFW requests a permit renewal upon expiration of the original section 10 permit, any delisting of a covered species during the original permit term will be documented in the list of changes that ODFW submits to NMFS (see *Section 6.2.3*). Under the renewed permit, ODFW will no longer be required to continue reporting on fishery impacts to the delisted species.

If a species is downlisted (from endangered to threatened) during the term of the section 10 permit, no change in species coverage will take place; however, updated information that contributed to the decision to downlist the species may be used to amend the terms and conditions of the CP and ITP, as described in *Section 6.3.4*.

6.3.3 Designation or revision of critical habitat within the plan area

As described in *Section 4.3*, the covered activities in this CP and the accompanying ITP are unlikely to negatively impact humpback whale or leatherback sea turtle critical habitat designated within key portions of the CP plan area. Additionally, although critical habitat has not been designated for blue whales, ODFW is not aware of any direct or indirect threats posed by the crab fishery to blue whale habitat that would impact recovery of the species. For this reason, designation or revision of critical habitat within the plan area is not expected to directly result in the need for any additional conservation measures or management activities.

However, designation or revision of critical habitat may constitute a significant improvement in species distribution information and warrant reevaluation of the existing CP conservation measures and initiation of an amendment process (as described in *Section 6.2.1*).

6.3.4 Changes to covered species abundance estimates, stock delineation, and/or distribution information

Over the term of the section 10 permit, the best available scientific information on species' and/or stocks' geographic range, population structure, growth trends, and abundance will continue to evolve. Consequently, NMFS will periodically review and report the stock status of each covered species in this CP.

ODFW will continue to rely on the best available scientific information for evaluating the effectiveness of CP conservation measures and the progress of the fishery towards minimizing impacts on covered species. As new information is collected, revisions to this CP may warrant ODFW submitting either a minor or major amendment request to NMFS (as described in *Section 6.2.1*).

6.3.5 Changes to take estimates and anticipated impacts on covered species

Reporting and documentation of whale and sea turtle entanglements are expected to improve over the term of the section 10 permit as a result of the conservation measures implemented through this CP and similar efforts being implemented in other West Coast fisheries to improve identification of entangling gear, along with efforts by NMFS to improve the quality of documentation and evaluation of entanglement events (see *Section 4.1.1*). As a result, the overall number of entanglement reports may increase and the proportion of entanglement reports for which gear can be positively identified or attributed is expected to increase. ODFW will work with NMFS to evaluate available data and consider whether additional analyses are needed to determine whether the number of entanglement reports is indicative of an increase in entanglement events, or an increase in the reporting rate.

ODFW will review all new entanglement reports involving Oregon crab gear and unidentified or unattributed gear, in relation to the West Coast entanglement record, over the term of the section 10 permit. Updated information will be applied to the take assessment method and anticipated impacts determination described in *Section 4* of this CP, or to an updated method based on new information, if agreed upon by NMFS. This will be reported to NMFS at least every five years (see reporting requirements in *Section 5.7*). If significant changes to the requested take levels in *Section 4.2* are warranted, ODFW will initiate a major amendment request (as described in *Section 6.2.1.2*).

6.4 Unforeseen circumstances

Unforeseen circumstances are defined in 50 CFR § 17.3 as changes in circumstances that affect a species or geographic area covered by the CP that could not reasonably be anticipated by plan developers and NMFS at the time of the CP's negotiation and development and that result in a substantial and adverse change in status of the covered species. Assuming that the CP is being properly implemented, the purpose of the No Surprises Rule is to provide assurances to the permittee that NMFS will not require additional measures or funding beyond what was agreed to in the CP, in light of unforeseen circumstances, without the consent of the permittee.

In the case of an unforeseen event, ODFW shall immediately notify the NMFS staff who have functioned as the principal contacts for the proposed action. In determining whether such an event constitutes an unforeseen circumstance, NMFS shall consider, but not be limited to, the following factors:

- Size of the current range of the affected species;
- Percentage of range adversely affected by the CP;
- Percentage of range conserved by the CP;
- Ecological significance of that portion of the range affected by the CP;
- Level of knowledge about the affected species and the degree of specificity of the species' conservation program under the CP; and
- Whether failure to adopt additional conservation measures would appreciably reduce the likelihood of survival and recovery of the affected species in the wild.

If NMFS determines that additional conservation measures are necessary to respond to the unforeseen circumstances where the CP is being properly implemented, the additional measures required of ODFW must be as close as possible to the terms of the original CP and must be limited to the CP's operating conservation program for the affected species, and maintain the original terms of the plan to the maximum extent possible. Additional conservation measures shall involve additional resource commitments or restrictions on the crab fishery otherwise allowed under original terms of the CP, only with the consent of ODFW.

Section 7 Funding

Implementation of this CP will require substantial investment of state resources, along with engagement of various partners from federal agencies, the crab industry, and non-governmental organizations.

7.1 Program Funding

ODFW is a moderate-sized executive branch state agency, responsible for fish and wildlife management, harvest, and expertise for the state of Oregon. The agency has approximately 1200 FTE and a current biennial budget of around $421 million. ODFW is subject to all Oregon state agency funding and budgeting rules, regulations, and processes, and is primarily funded through a two-year (biennial) budget cycle (July 1 of an odd-numbered year through June 30 of the next odd-numbered year). Funding sources include general funds from Oregon income taxes, funds from fees, permits, and licenses required of commercial and sport fisheries, federal grants, and other minor funding sources. The Oregon State Legislature appropriates and allocates funding on the biennial cycle to all state agencies, including ODFW. Generally, the agency receives base funding for positions and supplies and services costs that support those positions and the programs they implement. In addition, each biennial cycle includes proposals from the agency for special projects or augmentation of base funding.

As part of ODFW's Fish Division, the Marine Resources Program (MRP) is responsible for assessing and managing Oregon's marine stocks of fish and shellfish and their habitats, reporting on species status, and making technical and policy recommendations to ODFW's rulemaking body (the OFWC) and other resource management bodies (state, federal, tribal, etc.). The MRP has about 60 full-time permanent staff and 70 seasonal employees (approximately 100 FTE), and a 2021-2023 biennial operating budget of about $24.1M, which draws largely from dedicated state funds (licenses and fees), general funds, and federal funds. Legislative approval for ODFW's staffing and budget has generally been stable or growing since the late 1990s (over the past 10 – 12 biennia), including staffing and funding appropriated to the MRP. The legislative budget process generally provides inflationary adjustments to status quo program and allows for proposing program additions.

The MRP's core Dungeness crab management staff will be the primary staff implementing the CP and are part of the agency's base funding. For implementation of the CP beyond the capacity of the core staff, which could include data analysis, field work, and other expertise, the agency has a diversity of staff and skills represented in the MRP (also as base funding) and has some ability within base funding to bring in staff to work on crab-related projects for selected periods of time (see *Section 7.2.1* for a description of several MRP project areas). Finally, funding can be requested for augmentations in staff and resources during each budget cycle. These requests are reviewed and approved (or removed) at several stages during the budget development process for each biennium.

Within the overall agency biennial budget, program allocations are proposed by agency leadership, formally supported in successive steps by the OFWC and governor, and ultimately approved in the legislative budget process. As described in *Section 6.1.6*, the OFWC is also responsible for adopting rules related to crab fishery operations, including the conservation measures which have already been adopted in response to the marine life entanglement issue (see *Section 5.3*). OFWC leadership is intimately involved in long-term commitments of the agency, including the commitment of the agency to the CP process and implementation terms and conditions. In addition, and by way of providing assurance, the commercial Dungeness crab fishery is Oregon's most valuable single-species fishery and ODFW, the OFWC, the governor, and the Legislature place a high priority on supporting management actions that affect the fishery.

The ODFW budget has been stable or growing for some time, with key augmentations in staffing that specifically benefit Oregon's ability to manage the ocean commercial Dungeness crab fishery as described in *Section 7.2*. Due to the nature of the budget allocation process, availability of funds cannot be guaranteed throughout the duration of the ITP; however, there is no reason to believe that this will change substantially in the future. Table 7-1 provides retrospective information on the agency and MRP budget over the last five biennia in demonstration of budget stability. To the extent allowable with the Oregon state agency budgeting process, ODFW will direct staff resources as described in *Section 7.2.1*.

Table 7-1. Retrospective of ODFW and MRP budget and staffing.

Biennium	ODFW budget	MRP budget	MRP staff capacity
2021–2023	$421 million	$24.1 million	98.16 FTE
2019–2021	$397 million	$22.3 million	94.15 FTE
2017–2019	$364 million	$20.6 million	90.88 FTE
2015–2017	$359 million	$19.1 million	90.13 FTE
2013–2015	$344 million	$19.1 million	93.24 FTE

7.2 Estimated costs

The primary costs of this CP will be personnel costs for ODFW staff, as described below. Currently, funding is secured to cover the personnel costs required for implementation of the conservation measures described in *Section 5.3* and the short-term adaptive management responses described in *Section 5.6.1.3* which largely involve adjustments to the existing primary risk reduction measures. However, limited or lacking funding is a primary barrier to implementation for several of the future potential adaptive measures in *Section 5.6.2* and will have to be identified and/or pursued in the future in order to be implemented, if determined necessary.

7.2.1 ODFW personnel costs

Within MRP, ODFW has three full-time permanent staff whose responsibilities include management and mitigation of marine life entanglement issues in Dungeness crab gear, including the Marine Resources Program Manager, the State Fisheries Manager, and the Ocean Commercial Dungeness Crab Fishery Manager. The last was a legislatively-approved addition to MRP's staffing, which was filled in 2010, due to the recognized need for additional staffing capacity to meet the growing management responsibilities of the crab fishery. These three staff have been, and will continue to be, central to successful development and implementation of this CP, including key roles such as:

- Routine monitoring of available data streams (see *Section 5.4*);
- Implementation of this CP's adaptive management strategy (see *Section 5.6*);
- Coordination with NMFS staff regarding reported entanglement events, adaptive management decision making, and CP implementation;
- Participation in, and oversight of, CP advisory committees (see *Section 6.1.5*);
- Development and submission of progress reports, including necessary analyses, to NMFS (see *Section 5.7*);

- Collaboration with CDFW and WDFW staff through the Tri-State Committee to coordinate management strategies across the West Coast;
- Pursuance of funding and research collaborations (e.g., the Northwest Fisheries Science Center, the Southwest Fisheries Science Center, academic researchers) to fill critical information gaps, conduct monitoring, and carry out reporting, as funding allows; and
- Outreach to Dungeness crab fishery participants, stakeholders, and other coastal and ocean users about CP implementation and conservation measures.

Staffing costs for the primary staff involved in CP implementation are provided in Table 7-2.

Table 7-2. Estimated staffing costs for core crab management necessary to support CP implementation over the 20-year permit term. For each position, an annual cost (salary + benefits) is provided as of July 1, 2021. Based on an estimated percentage of workload/time spent on CP implementation, a cost of use is estimated for the 20-year permit term. Total 20-year staffing costs include the cost of use plus 10% for S&S including office costs, computer/phone costs, travel costs, etc. All estimates are provided in 2021 dollars, not adjusted for future inflation.

Personnel	Annual cost of position	% Workload for CP implementation	20-year cost of use	20-year S&S (at 10%)	20-year staffing cost for CP implementation
Marine Resources Program Manager	$184,908	15%	$554,724	$55,472	$610,196
State Fisheries Manager	$171,024	25%	$855,120	$85,512	$940,632
Ocean Commercial Dungeness Crab Fishery Manager	$138,816	75%	$2,082,240	$208,224	$2,290,464
Total staffing cost supporting CP implementation over permit term					$3,841,292

In addition to the staff with dedicated roles related to this issue, the MRP also has staff actively involved in the management of the crab fishery that will support CP implementation, including the Crab and Shrimp Assistant Project Leader and Commercial Crab sampler(s). Activities carried out by these positions have included assistance with preseason testing, dockside and at-sea sampling, logbook data entry and analysis, implementation of the post-season derelict gear program, and industry outreach and engagement. Additional activities may be built into the responsibilities of these support staff over time, as implementation needs evolve. Funding for these positions are standard costs for the management of the crab fishery and are not detailed here.

MRP is a diverse community of biologists and ocean resource experts, who collectively have significant expertise on ocean species and issues. Therefore, MRP will serve as a resource and provide opportunities for collaboration with the core ocean commercial Dungeness crab fishery management team. More specifically, MRP staff have expertise which may be leveraged in certain situations to help respond to CP implementation needs. While staff from these areas do not have specific roles related to CP implementation, the flexibility to draw from these projects to enrich the work being done to address this issue is largely at the discretion of the MRP and is an important component of this CP's overall funding plan.

There are four additional teams within MRP that are particularly poised to collaborate with the crab team. The Marine Fisheries Research Project conducts finfish-related fishery-independent scientific research to support management decision-making. Staff from this project possess interdisciplinary expertise and experience collaborating with a variety of partners on research related to marine species, habitats, and changing ocean conditions. This team and the Marine Habitat team both spend considerable time at-sea each year. The Marine Habitat Project has both a management and research focus. Among other things, the Marine Habitat Project is charged with providing scientific and policy analysis to inform management decisions regarding emerging and ongoing issues involving marine habitats and associated biological communities. The Marine Mammal Project focuses on pinniped management and research, but also works more broadly to provide sound information on marine mammal populations that can be used to support a balanced approach to the conservation of both fishery resources and marine mammal populations. Finally, the Shellfish Program is responsible for monitoring, assessing, and managing a number of recreational and commercial shellfish fisheries in Oregon. The Shellfish Program has expertise in management of the recreational and bay commercial crab fisheries. As CP implementation evolves, the expertise of these four teams is likely to become part of the CP's targeted adaptive management and monitoring approach.

Beyond MRP staff, ODFW personnel from other areas of the agency including the Information and Education Division (I&E), Administrative Services Division (ASD), and Information Systems Division (ISD) will also play roles in CP implementation. Recent examples of involvement from these areas include I&E assistance with news releases, ASD issuance of buoy tags and one-time retrieval waivers, and ISD development of a centralized crab logbook database to improve data management and prepare ODFW to better receive electronic logbook data in the future. A similar level of assistance is anticipated during CP implementation; however, it will be difficult to estimate the actual costs from these areas until that time.

Additionally, senior management within ODFW and MRP will also be highly engaged throughout the permit term.

7.2.2 Monitoring costs

ODFW is committed to implementing the monitoring program described in *Section 5.4* and will seek funding for one full-time staff position to carry out all aspects of the program. Key responsibilities for this position will include:

- Developing outreach materials to promote existing ad hoc reporting channels (particularly the Whale Alert app) and entanglement response best practices;
- Developing the necessary observation protocols and training programs for volunteer surveys and the augmentation of existing research surveys to include a covered species monitoring component;

- Establishing research collaborations, conducting volunteer recruitment, and maintaining observation networks over the permit term;
- Conducting statistical analyses to expand data and improve understanding of detection rates and broader fishery impacts on covered species;
- Using combined covered species and fishery effort distribution data to assess co-occurrence as a proxy for entanglement risk, and evaluate management measure effectiveness; and
- Compiling and synthesizing monitoring data to support analyses that inform management and fulfill CP reporting requirements.

Estimated ODFW staffing costs specific to implementation of the CP monitoring program are provided in Table 7-3.

Table 7-3. Estimated staffing cost for ODFW personnel to support the CP monitoring program over the 20-year permit term. A cost of use is estimated for the 20-year permit term based on a constant annual cost (salary + benefits), assuming 100% of this staff time is spent on CP monitoring program implementation. Total 20-year staffing cost includes the cost of use plus 10% for S&S including office costs, computer/phone costs, travel costs, etc. All estimates are provided in 2021 dollars, not adjusted for future inflation.

Personnel	Annual cost of position	% Workload for CP implementation	20-year cost of use	20-year S&S (at 10%)	20-year staffing cost for CP implementation
CP monitoring program staff	$138,816	100%	$2,776,320	$277,632	$3,053,952

Any monitoring activities beyond those committed to in *Section 5.4* (e.g., additional aerial surveys) will require funds beyond those staffing costs detailed above. ODFW will seek special project funds to be used for any monitoring needs beyond those described in the base program.

7.2.3 Enforcement costs

As described in *Section 6.1.7*, OSP Fish and Wildlife personnel will be primarily responsible for enforcing compliance with the management measures implemented under this CP. OSP is comprised of approximately 660 sworn personnel across all divisions. Of those sworn positions, 128 are assigned to the Fish and Wildlife Division. The OSP Fish and Wildlife Division has been responsible for enforcing Oregon's statutes and rules related to wildlife since the establishment of the Oregon State Police in 1931.

Similar to ODFW budget, OSP budget is determined biennially by the Oregon State Legislature. While staffing and budgets have some changes across time, the OSP budget and staffing for fish and wildlife priorities has been relatively stable or grown over the past five biennia (Table 7-4).

Table 7-4. Retrospective of OSP and Fish and Wildlife Division's budget and staffing.

Biennium	OSP Legislative Approved Budget[a]	OSP F&W Budget	F&W Sworn Capacity (FTE)
2021-23	$664 Million	$59 Million	128
2019-21	$496 Million	$55 Million	126
2017-19	$419 Million	$47 Million	120
2015-17	$380 Million	$42 Million	120
2013-15	$326 Million	$38 Million	117

[a]Figures do not include Office of State Fire Marshal (OSFM).

Within the Fish and Wildlife Division is the Marine Fisheries Team (MFT) which currently has one Sergeant and seven Troopers assigned to OSP offices in Astoria, Newport, Florence, Coos Bay, and Gold Beach. The MFT was established in 2015 to provide a more focused and consistent approach to enforcing Oregon's statutes and rules related to various commercial fisheries. In addition to the MFT, there are another 18 Fish and Wildlife Troopers who are assigned to offices along Oregon's coast and often assist the MFT with enforcement duties.

Staffing costs specific to the MFT as they relate to the CP are provided in Table 7-5.

Table 7-5. Estimated staffing costs for the MFT Troopers, not including the Sergeant, necessary to support enforcement of the CP over the 20-year permit term. For each position, an annual cost (salary, benefits, S&S) is provided at their respective top step level as of July 1, 2021. S&S includes things such as office costs, computer/phone costs, travel costs, etc. Based on an estimated percentage of workload/time spent on CP implementation, a cost of use is estimated for the 20-year permit term. All estimates are provided in 2021 dollars, not adjusted for future inflation.

Personnel	Annual cost of positions	% Workload for CP implementation	Annual cost of use	20-year cost of use
MFT Trooper (7)	$1,266,142[a]	10%	$126,614	$2,532,280

[a]Does not include capital outlay for things such as vehicles or other assets.

Additionally, senior management within OSP will also be highly engaged throughout the permit term.

In 2010, the OSP Fish and Wildlife Division purchased the patrol vessel Guardian. The Guardian is a former charter vessel that is 50 feet in length and equipped with a hydraulic crab block used for pulling and inspecting gear. There are associated costs with the use of the Guardian related to inspecting and seizure of crab gear. The annual operating costs of the Guardian (fuel, maintenance, moorage, etc.) are approximately $25,000, barring any major mechanical issues. The Guardian is currently moored at the Port of Newport, which is centrally located along the Oregon coast. Due to the relatively new regulations implemented to mitigate whale entanglements associated with crab gear, it is difficult to assess what the overall increased costs are related to the Guardian's usage solely for this purpose. However, in 2020, OSP F&W members worked almost 500 hours on the Guardian focused on Oregon's commercial Dungeness Crab fishery.

7.3 Partners

There are several entities that have been involved in funding recent projects or activities related to reducing the risk of marine life entanglements.

7.3.1 Pacific States Marine Fisheries Commission

The Pacific States Marine Fisheries Commission is an interstate compact agency that aims to promote and support policies and actions to conserve, develop, and manage fishery resources in a five-state member region (i.e., Alaska, California, Idaho, Oregon, and Washington). The PSMFC is led by 15 commissioners, three from each member state, including one representative from each state's fisheries management agency, one appointed by the State Legislature, and one private citizen appointed by each state's governor. A separate representative from each state's fisheries management agency serves as coordinator for their state. Through consultation with a fishing industry advisory committee, the commission members are responsible for setting policy, approving budgets, and providing direction to staff for all PSMFC activities. In this way, ODFW works with other resource agencies and the fishing industry to determine how federal and other funds may be directed to address regional needs.

PSMFC is designated to support the implementation of the Tri-State MOU and Tri-State protocol that calls for management coordination among California, Oregon and Washington on Dungeness crab fishing grounds from the Mendocino-Sonoma County border (near Point Arena, CA) to the US-Canada border (see *Sections 1.5.2.1 and 2.2.4*). PSMFC has supported the Tri-State discussions on regional issues and is committed to continuing to play this role through agreement with the states and with NMFS. Among other regional issues, PSMFC has committed time and funding support to better understanding marine life entanglements and finding solutions to reduce the risk of entanglement. In addition to supporting the Tri-State Committee discussions on entanglement risk reduction planning, PSMFC has been active on this issue in three key areas: 1) convening workshops to raise awareness, identify gear innovations, and develop risk reduction measures across the region, 2) participating in each state's whale entanglement working groups, and 3) facilitating testing of vessel location monitoring devices (for accountability and potentially informing hotspot management).

PSMFC has helped convene several multi-state workshops involving fishing industry members, marine mammal and gear experts, and state, federal, and tribal managers. Since 2017, this has included three workshops designed to facilitate information sharing, improve collective knowledge about whale entanglements, review forensic data provided by gear removed from entangled whales, and develop recommendations for gear innovations and other options to reduce entanglement risk. PSMFC staff have then participated in each of the three state's whale entanglement working groups to provide input and help shepherd the discussions.

Most recently in 2020, PSMFC secured a number of solar vessel logger units that were provided to captains along with one year of paid data transmission, in order to test system performance and data quality. The results of this testing will be of strong interest to all three West Coast states which are currently interested in pursuing lower-cost, near-real-time vessel monitoring tools to further strengthen crab traceability and help inform whale entanglement risk reduction measures. PSMFC will continue to support the Tri-State Dungeness crab fisheries in similar ways in the future, funding dependent.

At the policy level and starting in 2016, PSMFC Commissioner annual resolutions have included a commitment to working on the marine life entanglement issue with the states, federal entities, industry members, and non-governmental organizations (PSMFC, 2019). Based on this commitment and examples of past funding provided in support of this issue, it is reasonable to expect that ODFW will continue to work with and/or pursue funding from PSMFC to support activities related to CP implementation in the future.

7.3.2 Oregon Dungeness Crab Commission

The Oregon Dungeness Crab Commission is an industry-funded commission established by Oregon's Commodity Commission Act of 1977 (ORS § 576.051 to 576.455 and 576.991 (2)), that works on behalf of Oregon's commercial crab fishery. Eight commissioners are appointed by the director of the Oregon Department of Agriculture so that a majority of members are harvesters, two members are processors, and one is a member of the public at large (OAR 645-030). The ODCC directs Dungeness crab marketing, but also plays an important role in scientific research, sustainability certification, education/outreach projects, advocacy, and provides industry input on fishery-related regulatory and policy processes. The ODCC also acts as an important conduit on information between resource managers and the commercial crab fishing fleet, and serves as a member of the Oregon Dungeness Crab Advisory Committee and the Oregon Whale Entanglement Working Group. The Crab Commission budget is appropriated from an assessment on crab landing value ($) into Oregon. The annual value of crab landings has been stable or increased over the past several years, which has provided a stable or increasing budget for the commission to use in support of the discretionary activities described above.

The ODCC has been involved in addressing the issue of marine life entanglements through each of the roles described above. In 2019, the ODCC provided the initial funding to cover the first year of aerial surveys to collect seasonal whale distribution data off Oregon as part of the collaborative research project described in *Section 5.3.2.6*. The continuation of this work was supported through a Section 6 Species Recovery grant under the ESA and will be used to better understand spatial and temporal entanglement risk in Oregon waters. Additionally, in 2020, the ODCC sponsored a study to utilize an existing bioeconomic model to investigate the economic tradeoffs associated with two whale entanglement risk reduction measures, a late-season pot limit reduction and an early season closure, that have been considered for implementation in Oregon.

Furthermore, the ODCC provided funding during the 2019-20 and 2020-21 crab seasons to offset the increased costs that were transferred to the crab industry, resulting from the issuance of double-sided buoy tags for improved gear identification (see *Section 5.3.2.3*). The ODCC also committed funds for assisting with CP development which supported a limited duration ODFW staff position brought on in December 2020 to draft this CP and conduct appropriate data and policy assessments through December 2021.

Based on the ODCC's demonstrated commitment to participating in and supporting efforts to address issues facing the Oregon crab fishery, it is likely that ODFW will continue to work with and/or seek support from the ODCC to carry out activities related to CP implementation.

Section 8 Alternatives

Section 10(a)(2)(A)(iii) of the ESA and its regulations require that alternatives to the taking of federally listed species be considered and reasons why such alternatives are not implemented be discussed.

8.1 No-action alternative

A no-action alternative means that ODFW will not apply for an ITP. Under a no-action alternative, current conditions and activities that will not cause take of federally listed species could continue.

The first no-action alternative considered by ODFW would be to maintain operation of the crab fishery without taking any action to apply for an ITP. Under this scenario, any incidental take of ESA-listed species by the fishery would be prohibited under Section 9 of the ESA. At this time, a fishery management regime that will ensure that no take of federally listed species will occur has not been identified. Therefore, this alternative would leave ODFW vulnerable to legal action or enforcement penalties under the ESA and MMPA, and is not considered to be a viable option.

8.2 Fishery closure

A second no-action alternative considered by ODFW would be to implement a complete fishery closure in order to ensure that no incidental take of federally listed species will occur, thereby eliminating the need for ODFW to act to apply for an ITP.

As described in *Section 5.2*, the vision of this CP is to align management and conservation so that the economically and cultural important crab fishery and thriving ESA-listed whale and sea turtle populations can co-exist. The no-action alternative would directly contradict this vision and could result in complete economic collapse of the fishery which would result in significant negative impacts to the entire Oregon commercial fishing industry and the coastal communities that they support. For this reason, this alternative is not considered to be a viable option.

8.3 Permanently shortened season

The primary management approach described in *Section 5* is focused on reducing the amount of crab gear present off Oregon when and where entanglement risk is expected to be higher, based on species migration and entanglement patterns. Currently, this includes a reduction in pot limits beginning on May 1, which will be continued or modified based on a thorough evaluation process after a three-year period. Throughout the development of this CP's conservation program, ODFW considered permanently shortening the fishery season to a historically lower risk period by implementing an earlier season closure (e.g., April 1). However, this alternative was rejected due to the significant economic impacts to the crab fishery that are expected to result, particularly to the portion of the crab fleet that depend on spring and/or summer revenue for business vitality (see 'Summers' in *Section 2.2.11.3*).

Recently, the ODCC sponsored a study utilizing the existing crab fishery bioeconomic model (see *Section 2.2.6.1*) to determine economic impacts that could be expected from a suite of entanglement risk reduction management actions, including a season closure (implemented on the first day of April, May, or June) and a pot limit reduction (by 10%, 20%, or 30% starting in April, May, or June). This study demonstrated that the currently implemented 20% pot limit reduction on May 1 is expected to result in a 0.36% decrease in total harvest value, relative to the average revenue over the base period. A season closure on April 1, on the other hand, is expected to result in a nearly 5.7% decrease in total harvest value. When itemized by vessel class, an April 1 closure would mean the 'Summers' vessel class would lose over $21,000 per vessel on average, which is 16.4% of their fishery revenue. At the same time, impacts to other vessel classes range from a 4.1% loss to a 1.8% gain in their revenue (Davis and Sylvia, 2020).

A permanently shortened season is considered an extreme option that may result in unacceptable impacts to some sectors or individuals within the crab fishery. For this reason, this alternative was not proposed as a conservation measure in this CP; however, an earlier season closure remains an option that could be implemented as an adaptive management response (see *Section 5.6.1.3*).

8.4 Longlining/duplexing requirement

Section 5.6.2.1 describes the authorization of longlining or duplexing (i.e., two crab pots connected to a single vertical line) as a potential mechanism for significantly reducing the number of vertical lines, while still allowing a higher number of pots to be fished. While this option remains a viable future potential measure for implementation in certain areas and/or during a portion of the crab season, ODFW considered and rejected an alternative management approach involving a longlining/duplexing requirement in all areas throughout the season. Gear conflicts and enforcement concerns are the primary barriers to widespread implementation of longlining/duplexing. While there may be an opportunity for strategically implementing longlining in areas where gear conflict is expected to be less, the risks associated with implementation in high traffic areas or during peak harvest at the start of the crab season would likely be significant.

8.5 "Pop-up" gear requirement

Section 5.6.2.9 describes the implementation of "pop-up" or "ropeless" gear as a potential future technological option for minimizing or eliminating vertical lines. ODFW considered whether a requirement for pop-up gear was a viable alternative for implementation immediately, and determined that a reliable, affordable, and effective technological option does not exist that meets the needs of management and industry.

ODFW currently has the ability to authorize testing of pop-up gear and gear innovations through an Experimental Gear Permit and will continue to support gear innovation and testing off Oregon. ODFW will also pursue regulatory actions to implement gear configuration and design improvements, as they are demonstrated to be feasible for fishery operations and beneficial to covered species conservation. However, implementation of a requirement for pop-up gear at this time is not practical given the existing technological limitations.

8.6 Alternative capacity reduction strategies

Co-occurrence between crab gear and covered species may be reduced through targeted capacity reduction by decreasing the amount of gear deployed by each crab fishery participant, decreasing the overall number of participants, or some combination of both. *Section 5.3.1* describes a series of risk reduction measures implemented in the crab fishery that focus on restricting the amount of gear deployed off Oregon when and where ESA-listed species are expected to be present (i.e., when entanglement risk is elevated). However, ODFW has also considered several other potential strategies that are focused on reducing the number of participants in the Oregon crab fishery to provide an additional or alternative reduction in the amount of gear deployed. These include implementation of permit stacking, a late-season limited entry program, or a license buyback program.

A detailed description of each potential strategy is provided in *Section 5.6.2*, along with the unique challenges posed by each. For each strategy, ODFW has identified several key barriers which make implementation impractical at this time. For permit stacking, a great deal of work is needed to develop an effective program which simultaneously meets conservation goals while addressing industry concerns about potential unintended consequences (e.g., fishery restructuring). Similarly, the development of a potential late-season limited entry program is contentious and designing such a program would require careful consideration of a wide range of details, which is not reasonable in the near-term. Finally, a license buyback program requires an adequate funding mechanism, which has not been identified, to enable the purchase of enough permits to meaningfully reduce effort. For these reasons, ODFW does not consider any of these strategies to be practical for implementation at this time, although they will continue to be considered future potential measures for reducing entanglement risk.

8.7 Adoption of a Risk Assessment and Mitigation Program

To address the issue of marine life entanglements in the California commercial Dungeness crab fishery, CDFW has established a Risk Assessment and Mitigation Program (RAMP) which is a dynamic management framework designed to assess and manage entanglement risk. The RAMP involves conducting frequent reviews of available data prior to and throughout the fishery season, assessing entanglement risk relative to specific thresholds for identified factors, and implementing an appropriate management action as a response.

The RAMP relies on routine and reliable data collection efforts and ongoing analysis by CDFW and outside partners. ODFW considered the feasibility of implementing a program similar to California’s RAMP, but determined that the availability of existing data streams in Oregon is not yet sufficient to support such a program. Specifically, marine life concentrations are one of two key risk factors for which thresholds have been defined in California’s RAMP regulations. In

Oregon, ongoing, real-time sources of data on whale and sea turtle presence have not been identified. Additionally, information on the relationship between marine life concentrations and the resultant entanglement risk is insufficient to develop meaningful thresholds for use by management. Therefore, ODFW has implemented a management approach which is focused on reducing the number of vertical lines which are present when entanglement risk is expected to be elevated.

Section 9 References

9.1 Literature cited

Abrahms, B., Welch, H., Brodie, S., Jacox, M. G., Becker, E. A., Bograd, S. J., Irvine, L. M., *et al.* 2019. Dynamic ensemble models to predict distributions and anthropogenic risk exposure for highly mobile species. Diversity and Distributions, 25: 1182–1193.

Ainsworth, J. C., Vance, M., Hunter, M. V., and Schindler, E. 2012. The Oregon recreational Dungeness crab fishery, 2007-2011. Oregon Department of Fish and Wildlife, Marine Resources Program, Information Report No. 2012-04. 62 pp.

Anderson, D. M., Burkholder, J. M., Cochlan, W. P., Glibert, P. M., Gobler, C. J., Heil, C. A., Kudela, R. M., *et al.* 2008. Harmful algal blooms and eutrophication: examining linkages from selected coastal regions of the United States. Harmful Algae, 8: 39–53.

Bailey, H., Mater, B. R., Palacios, D. M., Irvine, L., Bograd, S. J., and Costa, D. P. 2009. Behavioural estimation of blue whale movements in the Northeast Pacific from state-space model analysis of satellite tracks. Endangered Species Research, 1–14.

Baker, C. S., Steel, D., Calambokidis, J., Falcone, E., González-Peral, U., Barlow, J., Burdin, A. M., *et al.* 2013. Strong maternal fidelity and natal philopatry shape genetic structure in North Pacific humpback whales. Marine Ecology Progress Series, 494: 291–306.

Barlow, J. 2016. Cetacean abundance in the California Current estimated from ship-based line-transect surveys in 1991-2014. National Oceanic and Atmospheric Administration, Southwest Fisheries Science Center, Administrative Report LJ-16-01, 63 pp.

Barlow, J., Calambokidis, J., Falcone, E. A., Baker, C. S., Burdin, A. M., Clapham, P. J., Ford, J. K. B., *et al.* 2011. Humpback whale abundance in the North Pacific estimated by photographic capture-recapture with bias correction from simulation studies. Marine Mammal Science, 27(4): 793–818.

Becker, E. A., Forney, K. A., Ferguson, M. C., Barlow, J., and Redfern, J. V. 2012. Predictive modeling of cetacean densities in the California Current Ecosystem based on summer/fall ship surveys in 1991-2008. NOAA Technical Memorandum, NOAA-TM-NMFS-SWFSC-499, 51 pp.

Benson, S. R., Eguchi, T., Foley, D. G., Forney, K. A., Bailey, H., Hitipeuw, C., Samber, B. P., *et al.* 2011. Large-scale movements and high-use areas of western Pacific leatherback turtles, *Dermochelys coriacea*. Ecosphere, 2(7): art84.

Benson, S. R., Forney, K. A., Harvey, J. T., Carretta, J. V., and Dutton, P. H. 2007. Abundance, distribution, and habitat of leatherback turtles (*Dermochelys coriacea*) off California, 1990–2003. Fishery Bulletin, 105(3): 337–347.

Benson, S. R., Forney, K. A., Moore, J. E., LaCasella, E. L., Harvey, J. T., and Carretta, J. V. 2020. A long-term decline in the abundance of endangered leatherback turtles, *Dermochelys coriacea*, at a foraging ground in the California Current Ecosystem. Global Ecology and Consevation, 24(e01371): 1–13.

Bettridge, S., Baker, C. S., Barlow, J., Clapham, P. J., Ford, M., Gouveia, D., Mattila, D. K., *et al*. 2015. Status review of the humpback whale (*Megaptera novaeangliae*) under the Endangered Species Act. National Marine Fisheries Service, Southwest Fisheries Science Center, NOAA-TM-NMFS-SWFSC-540, 240 pp.

Bostrom, B. L., Jones, T. T., Hastings, M., and Jones, D. R. 2010. Behavious and physiology: the thermal strategy of leatherback turtles. PLoS ONE, 5(11): e13925.

Branch, T. A., Allison, C., Mikhalev, Y. A., Tormosov, D., and Brownell, R. L., Jr. 2008. Historical catch series for Antarctic and pygmy blue whales. International Whaling Commission Scientific Committee Paper, SC/60/SH9. 11 pp.

Brierly, A. S., and Kingsford, M. J. 2009. Impacts of climate change on marine organisms and ecosystems. Current Biology, 19: R602–R614.

Brüniche-Olsen, A., Urban, R. J., Vertyankin, V. V., Godard-Codding, C. A. J., Bickham, J. W., and DeWoody, J. A. 2018. Genetic data reveal mixed-stock aggregations of gray whales in North Pacific Ocean. Biology Letters, 14(20180399): 1–4.

Burtenshaw, J. C., Oleson, E. M., Hildebrand, J. A., McDonald, M. A., Andrew, R. K., Howe, B. M., and Mercer, J. A. 2004. Acoustic and satellite remote sensing of blue whale seasonality and habitat in the Northeast Pacific. Deep-Sea Research II, 51: 967–986.

Caddy, J. F., and Mahon, R. 1995. Reference points for fisheries management. Food and Agriculture Organization of the United Nations, Fisheries Technical Paper No. 347, 83 pp.

Calambokidis, J., and Barlow, J. 2013. Updated abundance estimates of blue and humpback whales off the US West Coast incorporating photo-identifications from 2010 and 2011. Final Report for Contract AB133F-10-RP-0106, PSRG-2013-13R, 8 pp.

Calambokidis, J., and Barlow, J. 2020. Updated abundance estimates for blue and humpback whales along the U.S. West Coast using data through 2018. U.S. Department of Commerce, NOAA Technical Memorandum, NMFS-SWFSC-634. 20 pp.

Calambokidis, J., Barlow, J., Flynn, K., Dobson, E., and Steiger, G. H. 2017. Update on abundance, trends, and migrations of humpback whales along the US West Coast. International Whaling Commission Paper SC/A17/NP/13. 17 pp.

Calambokidis, J., Barlow, J., Ford, J. K. B., Chandler, T. E., and Douglas, A. B. 2009. Insights into the population structure of blue whales in the Eastern North Pacific from recent sightings and photographic identification. Marine Mammal Science, 1–17.

Calambokidis, J., Falcone, E. A., Quinn, T. J., Burdin, A. M., Clapham, P. J., Ford, J. K. B., Gabriele, C. M., *et al.* 2008. SPLASH: Structure of Populations, Levels of Abundance and Status of Humpback Whales in the North Pacific. Cascadia Research Contract Report AB133F-03-RP-00078, 57 pp.

Calambokidis, J., Steiger, G. H., Cubbage, J. C., Balcomb, K. C., Ewald, C., Kruse, S., Wells, R., *et al.* 1990. Sightings and movements of blue whales off Central California 1986–88 from photo-identification of individuals. Report of the International Whaling Commission, SC/A88/ID24. Special Issue 12: 343–348.

Calambokidis, J., Steiger, G. H., Curtice, C., Harrison, J., Ferguson, M. C., Becker, E., DeAngelis, M., *et al.* 2015. Biologically Important Areas for selected cetaceans within U.S. waters – West Coast region. Aquatic Mammals, 41(1): 39–53.

California Department of Fish and Wildlife (CDFW). 2020. Draft conservation plan for California's commercial Dungeness crab fishery. Submission to NOAA Fisheries, May 15, 2020. Marine Region, 79 pp.

Carretta, J. V. 2018. A machine-learning approach to assign species to 'unidentified' entangled whales. Endangered Species Research, 36: 89–98.

Carretta, J. V., Helker, V., Muto, M. M., Greenman, J., Wilkinson, K., Lawson, D., Viezbicke, J., *et al.* 2019. Sources of human-related injury and mortality for U.S. Pacific West Coast marine mammal stock assessments, 2013–2017. National Marine Fisheries Service, Southwest Fisheries Science Center, NOAA-TM-NMFS-SWFSC-616. 150 pp.

Carretta, J. V., Delean, B., Helker, V., Muto, M. M., Greenman, J., Wilkinson, K., Lawson, D., *et al.* 2020. Sources of human-related injury and mortality for U.S. Pacific West Coast marine mammal stock assessments, 2014–2018. National Marine Fisheries Service, Southwest Fisheries Science Center, NOAA-TM-NMFS-SWFSC-631. 147 pp.

Checkley, D. M., Jr., and Barth, J. A. 2009. Patterns and processes in the California Current System. Progress in Oceanography, 83: 49–64.

Croll, D. A., Marinovic, B., Benson, S., Chavez, F. P., Black, N., Ternullo, R., Tershy, B. R. 2005. From wind to whales: trophic links in a coastal upwelling system. Marine Ecology Progress Series, 289: 117–130.

Darling, J. D., Acebes, J. M. V., Frey, O., Urbán, R. J., and Yamaguchi, M. 2019. Convergence and divergence of songs suggests ongoing, but annually variable, mixing of humpback whale populations throughout the North Pacific. Scientific Reports, 9: 1–14.

Davenport, J., Fraher, J., Fitzgerald, E., McLaughlin, P., Doyle, T., Harman, L., and Cuffe, T. 2009. Fat head: an analysis of head and neck insulation in the leatherback turtle (*Dermochelys coriacea*). The Journal of Experimental Biology, 212: 2753–2759.

Davenport, J., Holland, D. L., and East, J. 1990. Thermal and biochemical characteristics of the lipids of the leatherback turtle *Dermochelys coriacea*: evidence of endothermy. Journal of the Marine Biological Association of the United Kingdom, 70: 33–41.

Davis, S., and Sylvia, G. 2020. Economic impacts from Oregon Department of Fish and Wildlife proposed regulations for whale entanglement avoidance. Oregon Dungeness Crab Commission transmittal memorandum, 36 pp.

Davis, S., Syvlia, G., Yochum, N., and Cusack, C. 2017. Oregon Dungeness crab fishery bioeconomic model: a fishery interactive simulator learning tool. Prepared by OSU Cosatal Oregon Marine Experiment Station and The Research Group, LLC for the Oregon Dungeness Crab Commission. 125 pp.

Demory, D. 1990. History and status of the Oregon Dungeness crab fishery. Oregon Department of Fish and Wildlife, Marine Region, 13 pp.

Doniol-Valcroze, T., Berteaux, D., Larouche, P., and Sears, R. 2007. Influence of thermal fronts on habitat selection by four rorqual whale species in the Gulf of St. Lawrence. Marine Ecology Progress Series, 335: 207–216.

Eckert, K. L., Wallace, B. P., Frazier, J. G., Eckert, S. A., and Pritchard, P. C. H. 2012. Synopsis of the biological data on the leatherback sea turtle (*Dermochelys coriacea*). U.S. Fish and Wildlife Service, Biological Technical Publication, BTP-R4015-2012, 160 pp.

Elfes, C. T., VanBlaricom, G. R., Boyd, D., Calambokidis, J., Clapham, P. J., Pearce, R. W., Robbins, J., *et al*. 2010. Geographic variation of persistent organic pollutant levels in humpback whale (*Megaptera novaeangliae*) feeding areas of the North Pacific and North Atlantic. Environmental Toxicology and Chemistry, 29(4): 824–834.

Fiedler, P. C., Reilly, S. B., Hewitt, R. P., Demer, D., Philbrick, V. A., Smith, S., Armstrong, W., *et al*. 1998. Blue whale habitat and prey in the California Channel Islands. Deep-Sea Research II, 45: 1781–1801.

Fleming, A., and Jackson, J. 2011. Global review of humpback whales (*Megaptera novaeangliae*). National Marine Fisheries Service, Southwest Fisheries Science Center, NOAA-TM-NMFS-SWFSC-474, 206 pp.

Fullerton, C., Donaldson, J., and Sandison, G. 1980. Memorandum of understanding relative to improvement management of the Pacific coast Dungeness crab fishery. 1 pp.

Gabriele, C. M., Straley, J. M., and Neilson, J. L. 2007. Age at first calving of female humpback whales in southeastern Alaska. Proceedings of the Fourth Glacier Bay Science Symposium, 159–162.

Gendron, D. 1992. Population structure of daytime surface swarms of *Nyctiphanes simplex* (Crustacea: Euphausiacea) in the Gulf of California, Mexico. Marine Ecology Progress Series, 87: 1–6.

Gilpatrick, J. W., and Perryman, W. L. 2008. Geographic variation in external morphology of North Pacific and Southern Hemisphere blue whales (*Balaenoptera musculus*). Journal of Cetacean Research and Management, 10(1): 9–21.

Gobler, C. J., and Baumann, H. 2016. Hypoxia and acidification in ocean ecosystems: couple dynamics and effects on marine life. Biology Letters, 12: 1–8.

Goblirsch, G., and Theberge, S. 2008. Getting to know Oregon's commercial fisheries: Traps. Oregon Sea Grant, Oregon State University, ORESU-G-08-002. 2 pp.

Goldbogen, J. A., Southall, B. L., DeRuiter, S. L., Calambokidis, J., Friedlaender, A. S., Hazen, E. L., Falcone, E. A., *et al.* 2013. Blue whales respond to simulated mid-frequency military sonar. Proceedings of the Royal Society B, 280(20130657): 1–8.

Greer, A. E., Jr., Lazell, J. D., Jr., and Wright, R. M. 1973. Anatomical evidence for a countercurrent heat exchanger in the leatherback turtle (*Dermochelys coriacea*). Nature, 244: 181.

Hain, J. H. W., Carter, G. R., Kraus, S. D., Mayo, C. A., and Winn, H. E. 1982. Feeding behavior of the humpback whale, *Megaptera novaeangliae*, in the western North Atlantic. Fishery Bulletin, 80(2): 259–268.

Hankin, D. G., Hackett, S. C., and Dewees, C. M. 2005. California's Dungeness crab: conserving the resource and increasing the net economic value of the fishery. Sea Grant Final Report, R/F-187, 32 pp.

Harvey, C., Garfield, N., Williams, G., Tolimieri, N., Andrews, K., Barnas, K., Bjorkstedt, E., *et al.* 2020. Ecosystem status report of the California Current for 2019–20: a summary of ecosystem indicators compiled by the California Current Integrated Ecosystem Assessment team (CCIEA). National Marine Fisheries Service, Northwest Fisheries Science Center, NMFS-NWFSC-160, 97 pp.

Hauri, C., Gruber, N., Plattner, G.-K., Alin, S., Feeley, R. A., Hales, B., and Wheeler, P. A. 2009. Ocean acidification in the California Current system. Oceanography, 22(4): 60–71.

Hazen, E. L., Palacios, D. M., Forney, K. A., Howell, E. A., Becker, E., Hoover, A. L., Irvine, L., *et al.* 2016. WhaleWatch: a dynamic management tool for predicting blue whale density in the California Current. Journal of Applied Ecology, 54: 1415–1428.

Hickey, B. M., and Banas, N. S. 2008. Why is the northern end of the California Current System so productive? Oceanography, 21(4): 90–107.

Hickey, B. M., Pietrafesa, L. J., Jay, D. A., and Boicourt, W. C. 1998. The Columbia River Plume study: subtidal variability in the velocity and salinity fields. Journal of Geophysical Research, 103(C5): 10339–10368.

Huyer, A., Sobey, E. J. C., and Smith, R. L. 1979. The spring transition in currents over the Oregon continental shelf. Journal of Geophysical Research, 84(C11): 6995–7011.

Ingebrigtsen, A. 1929. Whales caught in the North Atlantic and other seas. Rapports et Proces-Verbaux des Reunions Conseil International pour l'exploration de la Mer. 56: 1–26.

Ivashchenko, Y. V., Zerbini, A. N., and Clapham, P. J. 2015. Assessing the status and pre-exploitation abundance of North Pacific humpback whales. International Whaling Commission Paper SC/66a/IA/16. 25 pp.

International Whaling Commission (IWC). 2016. Report of the Scientific Committee. IWC/66/Rep01(2016), 138 pp.

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

Kahru, M., Kudela, R., Manzano-Sarabia, M., and Mitchell, B. G. 2009. Trends in primary production in the California Current detected with satellite data. Journal of Geophysical Research, 114(C02004): 1–7.

Keiper, C., Calambokidis, J., Ford, G., Casey, J., Miller, C., and Kieckhefer, T. R. 2011. Risk assessment of vessel traffic on endangered blue and humpback whales in the Gulf of the Farallones and Cordell Bank National Marine Sanctuaries. Summary of research results, submitted to Pacific Life Foundation. 21 pp.

King, J. R., Agostini, V. N., Harvey, C. J., McFarlane, G. A., Foreman, M. G. G., Overland, J. E., Lorenzo, E. D., *et al*. 2011. Climate forcing and the California Current ecosystem. ICES Journal of Marine Science, 68(6): 1199–1216.

Knowlton, A. R., Robbins, J., Landry, S., McKenna, H. A., Kraus, S. D., and Werner, T. B. 2015. Effects of fishing rope strength on the severity of large whale entanglements. Conservation Biology, 30(2): 318–328.

LaRiviere, P. E., and Barry, S. T. 1998. Limited entry in the Washington coastal Dungeness crab (Cancer magister) fishery: the first step toward rationalizing an overcapitalized and chaotic fishery. In Proceedings of the North Pacific Symposium on Invertebrate Stock Assessment and Management, pp. 325–333. Ed. By G. S. Jamieson and A. Campbell. Canadian Special Publication of Fisheries and Aquatic Sciences, 125, 462 pp.

Le Quéré, C., Andrew, R. M., Canadell, J. G., Sitch, S., Korsbakken, J. I., Peters, G. P., Manning, A. C., et al. 2016. Global carbon budget 2016. Earth System Science Data, 8: 605–649.

Legislative Policy and Research Office (LPRO). 2019. Endangered species: background brief. State of Oregon, 8 pp.

Marquez M., R. 1990. Sea turtles of the world: an annotated and illustrated catalogue of sea turtle species known to date. FAO Species Catalogue, FAO Fisheries Synopsis No. 125, Volume 11. 81 pp.

Mate, B. R., Lagerquist, B. A., and Calambokidis, J. 1999. Movements of North Pacific blue whales during the feeding season off Southern California and their southern fall migration. Marine Mammal Science, 15(4): 1246–1257.

McDonald, M. A., Hildebrand, J. A., and Mesnick, S. 2009. Worldwide decline in tonal frequencies of blue whale songs. Endangered Species Research, 9: 13–21.

Monnahan, C. C., Branch, T. A., and Punt, A. E. 2015. Do ship strikes threaten the recovery of endangered eastern North Pacific blue whales? Marine Mammal Science, 31(1): 279–297.

Monnahan, C. C., Branch, T. A., Stafford, K. M., Ivashchenko, Y. V., and Oleson, E. M. 2014. Estimating historical eastern North Pacific blue whale catches using spatial calling patterns. PLoS ONE, 9(6): e98974.

National Marine Fisheries Service (NMFS). 1991. Final recovery plan for the humpback whale, *Megaptera novaeangliae*. Prepared by the Humpback Whale Recovery Team, 105 pp.

National Marine Fisheries Service (NMFS). 1998. Recovery plan for the blue whale (*Balaenoptera musculus*). Prepared by Reeves, R. R., Clapham, P. J., Brownell, R. L., Jr., and Silber, G. K. for the National Marine Fisheries Service. 48 pp.

National Marine Fisheries Service (NMFS). 2012a. Endangered and threatened species; final rule to revise the critical habitat designation for the endangered leatherback sea turtle. 77 FR 4169, 33 pp.

National Marine Fisheries Service (NMFS). 2012b. Final biological report: final rule to review the critical habitat designation for leatherback sea turtles. 34 pp.

National Marine Fisheries Service (NMFS). 2012c. Process for distinguishing serious from non-serious injury of marine mammals. Office of Protected Resources, NMFS Instruction 02-038-01, 42 pp.

National Marine Fisheries Service (NMFS). 2012d. Process for distinguishing serious from non-serious injury of marine mammals. Office of Protected Resources, NMFS Policy Directive 02-238, 4 pp.

National Marine Fisheries Service (NMFS). 2013. Leatherback sea turtle (*Dermochelys coriacea*) 5-year review: summary and evaluation. Office of Protected Resources, 91 pp.

National Marine Fisheries Service (NMFS). 2014. Final Environmental Impact Statement for amending the Atlantic Large Whale Take Reduction Plan: vertical line rule. Volume I of II. 1258 pp.

National Marine Fisheries Service (NMFS). 2016. Endangered and threatened species; identification of 14 distinct population segments of the humpback whale (*Megaptera novaeangliae*) and revision of species-wide listing. 81 FR 62259, 62 pp.

National Marine Fisheries Service (NMFS). 2019a. Humpback whale (*Megaptera novaeangliae*): California/Oregon/Washington stock. Stock Assessment Report, 10 pp.

National Marine Fisheries Service (NMFS). 2019b. Blue whale (*Balaenoptera musculus musculus*): Eastern North Pacific stock. Stock Assessment Report, 7 pp.

National Marine Fisheries Service (NMFS). 2019c. Recovering Threatened and Endangered Species, FY 2017 – 2018 Report to Congress. 108 pp. Available at https://www.fisheries.noaa.gov/resource/document/recovering-threatened-and-endangered-species-report-congress-fy-2017-2018

National Marine Fisheries Service (NMFS). 2020a. Gray whale (*Eschrichtius robustus*): Eastern North Pacific stock. Draft Stock Assessment Report, 13 pp.

National Marine Fisheries Service (NMFS). 2020b. Gray whale (*Eschrichtius robustus*): Western North Pacific stock. Draft Stock Assessment Report, 8 pp.

National Marine Fisheries Service (NMFS). 2020c. Biological report for the designation of critical habitat for the Central America, Mexico, and Western North Pacific distinct population segments of humpback whales (*Megaptera novaeangliae*). 162 pp.

National Marine Fisheries Service (NMFS). 2020d. Recovery plan for the blue whale (*Balaenoptera musculus*), first revision to the July 1998 recovery plan for the blue whale. Office of Protected Resources, 133 pp.

National Marine Fisheries Service (NMFS). 2020e. Draft analysis of U.S. West Coast large whale entanglement serious injury and mortality assessments for use in conservation planning by states. West Coast Region, Protected Resources Division. 15 pp.

National Marine Fisheries Service (NMFS). 2020f. Criteria for determining negligible impact under MMPA Section 101(a)(5)(E). Office of Protected Resources, Procedural Directive 02-204-02, 20 pp.

National Marine Fisheries Service (NMFS). 2020g. NMFS line marking analysis for ODFW. West Coast Region, Protected Resources Division. 9 pp.

National Marine Fisheries Service (NMFS). 2021a. Endangered and threatened wildlife and plants; designating critical habitat for the Central America, Mexico, and Western North Pacific distinct population segments of humpback whales. 86 FR 21082, 76 pp.

National Marine Fisheries Service (NMFS). 2021b. West Coast Region's revised Endangered Species Act implementation and considerations about "take" given the September 2016 humpback whale DPS status review, species-wide revision of listings, and updates to best available science information. Memorandum for Protected Resources Division, West Coast Region, 15 July 2021. 18 pp.

National Marine Fisheries Service (NMFS). 2021c. Species in the spotlight: Pacific leatherback turtles (*Dermochelys coriacea*), priority actions 2021–2025, 20 pp. Available at https://media.fisheries.noaa.gov/2021-04/SIS-Action-Plan-2021-leatherback-FINAL-508.pdf

National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS). 1998. Recovery plan for U.S. Pacific populations of the leatherback turtle (*Dermochelys coriacea*). 65 pp.

National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS). 2020. Endangered Species Act status review of the leatherback turtle (*Dermochelys coriacea*). Report to the National Marine Fisheries Service Office of Protected Resources and U.S. Fish and Wildlife Service, 396 pp. Available at https://repository.library.noaa.gov/view/noaa/25629

Ocean Policy Advisory Council (OPAC). 1994. Oregon Territorial Sea Plan. Available at https://www.oregon.gov/lcd/OCMP/Pages/Territorial-Sea-Plan.aspx

Ocean Resources Management Task Force. 1991. Oregon Ocean Resources Management Plan. Available at https://www.oregon.gov/lcd/OCMP/Pages/Ocean-Plan.aspx

Oregon Coordinating Council on Ocean Acidification and Hypoxia (OAH Council). 2019. Oregon Ocean Acidification and Hypoxia Action Plan, 2019 – 2015. 24 pp. Available at https://www.oregonocean.info/index.php/ocean-acidification

Oregon Department of Agriculture (ODA). Industry notice, 20 November 2017. 5 pp.

Oregon Department of Fish and Wildlife (ODFW). 1984. Staff statement for public hearing Feb. 16, 1984 on summer Dungeness crab fishery. Oregon Fish and Wildlife Commission, 16 February 1984. Marine Region, 6 pp.

Oregon Department of Fish and Wildlife (ODFW). 1986. Misc. crab regulations. Oregon Fish and Wildlife Commission, Exhibit H. Marine Region, 7 pp.

Oregon Department of Fish and Wildlife (ODFW). 1990. Staff statement on petition to permit a two week period for removal of crab gear after the close of the season. Oregon Fish and Wildlife Commission. 9 pp.

Oregon Department of Fish and Wildlife (ODFW). 1992. Shellfish Program monthly reports. Marine Region, 54 pp.

Oregon Department of Fish and Wildlife (ODFW). 1995. Shellfish and Marine Habitat Program annual report, 1993. Marine Region, 15 pp.

Oregon Department of Fish and Wildlife (ODFW). 1996. Shellfish and Marine Habitat Program annual report, 1994. Marine Region, 17 pp.

Oregon Department of Fish and Wildlife (ODFW). 1997. Report to the Legislature on the Oregon ocean Dungeness crab fishery license limitation program. Marine Resources Program, 8 pp.

Oregon Department of Fish and Wildlife (ODFW). 2006. Dungeness crab pot limits. Oregon Fish and Wildlife Commission, 9 June 2006, Exhibit H. Marine Resources Program, 26 pp.

Oregon Department of Fish and Wildlife (ODFW). 2007. Commercial Dungeness crab fishery rules. Oregon Fish and Wildlife Commission, 8 June 2007, Exhibit H. Marine Resources Program, 6 pp.

Oregon Department of Fish and Wildlife (ODFW). 2009. Commercial Dungeness crab fishery management. Oregon Fish and Wildlife Commission, 2 October 2009, Exhibit C. Marine Resources Program, 14 pp.

Oregon Department of Fish and Wildlife (ODFW) 2012a. Technical Supplement to the Oregon Nearshore Strategy: Potential Impacts of Global Climate Change in Oregon's Nearshore Ocean. Marine Resources Program, 22 pp.

Oregon Department of Fish and Wildlife (ODFW). 2012b. Commercial Dungeness crab regulations. Oregon Fish and Wildlife Commission, 4 April 2012, Exhibit D. Marine Resources Program, 4 pp.

Oregon Department of Fish and Wildlife (ODFW). 2014a. Oregon Dungeness crab research and monitoring plan. Marine Resources Program, 25 pp.

Oregon Department of Fish and Wildlife (ODFW). 2014b. Commercial ocean Dungeness crab fishery logbook CPUE preliminary assessment – 3rd iteration. Marine Resources Program, 45 pp.

Oregon Department of Fish and Wildlife (ODFW). 2014c. Industry notice, 8 August 2014. Marine Resources Program, 2 pp.

Oregon Department of Fish and Wildlife (ODFW). 2014d. Commercial Dungeness crab fishery regulations and update on proposed limit reference point policy. Oregon Fish and Wildlife Commission, 1 August 2014, Exhibit F. Marine Resources Program, 6 pp.

Oregon Department of Fish and Wildlife (ODFW). 2016. Oregon Nearshore Strategy. Marine Resources Program. Available at http://oregonconservationstrategy.org/oregon-nearshore-strategy/

Oregon Department of Fish and Wildlife (ODFW). 2017. Industry notice, 7 November 2017. Marine Resources Program, 3 pp.

Oregon Department of Fish and Wildlife (ODFW). 2018. Industry notice, 11 May 2018. Marine Resources Program, 2 pp.

Oregon Department of Fish and Wildlife (ODFW). 2019a. Commercial and recreational fixed gear regulations. Oregon Fish and Wildlife Commission, 13 September 2019, Exhibit B. Marine Resources Program, 16 pp.

Oregon Department of Fish and Wildlife (ODFW). 2019b. Economic contributions of Oregon's commercial marine fisheries. Prepared for ODFW by ECONorthwest, 30 pp.

Oregon Department of Fish and Wildlife (ODFW). 2020a. 12th annual ODFW Marine Resources Program Dungeness crab fishery newsletter. 10 pp.

Oregon Department of Fish and Wildlife (ODFW). 2020b. Reducing risk of whale entanglement in commercial crab fishing gear. Oregon Fish and Wildlife Commission, 11 September 2020, Exhibit C. Marine Resources Program, 19 pp.

Oregon Fish and Wildlife Commission (OFWC). 2014. Minutes, 1 August 2014. 36 pp.

Oregon Whale Entanglement Working Group (OWEWG). 2018. Oregon commercial Dungeness crab fishing directive to minimize whale entanglement risk. 2 pp.

Pacific Fishery Management Council (PFMC). 1979. Draft Fishery Management Plan for the Dungeness Crab Fishery off Washington, Oregon and California. 93 pp.

Pacific Fishery Management Council (PFMC). 2013. Pacific coast fishery ecosystem plan for the U.S. portion of the California Current Large Marine Ecosystem. A report of the PFMC pursuant to National Oceanic and Atmospheric Administration Award Number FNA10NMF4410014, 190 pp.

Pacific States Marine Fisheries Commission (PSMFC). 2018. Forensic review workshop report, 28-29 August 2018. Appendix M, Gear ID forensics. Available at http://habitat.psmfc.org/preventing-whale-entanglement/

Pacific States Marine Fisheries Commission (PSMFC). 2019. 72nd annual report of the Pacific States Marine Fisheries Commission, presented by the Commissioners of the Pacific States Marine Fisheries Commission in compliance with the State enabling acts creating the Commission and Public Laws 232; 766; and 315 of the 80th; 87th; and 91st Congresses of the United States. 91 pp. Available at http://www.psmfc.org/wp-content/uploads/2020/10/psmfc_annualreport_2019_HR.pdf

Paladino, F. V., O'Connor, M. P., and Spotila, J. R. 1990. Metabolism of leatherback turtles, gigantothermy, and thermoregulation of dinosaurs. Nature, 344(6269): 858–860.

Ralls, K. 1976. Mammals in which females are larger than males. The Quarterly Review of Biology, 51: 245–276.

Rasmuson, L. K. 2013. The biology, ecology, and fishery of the Dungeness crab, Cancer magister. In Advances in Marine Biology, Vol. 65, pp. 95–148. Ed. By M. Lesser. Academic Press, Burlington. 176 pp.

Rasmussen, K., Palacios, D. M., Calambokidis, J., Saborio, M. T., Dalla Rosa, L., Secchi, E. R., Steiger, G. H., *et al.* 2007. Southern Hemisphere humpback whales wintering off Central America: insights from water temperature into the longest mammalian migration. Biology Letters, 3: 302–305.

The Research Group, LLC (TRG). 2021. Oregon commercial and recreational fishing industry economic activity coastwide and in proximity to marine reserve sites for years 2018 and 2019, executive summary. Prepared for Oregon Department of Fish and Wildlife, Marine Reserve Program and Marine Resources Program. 56 pp.

Reilly, S. B., and Thayer, V. G. 1990. Blue whale (*Balaenoptera musculus*) distribution in the eastern tropical Pacific. Marine Mammal Science, 6(4): 265–277.

Rice, D. W. 1978. The humpback whale in the North Pacific: distribution, exploitation and numbers. U.S. Department of Commerce, NTIS PB 280–794.

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

Romsos, C. G. 2004. Mapping surficial geologic habitats of the Oregon continental margin using integrated interpretive GIS techniques. MS thesis, Oregon State University, Corvallis, OR.

Saez, L., Lawson, D., DeAngelis, M., Petras, E., Wilkin, S., and Fahy, C. 2013. Understanding the co-occurrence of large whales and commercial fixed gear fisheries off the west coast of the United States. National Marine Fisheries Service, Southwest Regional Office, NOAA-TM-NMFS-SWR-044, 102 pp.

Saez, L., Lawson, D., and DeAngelis M. 2021. Large whale entanglements off the U.S. West Coast, from 1982-2017. National Marine Fisheries Service, NOAA Technical Memorandum NMFS-OPR-63A, 50 pp.

Samhouri, J. F., Feist, B. E., Fisher, M. C., Liu, O., Woodman, S. M., Abrahms, B., Forney, K. A., *et al*. Marine heatwave amplifies conflict between fisheries and conservation. *In review*.

Santora, J. A., Mantua, N. J., Schroeder, I. D., Field, J. C., Hazen, E. L., Bograd, S. J., Sydeman, W. J., *et al*. 2020. Habitat compression and ecosystem shifts as potential links between marine heatwave and record whale entanglements. Nature Communications, 11(536): 1–12.

Schoenherr, J. R. 1991. Blue whales feeding on high concentrations of euphausiids around Monterey Submarine Canyon. Canadian Journal of Zoology, 69(3): 583–594.

Sears, R., Ramp, C., Douglas, A. B., and Calambokidis, J. 2013. Reproductive parameters of eastern North Pacific blue whales *Balaenoptera musculus*. Endangered Species Research, 22: 23–31.

Sears, R., Williamson, J. M., Wenzel, F. W., Bérubé, M., Gendron, D., and Jones, P. 1990. Photographic identification of the blue whale (*Balaenoptera musculus*) in the Gulf of St. Lawrence, Canada. Report of the International Whaling Commission, SC/A88/ID23. Special Issue 12: 335–342.

Seminoff, J.A., and Dutton, P. H. 2007. Leatherback turtles (*Dermochelys coriacea*) in the Gulf of California: distribution, demography, and human interactions. Chelonian Conservation and Biology, 6(1): 137–141.

Spotila, J. R., Reina, R. D., Steyermark, A. C., Plotkin, P. T., and Paladino, F. V. 2000. Pacific leatherback turtles face extinction. Nature, 405: 529–530.

Stafford, K. M., Nieukirk, S. L., and Fox, C. G. 2001. Geographic and seasonal variation of blue whale calls in the North Pacific. Journal of Cetacean Research and Management, 31(1); 65–76.

Stewart, J. D., and Weller, D. W. 2021. Abundance of Eastern North Pacific gray whales 2019/2020. National Marine Fisheries Service, Southwest Fisheries Science Center, Technical Memorandum NOAA-TM-NMFS-SWFSC-639, 7 pp.

Szesciorka, A. R. 2015. Using new tag attachments to study humpback whale fine-scale spatiotemporal dive behavior, habitat use, and reaction to ships off Northern California. MS Thesis, San Jose State University, San Jose, CA.

Taylor, B. L., Chivers, S. J., Larese, J., and Perrin, W. F. 2007. Generation length and percent mature of cetaceans. National Marine Fisheries Service, Southwest Fisheries Science Center, Administrative Report LJ-07-01, 24 pp.

Taylor, B. L., Scott, M., Heyning, J., and Barlow, J. 2003. Suggested guidelines for recovery factors for endangered marine mammals. National Marine Fisheries Service, Southwest Fisheries Science Center, Technical Memorandum NOAA-TM-NMFS-SWFSC-354, 6 pp.

Tweddle, J. F., Strutton, P. G., Foley, D. G., O'Higgins, L., Wood, A. M., Scott, B., Everroad, R. C., *et al*. 2010. Relationships among upwelling, phytoplankton blooms, and phycotoxins in coastal Oregon shellfish. Marine Ecology Progress Series, 405: 131–145.

U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS). 1998. Endangered species consultation handbook, procedures for conducting consultation and conference activities under section 7 of the Endangered Species Act. 219 pp.

U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS). 2016. Habitat conservation planning and incidental take permit processing handbook. 405 pp.

Urbán R., J., Weller, D., Martínez A., S., Tyurneva, O., Bradford, A. Burdin, A., Lang, A., *et al*. 2019. New information on the gray whale migratory movements between the western and eastern North Pacific. International Whaling Commission Paper SC/68A/CMP/11 Rev1. 12 pp.

Wade, P. R., Quinn, T. J., II, Barlow, J., Baker, C. S., Burdin, A. M., Calambokidis, J., Clapham, P. J., *et al*. 2016. Estimates of abundance and migratory destination for North Pacific humpback whales in both summer feeding areas and winter mating and calving areas. International Whaling Commission Paper SC/66b/IA/21. 42 pp.

Wade, P. R. 2017. Estimates of abundance and migratory destination for North Pacific humpback whales in both summer feeding areas and winter mating and calving areas revision of estimates in SC/66b/IA21. International Whaling Commission Scientific Committee Report SC/A17/NP/11. 9 pp.

Wade, P. R. 2021. Estimates of abundance and migratory destination for North Pacific humpback whales in both summer feeding areas and winter mating and calving areas. International Whaling Commission Report SC/68c/IA/03. 32 pp.

Waldron, K. D. 1958. The fishery and biology of the Dungeness crab (Cancer magister Dana) in Oregon waters. Fish Commission of Oregon, Report No. 24, 45 pp.

Wallace, B. P., Tiwari, M., and Girondot, M. 2013. *Dermochelys coriacea*. The IUCN Red List of Threatened Species. E. t6494A43526147. Accessed 23 July 2020.

Ware, C., Wiley, D. N., Friedlaender, A. S., Weinrich, M., Hazen, E. L., Bocconcelli, A., Parks, S. E., *et al*. 2013. Bottom side-roll feeding by humpback whales (*Megaptera novaeangliae*) in the southern Gulf of Maine, U.S.A. Marine Mammal Science, 30(2): 1–18.

Washington Department of Fish and Wildlife (WDFW). 2020. Coastal Dungeness crab whale entanglement (decision). Summary Sheet. Washington Fish and Wildlife Commission, 17 January 2020. 25 pp.

Washington Whale Entanglement Working Group (WWEWG). 2018. Washington commercial Dungeness crab fishing 2018-2019 directive to minimize whale entanglement risk. 2 pp.

Werner, T., and McLellan-Press, K. 2016. Global assessment of large whale entanglement and bycatch reduction in fixed fishing gear. Final report submitted to NOAA Fisheries, Office of International Affairs. NOAA Award Number: NA15NMF4630357. 85 pp.

Witteveen, B. H., Worthy, G. A. J., and Roth, J. D. 2009. Tracing migratory movements of breeding North Pacific humpback whales using stable isotope analysis. Marine Ecology Progress Series, 393: 173–183.

Youde, J. G., and Wix, J. R. 1967. Economics of the Dungeness crab industry. Oregon State University, Corvallis Agricultural Experiment Station, Circular of Information 627. 24 pp.