State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Director's Office
P.O. Box 944209
Sacramento, CA 94244-2090
www.wildlife.ca.gov

GAVIN NEWSOM, Governor
CHARLTON H. BONHAM, Director

May 15, 2020

Penny Ruvelas
Long Beach Office Branch Chief - Protected Resources Division
NOAA Fisheries West Coast Region
U.S. Department of Commerce

SUBJECT: California Department of Fish and Wildlife Draft Conservation Plan Submission for Humpback whales, Blue whales and Pacific Leatherback Sea Turtles

Dear Ms. Ruvelas:

The California Department of Fish and Wildlife (CDFW) has completed initial drafting of its Conservation Plan (CP) for the California commercial Dungeness crab fishery in support of its anticipated submission of an application for an Incidental Take Permit (ITP) under Section 10 of the Endangered Species Act (ESA). This draft CP describes a comprehensive strategy to monitor, minimize, and mitigate entanglement of certain ESA-listed whales and sea turtles in commercial Dungeness Crab fishing gear off the coast of California. This letter also serves to formally request your agency's guidance and assistance to further advance the CP before final submission with the Incidental Take Permit (ITP) application. The ESA-listed species proposed for coverage under this draft CP and eventual application include Humpback whales (*Megaptera novaeangliae*), Blue whales (*Balaenoptera musculus*) and Pacific Leatherback sea turtles (*Dermochelys coriacea*).

The foundation and regulatory framework for the CP is the Risk Assessment and Mitigation Program (RAMP). The RAMP is currently undergoing the state rulemaking process and will add Section 132.8 to Title 14 of the California Code of Regulations (anticipated to be effective by November 1, 2020). This program will assess and manage risk of entanglement of the above listed species for the commercial Dungeness crab fishery. In addition, CDFW has implemented several other measures to address marine life entanglement. They include frequent risk assessments during the 2019-20 fishing season in consultation with the California Dungeness Crab Fishing Gear Working Group (Working Group), development of a best practices guide in partnership with the Working Group, implementation of a standardized gear marking program for trap gear fisheries, support of alternative gear testing, implementation of a regulation limiting surface gear, and implementation of a lost or abandoned commercial Dungeness crab trap program. Complimenting the foundational RAMP regulation, these efforts provide additional important measures to minimize the risk of entanglements. CDFW fully believes in development of management measures that not only reduce entanglement impacts to listed species, but also minimize impacts to the fleet and support a sustainable, robust fishery.

The underlying structure of the RAMP was developed by the Working Group through a multi-year iterative process. The Working Group was convened in 2015 to address the increased rate of entanglements in California commercial Dungeness crab fishing gear and is comprised of commercial and recreational fishermen, environmental organization representatives, state and federal agencies, and subject matter experts. Additionally, the RAMP has undergone extensive public outreach through the regulatory development process. We anticipate continued collaboration with the Working Group and all interested stakeholders, many of which will be directly affected by the outcome of this process, will provide additional valuable input as we further refine this draft CP. CDFW has a strong interest in working with NOAA Fisheries to facilitate effective and efficient communication with these groups.

We look forward to continuing close coordination with your agency as we work to finalize this draft CP and ITP application, and are ready to discuss next steps at your earliest convenience.

Sincerely,

Charlton H. Bonham
Director

ec: Wendy Bogdan, General Counsel
Office of the General Counsel
Wendy.Bogdan@Wildlife.ca.gov

Craig Shuman, D. Env. Regional Manager
Marine Region
Craig.Shuman@Wildlife.ca.gov

Sonke Mastrup, Program Manager
Marine Region
Sonke.Mastrup@Wildlife.ca.gov

Mary Loum, Attorney
Office of the General Counsel
Mary.Loum@Wildlife.ca.gov

Ryan Bartling, Senior Environmental Scientist
Marine Region
Ryan.Bartling@Wildlife.ca.gov

Draft Conservation Plan for California's Commercial Dungeness Crab Fishery

Submission to NOAA Fisheries

May 15, 2020

California Department of Fish and Wildlife

Marine Region

Table of Contents

CHAPTER 1. INTRODUCTION AND BACKGROUND 1
1.1 Background 1
1.2 ITP Applicant 1
1.3 Regulatory Framework 2
1.4 Fishery Interactions and Covered Species 4
1.5 Stakeholder Involvement 6
CHAPTER 2. PROJECT DESCRIPTION AND ACTIVITIES COVERED BY THE PERMIT 8
2.1 Plan Area 8
2.2 Covered Activities 8
2.3 Permit Duration 12
CHAPTER 3. ENVIRONMENTAL SETTING AND BIOLOGICAL RESOURCES 13
3.1 Environmental Setting 13
3.2 Covered Species 17
CHAPTER 4. POTENTIAL BIOLOGICAL IMPACTS AND TAKE ASSESSMENT 22
4.1 Estimation of Interactions and Anticipated Take 22
4.2 Effects on Critical Habitat 27
4.3 Cumulative Impacts 29
4.4 Anticipated Impacts of Taking 32
4.5 Natural Events and Uncertainty 32
4.6 Climate Change Considerations 34
CHAPTER 5. CONSERVATION PROGRAM 36
5.1 Biological Goals and Objectives 36
5.2 Risk Assessment and Mitigation Program 36
5.3 Gear Retrieval Program 56
5.4 Best Practices and Other Outreach 57
5.5 Effectiveness Monitoring 59
CHAPTER 6. PLAN IMPLEMENTATION 60
6.1 Coordination and Key Partners 60
6.2 Conservation Program Implementation 61
6.3 Adaptive Management 62
6.4 Amendments 63
6.5 Suspension/Revocation, Renewal 64
6.6 Funding Sources and Assurances 64
CHAPTER 7. ALTERNATIVE 68
7.1 Permanently Shortened Season 68
Works Cited: 69

DRAFT

CHAPTER 1. INTRODUCTION AND BACKGROUND

1.1 Background

This Conservation Plan (CP) prescribes a comprehensive strategy to monitor, minimize and mitigate entanglement of ESA-listed whales and sea turtles from Dungeness crab fishing gear off the coast of California. Between 1982 and 2017, the National Marine Fisheries Service (NMFS) confirmed 434 entanglements of large whales in fishing gear off the US West Coast (Saez et al. 2020). Entanglement events in fixed gear (i.e. trap and gillnet fisheries) have been confirmed for blue whales (*Balaenoptera musculus*), fin whales (*B. physalus*), gray whales (*Eschrichtius robustus*), humpback whales (*Megaptera novaeangliae)*, killer whales (*Orcinus orca*), minke whales (*B. acutorostrata*), and sperm whales (*Physeter macrocephalus*). blue whales, fin whales, and sperm whales are protected under the federal Endangered Species Act (ESA) throughout their range. Certain Distinct Population Segments (DPS) of humpback whales, killer whales, and gray whales are also protected under the ESA.

The number of confirmed large whale entanglements off the West Coast (all gear types) increased sharply in 2014, from an average of 9 per year from 1982 – 2013 to an average of 41 per year from 2014-2017 (Saez et al. 2020). While the number of confirmed entanglements has decreased from the highs of 53 and 55 in 2016 and 2017, respectively, entanglements still remain above pre-2014 levels (2018, n= 46, 2019, n = 29; NMFS 2019a; NMFS 2020). The increased number of entanglements is likely due to a combination of factors, including changes in the abundance and distribution of whales and forage, shifting patterns in human activities, and increased public awareness and reporting.

Nearly half (43%) of confirmed West Coast large whale entanglements involve unknown gear types (Saez et al. 2020). Of the instances where gear can be identified (n = 247), about a third (n = 85, 31%) involve gillnet, a gear type used in multiple fisheries (both state and federally managed), targeting different species such as white sea bass, swordfish and salmon. In terms of gear which can be identified to a specific fishery, commercial Dungeness crab gear is the most common (n = 74, 30%), of which 83% (n = 47) involve gear set in California. There has also been a single documented interaction between the California commercial Dungeness crab fishery and the ESA-listed Pacific leatherback sea turtle (*Dermochelys coriacea*), which was successfully disentangled by the reporting fisherman. The California Department of Fish and Wildlife (CDFW) has prepared this CP to support its application for an Incidental Take Permit (ITP) under Section 10 of the ESA which will provide authorization for limited incidental take of Covered Species in the California commercial Dungeness crab fishery.

1.2 ITP Applicant

CDFW is the primary wildlife management agency in California. It is responsible for issuing licenses for the commercial Dungeness crab fishery and enforcing laws and regulations that minimize the fishery's bycatch and habitat impacts. In 2018 the California legislature delegated authority to CDFW to establish criteria and protocols to evaluate and respond to potential risk of marine life entanglement in commercial Dungeness crab fishing gear (SB1309, McGuire).

1.3 Regulatory Framework

Even though ESA establishes the fundamental regulatory framework for this CP, state and other federal laws are relevant to its framing. These laws include the Marine Mammal Protection Act (MMPA), National Environmental Policy Act (NEPA), California Environmental Quality Act (CEQA), various provisions of the California Fish and Game Code (FGC) and California Code of Regulations (CCR), and the California Administrative Procedure Act (California APA).

1.3.1 Endangered Species Act

ESA requires federal agencies to prevent additional declines in and support recovery of species that are listed under the act as either in danger of extinction throughout all or a significant portion of its range (as "endangered") or as likely to become endangered in the foreseeable future (as "threatened"). ESA defines species to include "any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature" (16 USC § 1532(16)).

Under Section 4 of ESA, NMFS is responsible for listing most marine species and designating critical habitat for those species that become listed. The agency is also responsible for monitoring and evaluating the status of these listed species, as well as developing and implementing recovery plans for them. Section 9 includes a broad prohibition on take of listed species, which is defined to include activities which "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect" a member of a species (16 USC § 1538).

Section 10 provides an exemption process for take of listed species incidental to otherwise lawful activities, such as commercial fisheries (16 USC § 1539(a)(1)(B)). To issue such a permit, NMFS requires a Section 10(a)(1)(B) application and a CP for the impacted species (16 USC § 1539(a)(2)). Accordingly, this CP will accompany a Section 10(a)(1)(B) permit application submitted to NMFS. A CP seeking exemption for take of listed species must discuss the following:

- The impact which will likely result from such taking
- What steps the applicant will take to minimize and mitigate such impacts, and the funding that will be available to implement such steps
- What alternative actions to such taking the applicant considered and the reasons why such alternatives are not being utilized
- Such other measures that NMFS may require as being necessary or appropriate for purposes of the plan

Before issuing an incidental take permit under Section 10, NMFS must comply with the consultation requirements in Section 7 (16 USC § 1536(a)-(b)) to ensure that issuing a permit will not jeopardize the continued existence of the listed species or result in the destruction or adverse modification of any designated critical habitat. In the case of marine mammals, the Secretary must also evaluate whether the taking is authorized under Section 101(a)(5) of MMPA (16 USC § 1371(a)(5)) and any measures necessary to ensure such compliance (16 USC § 1536(b)(4)(C)).

1.3.2 Marine Mammal Protection Act

The MMPA establishes a national policy of preventing additional decline and supporting rebuilding and recovery of marine mammal populations. Under the MMPA, NMFS is responsible for evaluating the status of marine mammal species and developing conservation plans for species or stocks designated as depleted (16 USC § 1383b), developing stock assessment reports to evaluate stock status (16 USC § 1386), coordinating responses to marine mammal standings and entanglements (16 USC §§ 1421 & 1421b), assessing mortality and serious injury of incidental anthropogenic interactions with marine mammals arising from commercial fisheries (16 USC § 1387), and issuing permits and authorizations for take of marine mammals (16 USC §§ 1373 & 1374).

The MMPA generally prohibits "take" of marine mammals in US waters, which is defined as activities which "harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal" (16 USC § 1362). The law also provides limited exemptions for take by authorizing several types of take permits. Section 101(a)(5)(E) allows permitting for incidental take by commercial fishing vessels of certain stocks listed under the ESA (16 USC § 1371(a)(5)(E)). To issue such a permit, the Secretary of Commerce must find, among other things, that the incidental mortality and serious injury from the permitted commercial fishing activity will have a "negligible impact" on protected marine mammals (16 USC § 1371(a)(5)(E)).

The MMPA also allows for the Secretary of Commerce to issue specific authorizations to commercial vessels participating in all fisheries which result in incidental take of marine mammals, with the goal that serious injury and mortality resulting from such take be reduced to insignificant levels (i.e. near zero; 16 USC § 1387). In order to qualify for the take authorization, fishery participants must comply with any applicable restrictions on the fishery and report any interactions with marine mammals.

1.3.3 National Environmental Policy Act and California Environmental Quality Act

NEPA requires every federal agency to use all practicable means and measures to protect environmental values and makes environmental protection a part of its mandate (42 USC §§ 4321-1470m-12). The statute requires every federal agency to conduct a formal environmental analysis when taking an action that significantly affects the environment (42 USC § 4332).

CEQA is the California state counterpart to NEPA. Like NEPA, CEQA generally requires state and local government agencies to inform decision makers and the public about the potential environmental impacts of proposed projects, and to reduce those environmental impacts to the extent feasible (California Public Resources Code §§ 21000-21189.3). A joint Environmental Impact Report or Environmental Impact Statement will be prepared to satisfy the requirements of both NEPA and CEQA in relation to this CP.

1.3.4 California Fish and Game Code and California Code of Regulations

Primary management authority for the commercial Dungeness crab fishery rests with the California legislature, which has enacted several statutes constraining allowable fishing activity. Certain statutes have expressly delegated authority for specific aspects of fishery management

to CDFW, which has then adopted implementing regulations. Therefore, legislative statutes (codified in FGC) and CDFW regulations (codified in Title 14, CCR) jointly provide for the management framework of this fishery.

The commercial Dungeness crab fishery in California is regulated by FGC sections 8275 *et seq* and implementing regulations in Title 14, CCR, sections 132.1 through proposed section 132.8. These provisions address season dates, a trap limit program, ability for delays of the fishery due to crab meat quality, and a permitting structure, among other things. Some specific statues and regulations which provide relevant authority to CDFW and important context for understanding the construction of this CP are highlighted below:

- FGC § 5523 authorizes CDFW to restrict the commercial take of Dungeness crab due to human health risks.
- FGC § 8276.1 authorizes CDFW to restrict the commercial take of Dungeness crab due to the risk of marine life entanglement; additional details will be provided in Title 14, CCR, § 132.8.
- FGC § 8276.2 allows CDFW to delay the commercial Dungeness crab season in specified fishing districts when the quality of crab is poor.
- FGC § 8276.5 prescribes the trap limits for commercial Dungeness crab vessel permit holders; additional details are provided in Title 14, CCR, §§ 132.1-132.2.
- FGC § 8279.1 prohibits commercial Dungeness crab fishery participants from fishing in areas where openings are delayed either due to human health risks or poor crab meat quality for 30 days if these participants have already fished in other areas.
- FGC § 9002.5 requires CDFW to develop a program that facilitates retrieval of lost and abandoned commercial crab traps following the end of the fishing season; additional details are provided in Title 14, CCR, § 132.7.
- FGC § 9005 requires every commercial fishing trap to be marked with a buoy.

1.3.5 California Administrative Procedure Act

California APA (Government Code §§ 11340-11365) establishes rulemaking procedures and standards for state agencies in California. Unless otherwise exempt, the adoption of every regulation must comply with the requirements of the California APA. The law is designed to provide the public with a meaningful opportunity to participate in the adoption of state regulations and to ensure that regulations are clear, necessary, and legally valid. State regulations must also be adopted in compliance with relevant regulations implementing the California APA (Title 1, CCR, §§ 1-280)

1.4 Fishery Interactions and Covered Species

California commercial Dungeness crab gear is known to interact with blue whales, gray whales, humpback whales, and killer whales, as well as Pacific leatherback sea turtles. Between 1982 and 2017, interactions have occurred most often with humpback whales (n = 29) and gray whales (n = 8; Saez et al. 2020).

The following ESA-listed species are proposed for coverage under this ITP (Covered Species):

- Humpback whale *(Megaptera novaeangliae)* – Central America Distinct Population Segment (DPS) and Mexico DPS
- Blue whale *(Balaenoptera musculus)*
- Pacific leatherback sea turtle *(Dermochelys coriacea)*

Humpback whales were originally listed under ESA in June 1970, and in April 2015 NMFS proposed revising the listing status to designate 14 DPS. On September 8, 2016, the Central America DPS and Mexico DPS, which are both known to occur along the California coast (see Chapter 3) were listed as endangered and threatened, respectively (81 FR 62259). Multiple interactions have also been documented with blue whales, which were listed as endangered on July 30, 1970 (35 FR 18319). Pacific leatherback sea turtles were listed as endangered under the Endangered Species Act on April 10, 1970 (35 FR 5691). While only one Pacific leatherback sea turtle interaction has been documented in this fishery, they are included as a Covered Species due to its extremely low population abundance.

The following ESA-listed species are not proposed for coverage under this ITP:

Gray whales were originally listed in December 1970, but in 1994 NMFS de-listed the Eastern North Pacific DPS (59 FR 31094) Because gray whales off of California are part of the Eastern North Pacific DPS and no longer covered under the ESA, and it is unlikely they will be re-listed during the term of this permit given the increasing population sizes, they are not included as a Covered Species under this CP.

Under the MMPA, there are eight recognized killer whale populations in the Pacific: AT1 Transient; Eastern North Pacific Alaska Resident; Eastern North Pacific Northern Resident; Eastern North Pacific Offshore; Eastern North Pacific Southern Resident; Gulf of Alaska, Aleutian Islands, and Bering Sea Transient; Hawaii; and West Coast Transient. Only three of these stocks have members that are known to visit California waters: Eastern North Pacific Offshore, Eastern North Pacific Southern Resident, and West Coast Transient (NMFS 2018c; NMFS 2019d). Of these, only the Southern Resident DPS, the same individuals comprising the Eastern North Pacific Southern Resident stock under MMPA, is listed as endangered under the ESA (70 FR 69903).

There have been two confirmed killer whale entanglements in California commercial Dungeness crab traps since 1982, one in 2015 and one in 2016 (Saez et al. 2020). However, there has been no indication that these entanglements involved members of the Southern Resident population (NMFS 2019d). Animals from this population are the rarest among the ones that appear off the Californian coast, consisting of just over 12% of the individuals, and the 2018 stock assessment for the Southern Resident stock puts the known total fishery mortality and serious injury for the stock at zero (NMFS 2019d). Because of the apparent low likelihood of interaction between the ESA-listed DPS and the fishery, killer whales are not included in this CP.

While fin whales are known to occur within the plan area (see Chapter 2), only 6 entanglements have been documented off the West Coast since 1982, and none of them have been confirmed as California commercial Dungeness crab gear (Saez et al. 2020). Of these entanglements, one

was confirmed as drift gillnet gear and five were categorized as unknown gear. Due to the rarity of these entanglements, and lack of documented interactions with trap/pot gear, we do not propose including it as a Covered Species under this CP.

California sea otters are listed under both the federal ESA and California ESA, and are known to occur in the plan area. Interactions between otters and trap gear have been rare, with only 4 mortalities known to have occurred in California and none since 2000 (Hatfield et al. 2011, USFWS 2017). Of these mortalities, one was confirmed in lobster gear, one in rock crab gear, and two in suspected sablefish gear. These mortalities were due to drowning when the otter entered the trap, rather than entanglement in the line or buoys. There is no direct evidence of interaction between otters and Dungeness crab gear since revision were made to gear design in the 1980's. Due to this, and California state law which prohibits take and possession, CDFW is not seeking coverage for incidental take of sea otters as part of this ITP. Any future interactions between Dungeness crab gear and otters would likely prompt CDFW to investigate whether additional steps were needed, such as requiring gear modifications which would reduce or eliminate the likelihood of such interactions.

1.5 Stakeholder Involvement

[Note: Will update and expand this section prior to final CP submission]

1.5.1 Tribal

On December 23, 2019 CDFW provided formal notice to California tribal governments regarding the development of the regulations that would form the core of the management measures under this CP. CDFW requested preliminary input by February 1, 2020. CDFW staff also provided a brief update during the January 17, 2020 Fish and Game Commission Tribal Committee meeting in Los Alamitos. As of the date of this CP, no requests for government-to-government consultation have been received. Three tribal governments did contact CDFW. Buena Vista Rancheria and Yocha Dehe Wintum Nation requested further notification as the process develops so that they may consider potential tribal impact. Jackson Rancheria did request additional information about the scope of the rulemaking but did not request additional follow-up.

1.5.2 California Dungeness Crab Fishing Gear Working Group

CDFW, the California Ocean Protection Council (COPC), and NMFS first convened the California Dungeness Crab Fishing Gear Working Group (Working Group) to address marine life impacts from the California Dungeness crab fishery in 2015. This broad cross-section of key stakeholders, including fishermen and environmental organizations, has been instrumental in making recommendations to state management agencies and the California legislature regarding actions to reduce entanglement risk.

CDFW has provided routine updates to and solicited feedback from the Working Group during development of this CP. The Working Group provided feedback on key aspects of this CP, including triggers for management action, avoidance/minimization measures, and other aspects of Chapter 5 prior to submission of a preliminary CP to NMFS in May 2020. In addition to public

scoping meetings, CDFW conducted additional, targeted outreach with this group prior to official submission of the ITP application.

1.5.3 Other Outreach

In March 2019, CDFW created a dedicated webpage (www.wildlife.ca.gov/Conservation/Marine/WhaleSafeFisheries) where updates about the ITP process were posted. CDFW also created a listserv where interested individuals could sign up for updates regarding development of the CP, and a dedicated email account where individuals could send comments regarding CDFW's Whale Safe Fishery efforts. As of April 13, 2020, 53 individuals had signed up to receive these announcements.

CDFW notified commercial fishery participants of this CP's development and invited their comments in an outreach newsletter mailed in October 2019. Updates were also provided at public meetings of the Dungeness Crab Task Force (DCTF) in October 2019 and the Legislature's Joint Committee on Fisheries and Aquaculture in November 2019 and March 2020.

CDFW also conducted a webinar meeting in March 2020 during which staff provided a pre-notice preview of the proposed Risk Assessment and Mitigation Program (RAMP) regulations (which form the core of the management responses under this CP) and provided updates regarding the overall ITP process. Invitations were broadly distributed to commercial and recreational Dungeness crab fishery participants, harbor masters, the Working Group, and environmental interest groups. Around 80 individuals, including several Working Group members, attended.

Potential inclusion of the recreational crab sector in this ITP, and associated regulatory changes, was discussed at the July 2019, November 2019, and March 2020 meetings of the Fish and Game Commission's Marine Resources Committee, the August 2019, December 2019, and February 2020 meetings of the full Commission, and during in person and webinar meetings held by CDFW in December 2019 and January 2020.

DRAFT

CHAPTER 2. PROJECT DESCRIPTION AND ACTIVITIES COVERED BY THE PERMIT

2.1 Plan Area

This plan area of this CP and the permit area of the associated ITP consist of all ocean waters offshore of California out to 200 nautical miles. The California commercial Dungeness crab fishery occurs almost exclusively north of Point Conception (CDFW 2019a). However, Dungeness crab fishing is allowed south of Point Conception, where Dungeness crab do occasionally occur. Furthermore, commercial Dungeness crab traps may be moved by oceanographic currents, or entangled marine life, into the Southern California Bight.

Figure 2-1: Plan and Permit Area, including California coastal counties, typical ports of landing and the boundary between the Northern Management Area and Central Management Area (Basemap provided by USGS)

2.2 Covered Activities

The commercial Dungeness crab fishery in California began in the mid-1800s, and over time developed into one of the most valuable commercial fisheries in the state (Wild & Tasto 1983). Since 2010, the fishery has regularly exceeded 50 million dollars in ex-vessel value each season (CDFW 2019a), and it plays a particularly significant role in Bodega Bay and other

Northern California ports (Magel et al., in review). Landings then enter the larger California seafood economy, which has generated over $22.8 billion in sales and supported nearly 125,000 jobs in 2016 (NMFS 2018b).

For existing management purposes, the fishery is divided into two areas by the Sonoma-Mendocino county line. The Northern Management Area (NMA) extends from the Sonoma-Mendocino county line to Oregon and the Central Management Area (CMA) extends from the Sonoma-Mendocino county line to Mexico (Figure 2-1). The season runs from December 1 to July 15 in the NMA and from November 15 to June 30 in the CMA (FGC § 8276), however most landings occur within the first two months of the season (Figure 2-2).

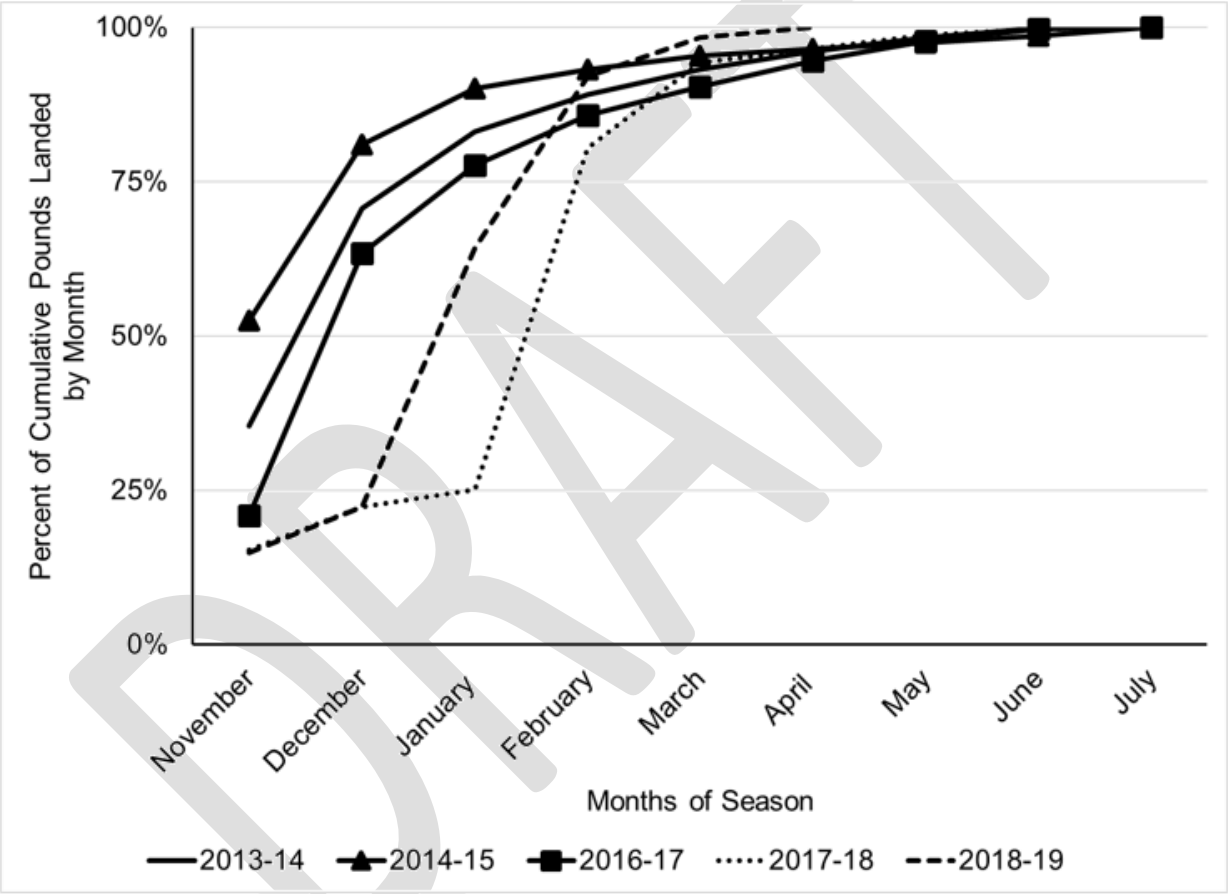

Figure 2-2. Percent of Cumulative Pounds of Dungeness Crab Landed by Month Between 2013-14 and 2018-19 (Not Including 2015-16 Disaster Season). Note The 2018-19 Season Ended April 15. Source: CDFW Marine Landings Data System.

[Note: Will update Figure 2-2 with 2020-21 data prior to final CP submission]

The California Legislature first implemented a restricted access program capping the fishery at 681 permits in 1995 (AB 3337, Hauser, 1994). A trap limit program to further control effort was established in 2013 (SB 369, Evans, 2011). Dungeness crab vessel permitholders were divided into 7 tiers based on their total California Dungeness crab landings from the 2003-2004 through 2007-2008 seasons. Those in the highest tier were allotted 500 traps, and those in the lowest

tier were allotted 175 traps. Trap allotments are enforced with biennial buoy tags marked with the permit number. While originally implemented due to concerns over overcapacity and latent permits, the unique gear marking has allowed commercial Dungeness crab gear to be easily identified during marine life entanglement. For the 2020 permitting year, 551 permits were renewed across the 7 tiers (Table 2-1).

Table 2-1. The Number of Dungeness Crab Permits Renewed in 2020 by Trap Tier (CDFW Automatic License Data System 2020).

Tier	Trap Number	Number of Permits
1	500	58
2	450	53
3	400	57
4	350	55
5	300	55
6	250	162
7	175	111

Commercial landings data submitted to CDFW include the amount (volume) of landings, the dates the landings are made, and the general fishing location. However, fishing effort is not directly reported. There is currently no logbook or observer requirement for the Dungeness crab fishery which could provide information on the total number of traps fished. CDFW staff must make assumptions in order to infer fishing effort level using existing landings data. For instance, maximum trap estimates can be made by adding up the trap allotments for each permit, and further refined by only including vessels which made landings in a given season, port complex, or other spatiotemporal unit. However, this likely results in an overestimation because not every permit holder consistently utilizes their full trap allotment and trap deployment rates likely vary over space and time. When assessing fishing effort over relatively short timescales (e.g. weeks or months), landings-based estimates may also underestimate deployed gear if a vessel does not make a landing during that time period.

Based on the permits issued for the 2020 permitting year (n = 551), the entire commercial Dungeness crab fleet could potentially fish up to 171,325 traps. If only active permit holders (as determined by landings during the season) are taken into account, the number would be lower. Even then, the number does not account for the fact that not all participants deploy their full allotments of traps.

The fishery uses traps constructed from two circular iron frames 3 to 3.5 feet in diameter connected by spokes on the outer edges (Figure 2-3). The frame is wrapped with strips of rubber and the entire frame is covered with stainless steel wire mesh.

Figure 2-3. Commercial Dungeness Crab gear. Photo by Christy Juhasz (CDFW).

Fishing could occur up to a depth of 600 feet (100 fathoms), but rarely does occur beyond 300 feet (50 fathoms). Fishing depths are dependent on multiple factors, including fishing location, time of year, and to a lesser extent, the type of vessel fishing. Fishing locations are dependent on the time of year, home port and access to processing facilities. Under current law, traps must be serviced at least once every 96 hours (FGC § 9004). Every trap or string of traps must be marked with a buoy (FGC § 9005) and the operator of a Dungeness crab trap shall mark the buoy with their commercial fishing license number only (FGC § 9006). Additionally, FGC § 9012 prohibits connecting multiple traps with a common line in Districts 6, 7, 8, and 9 (NMA). Requiring each trap to be individually buoyed helps CDFW enforce its trap limit program. However, this requirement prevents use of "trawls" (aka "strings"), which are common in East Coast trap fisheries.

[Note: will insert a side-by-side graphic showing traditional one-pot/one-line and trawl set ups. For reference: https://www.fisheries.noaa.gov/feature-story/faces-north-atlantic-right-whale-conservation-mike-asaro-entanglement-prevention]

In response to marine life entanglement issues, in October 2018 CDFW adopted a regulation restricting the amount of line and buoys that can be attached to each trap (14 CCR §132.6). Fishermen commonly use trailer buoys to provide additional flotation in high current locations and to increase visibility of the gear. This rule stipulates no more than two trailer buoys may be used, and the distance from the front end of the main buoy to the tail end of the last trailer buoy cannot exceed 24 feet when a trap is fished in depths less than or equal to 35 fathoms, or 36 feet when fishing in depths greater than 35 fathoms (Figure 2-4).

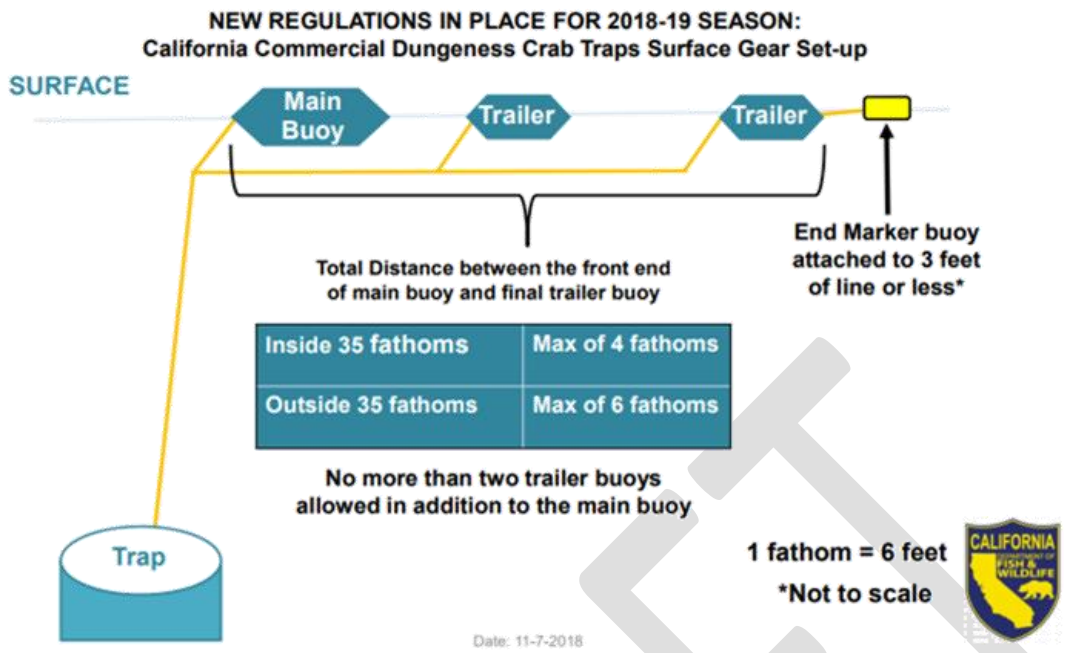

Figure 2-4. Schematic showing surface gear restrictions in place as of October 2018. Credit: CDFW. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=161957&inline

2.3 Permit Duration

CDFW is requesting a 15-year ITP. Based on initial consultation with NMFS during preparation of this CP, a permit duration in multiples of 3-year increments facilitates alignment with required MMPA authorizations. A 15-year period provides sufficient time to implement the permit and evaluate the adaptive management procedures described in Chapters 5 and 6; it also provides the Dungeness crab fleet predictability by providing a set framework within which the fishery will operate. Additionally, this period will likely encompass multiple large-scale oceanographic regimes, which new research by Santora et al. (2020) has directly linked to entanglement events. By the end of the 15-year period, additional research will likely become available to further inform the conservation of the Covered Species and inform development of future Conservation Plans.

DRAFT

CHAPTER 3. ENVIRONMENTAL SETTING AND BIOLOGICAL RESOURCES

3.1 Environmental Setting

The waters offshore California are part of the California Current Large Marine Ecosystem (CCLME), a highly productive coastal ecosystem spanning the West Coast of North America from British Columbia to Baja California (Talley 2011). Like other eastern boundary current systems, the CCLME experiences significant, sustained upwelling events that provide critical food source for larger animals such as large whales and sea turtles (Carr & Kearns 2003; Talley 2011). At the same time, the productive ecosystem also supports some of the most vibrant fisheries on the planet, including the commercial Dungeness crab fishery in California. In 2018, over $180 million worth of seafood in ex-vessel value was landed in California, of which just over one-third was attributed to the California Dungeness crab fishery (CDFW 2019).

Wind is the primary driver of CCLME's productivity (Carr & Kearns 2003). The prevailing alongshore wind in the Northeastern Subtropical Pacific drives upwelling along the U.S. West Coast due to Ekman transport of warm surface water offshore that is replaced by deeper nutrient-rich water (Marchesiello et al. 2003). The nutrients brought to the surface of the ocean by the upwelled water in turn drive the production of various pelagic species. These include the oceanic krill species *Euphausia pacifica* and *Thysanoessa spinifera*, as well as forage fishes *Engraulis mordax* (Northern Anchovy), *Sardinops sagax* (Pacific Sardine), Ammodytidae (Sand Lance), and *Clupea pallasil* (Pacific Herring), that are preyed upon by many large baleen whales (Brinton 1976; Schoenherr 1991; Clapham et al. 1997; Di Lorenzo & Ohman 2013; Fleming et al. 2016), The production also help drive various Scyphomedusae (jellies) blooms the Pacific leatherback sea turtle relies on for forage.

3.1.1 Prey Species: Krill

The stretch of coast between the California-Oregon border and Point Sur generally experience the strongest upwelling within the CCLME, as well as the most variability from year to year (Bograd et al. 2009). A few smaller hotspots where krill populations are known to bloom occur north of San Francisco Bay (1, 2, Figure 3-1). The northernmost significant hotspot in California, however, starts just south of the Farallon Islands, and the stretch of prime krill range extends to just north of Pacific Grove (3, 4, 5, Figure 3-1). This group of hot spots are centered around the depth range of 200-500 meters in the north until Monterey Bay, where the center shifts to the depth range of 1000-2000 meters but essentially covers most of the bay (Santora et al. 2011).

On average, the area south of Point Sur experiences less upwelling than the area immediately to the north, but upwelling tends to last longer and is more consistent (Bograd et al. 2009). Several major krill hotspots are known to occur here. One group occurs in the depth range of 200-1000 m starting just south of Point Sur and ends just north of Point Conception (6, 7, Figure 3-1), and another major hotspot is located just south of Point Conception (8, Figure 3-1). At the southern end, a less intense group of hotspots also exists between the northern and southern Channel Islands (9-10, Figure 3-1).

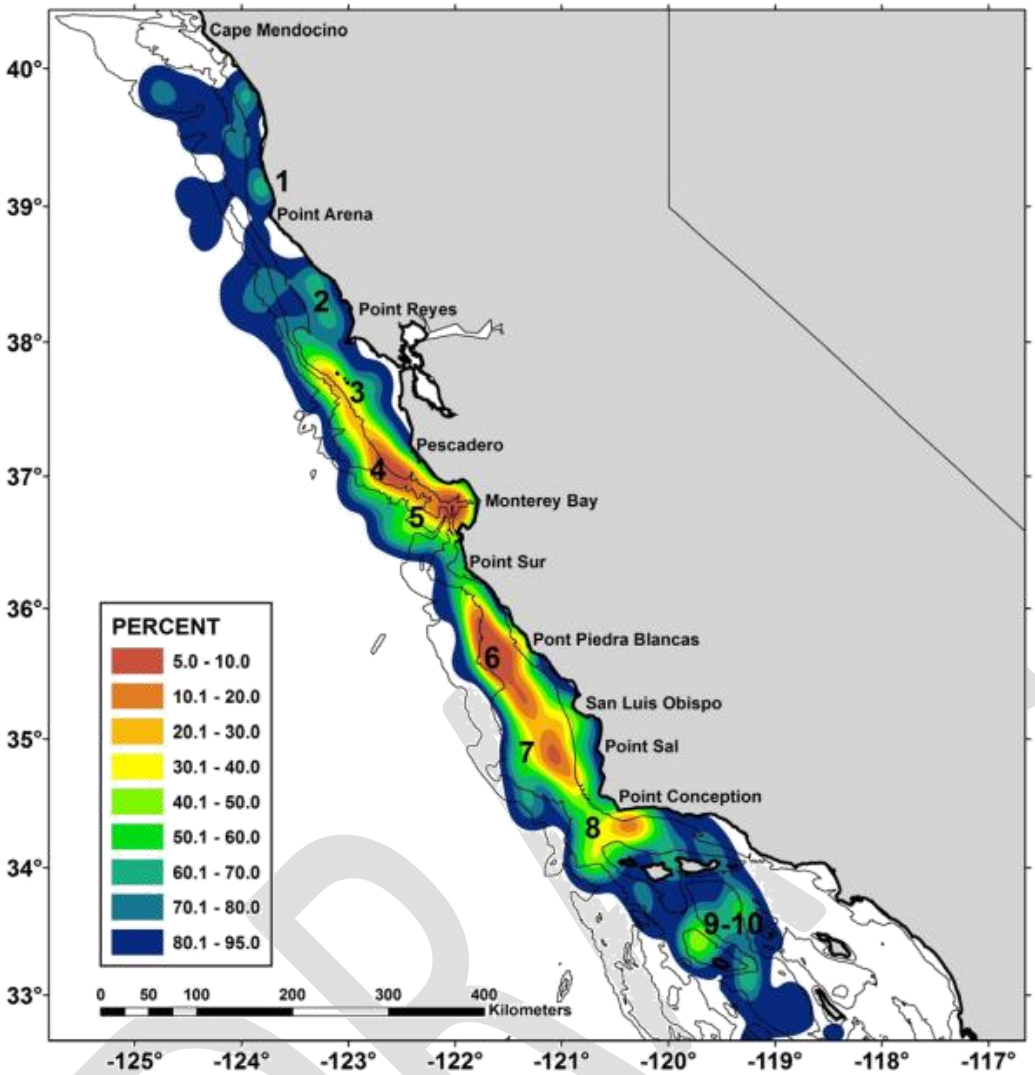

Figure 3-1. Krill hotspots along California coast during May-June, 2004-2009, depth contours denote 200 m, 1000 m, and 2000 m isobaths, respectively; percent value denotes the relative krill abundance of an area as a percentile within all sampled areas; areas in the 5th to 20th percentiles are considered "high," and areas in the 20th to 40th percentile are considered "medium" (Santora et al. 2011).

3.1.2 Prey Species: Forage Fishes

Forage fishes such as Northern Anchovy and Pacific Sardine can potentially occur at a higher frequency than krill in warmer conditions when upwelling is weaker (Fleming et al. 2016). Pacific Sardine in particular are known to thrive in warmer conditions (Lluch-Belda et al. 1991; Chavez et al. 2003). Both species are known to occur off the coast of California during the winter-spring spawning season (Bakun & Parrish 1982; Demer et al. 2012). To date, no studies have examined the relative preference of large baleen whales, specifically humpback whales, for Pacific herring or Sand lance during warmer years. A recent study suggests that Pacific herring, like most species in the CCLME, are more abundant during colder years (Sydeman et al. 2018).

3.1.3 Prey Species: Scyphomedusae

Scyphomedusae such as *Chrysaora fuscescens* (Brown Sea Nettles), are known to congregate in several regions off the California coast during the upwelling months of March through September (Graham et al. 1992; Benson 2019). Northern Monterey Bay in particular exhibits strong seasonal oceanographic features that retain large numbers of Scyphomedusae (Graham et al. 2001). This retention site is driven by the region's upwelling (Graham & Largier 1997), and Scyphomedusae blooms thus are likely to be correlated to the upwelling strength of a given year.

3.1.4 Eastern Pacific Marine Heat Wave (2013-2018)

A large marine heatwave event, colloquially dubbed "the Blob", dominated the CCLME between the Winter of 2013 and the Fall of 2018. This large marine heatwave coincided with a weak El Nino condition in Winter of 2014, as well as a stronger El Nino condition the following year (Peterson et al. 2017). Both events resulted in a concentration of warm water movements northward along the U.S. West Coast.

The resulting warming of the coastal Northeastern Pacific greatly affected the CCLME. The warm surface water both delayed the onset of upwelling and reduced its strength, since the deep nutrient-rich cold water must break through a deeper and warmer layer of surface water (Peterson et al. 2015b). A retrospective look at the overall upwelling strength off Central California showed a clear, precipitous drop (Figure 3-2). The copepod composition along the West Coast accordingly shifted dramatically to warm-water species, and the abundance of oceanic krill greatly decreased (Cavole et al. 2016).

The diminished krill abundance very likely altered the migrating behavior of large whales that rely on krill as their primary food source. The most notable change for great whales is the compression of optimal habitat where the whales can forage (Abrahms et al. 2019; Santora et al. 2020). While upwelling did not completely disappear in CCLME, it was restricted to a narrow band along the coast (Figure 3-3; Harvey et al 2020; Santora et al. 2020). This change in effect brought the whales closer to shore, where more fishing activities occur.

DRAFT

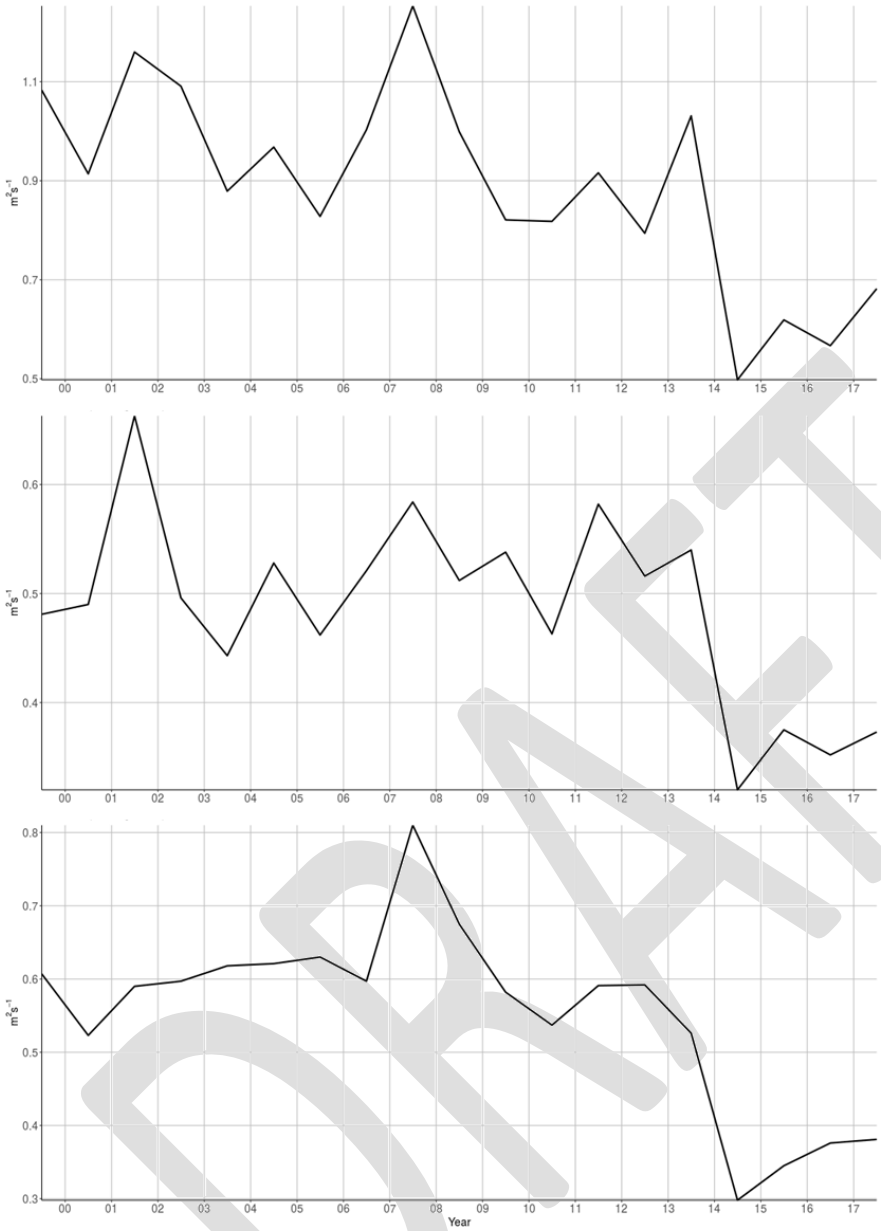

Figure 3-2. Coastal Upwelling Transport Index (m2/s) from 1999 to 2018 off California coast at 39N (top), 38N (middle), and 37N (bottom) (Source: NOAA, available at: https://oceanview.pfeg.noaa.gov/products/upwelling/cutibeuti).

DRAFT

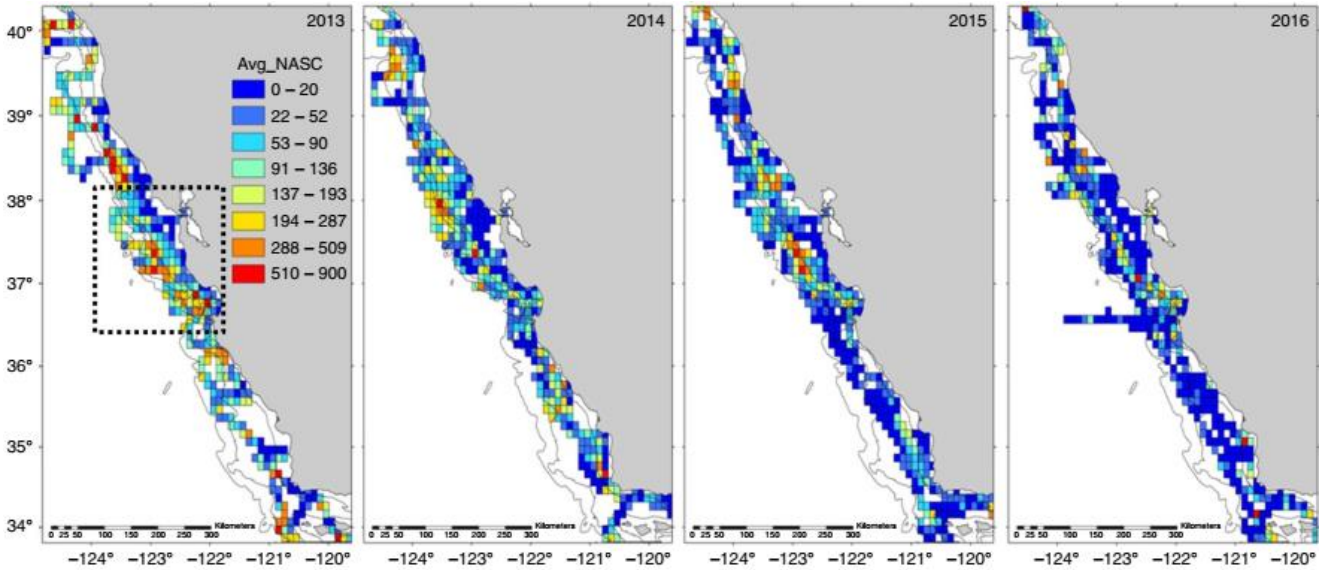

Figure 3-3. Acoustically determined krill distribution (m2nmi-2) over 25 km2 grids; produced by Santora et al. 2020 based on data from California Current Integrated Ecosystem Assessment

3.2 Covered Species

3.2.1 Humpback Whales: Central America DPS and Mexico DPS

There are 4 DPS' of humpback whales in the North Pacific: Hawaii, Central America, Mexico, and Western North Pacific (Figure 3-4). Of these, only members of the Mexico DPS and Central America DPS enter waters off California each year. While some humpback whales are present year-round off California, the numbers increase each year when they migrate from their winter breeding grounds in Mexico/Central America to their summer foraging grounds in more northern latitudes (Forney & Barlow 1998). These whales are typically sighted off California from March through November, with sightings being most common during summer and fall (Calambokidis et al. 2015). The Mexico DPS breeds along the Pacific coast of mainland Mexico and the Revillagigedo Islands, and feeds along a broad swath of Northeastern Pacific Ocean from Central California to the Aleutian Islands (81 FR 62260, 2016). The Central America DPS breeds along the Pacific coasts of Costa Rica, Panama, Guatemala, El Salvador, Honduras, and Nicaragua and feeds almost exclusively offshore of California and Oregon (81 FR 62260, 2016).

DRAFT

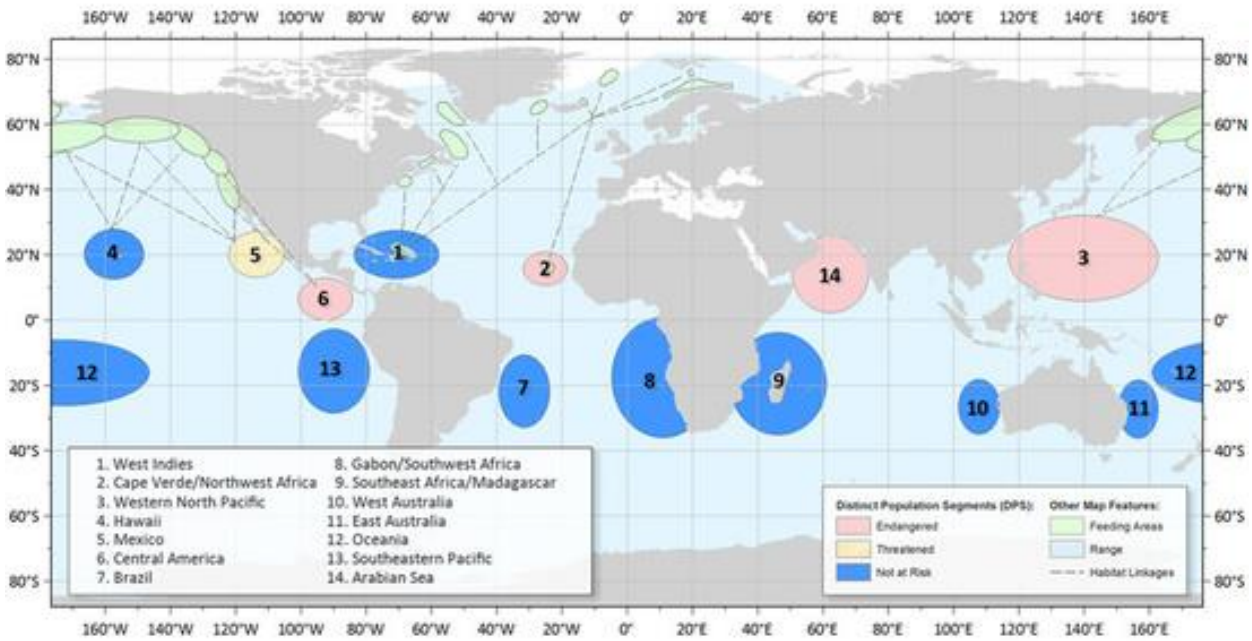

Figure 3-4. Map showing locations of 14 Humpback Whale Distinct Population Segments breeding and feeding areas. Source: https://www.fisheries.noaa.gov/species/humpback-whale, accessed 2/21/2020.

For the purpose of management under MMPA, NMFS recognizes a single stock of humpback whales along the US West Coast (the California/Oregon/Washington stock), with a current estimated abundance of 2,900 individuals and a minimum population estimate of 2,784 individuals (NMFS 2019c). Most humpback whales that feed in California waters originate from the threatened Mexico DPS (~90%), while a much smaller fraction originate from the endangered Central American DPS (Wade et al. 2016). While photographic catalogs of unique fluke markings and genetic sampling provide opportunities to identify which DPS a given humpback whale belongs to, this information is generally not available in real time to state fishery managers. Therefore, for the purposes of management actions under this CP, CDFW does not propose differentiating between the two DPS.

[Note: CDFW will review studies relevant to the DPS population proportions and expand this section prior to submitting final CP]

Humpback whale migratory patterns have changed in recent years, with increased sightings in the estuarine environments of Puget Sound, the mouth of the Columbia River, and San Francisco Bay (Calambokidis et al. 2017). The species is known to be an opportunistic feeder that switches between a variety of prey species depending on the prevailing ocean conditions (Kieckhefer et al. 1995; Clapham et al. 1997; Fleming et al. 2016, Santora et al. 2020). The recent nearshore feeding behavior of humpback whales targeting schooling forage fishes was likely due to a lack of krill in the CCLME (Calambokidis et al. 2017). Some of the changes in whale occurrence, such as the expansion of peripheral habitats and more animals overwintering or arriving early in the season, also suggest that the population may be approaching carrying capacity. These changes significantly increase the chance of spatial and temporal overlap with

Dungeness crab fisheries in winter and early spring, and thus the risk of entanglements (Calambokidis et al. 2017, Santora et al. 2020).

3.2.2 Blue Whales

Blue whales are found globally in every ocean except the Arctic. There are five recognized subspecies of Northern blue whale (B. m. musculus). For purposes of management under the MMPA, NMFS divides the North Pacific blue whale into Eastern North Pacific (ENP) and Central North Pacific stocks based on a suite of behavioral and morphological data (NMFS 2018a; NMFS 2019b). Members of the ENP population transit through California waters every year (Figure 3-4). Current estimated abundance for the ENP stock is 1,647 individuals, with a minimum population estimate of 1,551 whales (NMFS 2019b).

Similar to the humpback whale, the blue whale migrates towards colder regions in the spring to feed on the abundant summer zooplankton and toward the subtropics in the fall to calf (Reilly et al. 1990; Mate et al. 1999; Abrahms et al. 2019). Animals generally begin leaving California and areas further north starting in November, and do not begin to re-enter California waters until spring (Bailey et al. 2009). blue whale distribution is strongly associated with oceanographic features that correlate with high krill abundance, such as upwelling zones and thermal fronts (Doniol-Valcroze et al. 2007). Nine biologically important foraging areas have been identified off California, with 6 in Southern California and 3 in Central California; these include the Southern California Bight, Monterey Bay, Gulf of Farallones, Cape Mendocino, and Cape Blanco (Calambokidis et al. 2015). Productivity in these areas begins to rise around May of each year and remains elevated throughout the summer and early fall. By November, suitable habitats typically occur south of Point Conception.

Blue whales are found in coastal and pelagic environments on the continental shelf (Fiedler et al. 1998) and in deep water far offshore between the surface and depths of over 100 m (Croll et al. 2001) where they forage exclusively on dense patches of pelagic euphausiids such as Euphasia pacifica and Thysanoessa spinifera (Schoenherr 1991; Fiedler et al. 1998, Croll et al. 2001). Individuals typically forage in small groups at depths shallower than 100 m, although some forage deeper in the 250 to 300 m range (Calambokidis et al. 2008). The ENP population has expanded its range during warm years when krill is scarce (Peterson et al. 2006). Individuals that move closer to shore would experience an elevated risk of interactions with commercial Dungeness crab gear.

3.2.3 Pacific Leatherback Sea Turtles

Pacific leatherback sea turtles are the largest and most widely distributed sea turtle species in the world. They nest exclusively on tropical beaches, but migrate throughout temperate ocean regions to forage for gelatinous prey. The species exhibits very strong site fidelity, returning to the same region to forage every year. Pacific leatherback sea turtles found in California nest on beaches in the Western Pacific (Starbird et al. 1993; Benson et al. 2011). In a 2011 study tracking the migration of multiple summer-nesting individuals, 10 individuals out of the 37 with sufficient data (~27%) foraged inside the larger California Current Ecosystem (Benson et al. 2011).

Pacific leatherback sea turtles can be found north of Mexico along the U.S. West Coast and as far north as Alaska, but are most commonly observed off Central California between Point Arena and Point Sur (Stinson 1984). Pacific leatherback sea turtles forage in areas with an abundance of Sea Nettles (*Chrysaora fuscescens*), particularly Monterey Bay and the Gulf of the Farallones (see Figure 3-5). The animals also feed on *C. colorata*, *Aurelia spp.,* and other Scyphomedusae (Starbird et al. 1993; Benson et al. 2007).

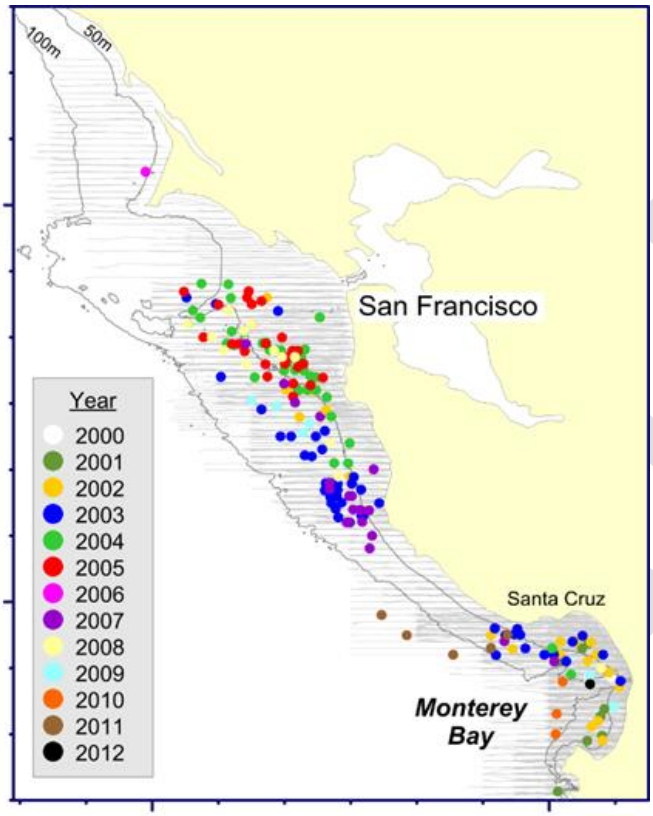

Figure 3-5. Sighting of Pacific Leatherback Sea Turtles off California Coast from 2000 to 2012 from Aerial Survey (Source: Benson et al. 2019).

The species' distribution off of California varies from year to year, but appears to be correlated with the Northern Oscillation Index (NOI; Benson et al. 2007). The correlation is likely due to a positive NOI score's relationship with increased upwelling, which supports greater production of the gelatinous zooplankton that the turtles feed on.

Pacific leatherback sea turtles generally arrive in California waters in late spring around June and remain into the late fall around October, when the water is warm and large summer jelly blooms develop in areas such as the Monterey Bay (Graham et al 2001; Mills 2001; Purcell 2005; Benson et al. 2007). Individuals begin to depart the CCLME when water temperature begins to drop and jelly productivity decreases (Thomas & Strub 2001). Pacific leatherback sea turtles migrate to the Equatorial Eastern Pacific for 2 to 3 months to overwinter starting in November. They then either return to waters off Central California or continue on to nesting beaches on Jamursba Medi in Indonesia over summer (Benson et al. 2007).

Like the blue whale, the Pacific leatherback sea turtle has a specialized diet and does not engage in prey switching, limiting its capacity to adapt to changing environmental conditions which affect forage availability (Hazen et al. 2013). How this would affect the species' entanglement risk is not clear. The front in north Monterey Bay where Scyphomedusae generally congregate is formed by water upwelled near Año Nuevo Point further north and advected into Monterey Bay (Graham et al. 1992). If the level of upwelling along the coast is weak, presumably there would be little upwelled water that can be advected into Monterey Bay to form a front to begin with. If there is no Scyphomedusae bloom inside the bay, it stands to assume that the animals would not enter the bay and overlap with fishing activities. Yet the only Pacific leatherback sea turtle entanglement on record occurred during the 2015-2016 fishing season, when upwelling was known to be weak (Figure 3-2). Telemetry data also show several individuals foraging off Central California during the low upwelling years of 2016 and 2017 (Benson 2019).

DRAFT

CHAPTER 4. POTENTIAL BIOLOGICAL IMPACTS AND TAKE ASSESSMENT

4.1 Estimation of Interactions and Anticipated Take

4.1.1 Current Take Levels

Take of the Covered Species occurs when animals become entangled in either the vertical lines connecting the trap to the surface buoy(s), or the surface gear itself. Depending on the severity of the entanglement, and whether the animal is released through its own action or a successful intervention by a disentanglement team, the entanglement may result in no harm, minimal harm, serious injury (e.g. amputation of a flipper or fluke, impeding movement and feeding), or mortality.

Confirmed entanglements (i.e. NMFS personnel were able to verify the entanglement occurred, and the entanglement is distinct from other reports) involving gear that could not be identified make estimating take difficult for this CP. Out of the 434 confirmed entanglements off the West Coast between 1982 and 2017, nearly half (43%) involved unknown gear (Saez et al. 2020). Of those where gear can be identified (n = 274), 30% (n = 74) involve commercial Dungeness crab gear. Looking specifically at the 167 humpback whale entanglements over this period, 45% (n = 76) involve unknown gear. Of the 91 humpback whale entanglements where gear can be identified, 53% (n = 48) were commercial Dungeness crab (Table 4-1). The fishery is also responsible for all three blue whale entanglements where gear could be identified (Table 4-1).

DRAFT

Table 4-1. Confirmed fishery type, by whale species, in confirmed entanglement records, 1982-2017 (recreated from Saez et al. 2020).

Fishery Type	Blue	Fin	Gray	Humpback	Killer	Minke	Sperm	Unidentified	Total
Hook and Line - Salmon troll	0	0	0	2	0	0	0	0	**2**
NET - Drift gillnet	0	1	4	4	0	4	10	0	**23**
NET - Gillnet	0	0	72	7	0	0	4	2	**85**
NET - Netting	0	0	24	11	0	2	0	3	**40**
OTHER - Weather buoy	0	0	0	1	0	0	0	0	**1**
OTHER - Salmon cables	0	0	1	0	0	0	0	0	**1**
POT - Dungeness crab comm.	3	0	19	48	2	0	0	2	**74**
POT - Dungeness crab rec.	0	0	0	3	0	0	0	0	**3**
POT - Lobster	0	0	2	1	0	0	0	0	**3**
POT - Sablefish	0	0	0	5	0	0	0	0	**5**
POT - Spot prawn	0	0	0	9	0	0	0	0	**9**
POT - Rock crab	0	0	1	0	0	0	0	0	**1**
Total	**3**	**1**	**123**	**91**	**2**	**6**	**14**	**7**	**247**

The prevalence of commercial Dungeness crab traps in cases where gear was identified, coupled with the fact that the commercial Dungeness crab fishery deploys the highest number of traps out of all trap fisheries in California, suggests that a substantial number of entanglements where the fishing gear could not be identified could have been caused by commercial Dungeness crab traps as well. Therefore, the management triggers described in Chapter 5 consider both entanglements confirmed in California commercial Dungeness crab gear as well as those confirmed in unknown gear.

Identification of commercial Dungeness crab gear has been feasible largely because of specialized marking. Commercial Dungeness crab gear in California, Oregon, and Washington must be marked with a buoy tag (California began requiring the tag as part of its trap limit program starting with the 2013-14 season). When the buoy is visible, or the gear can be retrieved by a disentanglement team, this unique tag makes it relatively easy to attribute an entanglement to the commercial Dungeness crab fishery. Each state uses different colors and shapes for their tags (Figure 4-1), enabling forensic experts at NMFS to differentiate between California, Oregon, and Washington commercial Dungeness crab gear.

Since the 2013-14 season, there have been 36 known humpback whale, 3 known blue whale, and 1 known Pacific leatherback sea turtle entanglements in California commercial Dungeness crab gear (Table 4-2). This period (2013 on) during which trap gear could be more easily identified as California commercial Dungeness crab, overlaps to a large degree with the large marine heatwave phenomenon described elsewhere in this CP as well as increased efforts by NMFS to encourage reporting of entanglements. Determining whether the higher numbers of confirmed entanglements in California commercial Dungeness crab gear starting with the 2013-

14 season represents a true increase in the number of entanglements or is a result of enhanced detection, or a combination of both factors is impossible. Regardless, CDFW is committed to reducing entanglements below the levels documented in recent seasons, as described further in Chapters 5 and 6.

[Note: Entanglement numbers will be updated prior to final CP submission]

Figure 4-1. From left to right: Examples of California, Oregon, and Washington buoy tags (tier specific and replacements). Color (for all three states) and shapes (for Washington) vary between seasons. Photos provided by Lauren Saez, NMFS.

Table 4-2. Confirmed Entanglements in California Commercial Dungeness Crab Gear, by Season, 2013-14 to 2019-20. Season includes November of the first year through October of the following year. Information from NOAA 2020 and personal communications from Lauren Saez (2/24/2020) and Justin Greenman (2/26/2020), NMFS. [confirm * values in November 2020]

Season	Humpback Whales	Blue Whales	Pacific Leatherback Sea Turtles
2013-14	2	0	0
2014-15	6	0	0
2015-16	15	2	1 (released alive)
2016-17	3	1	0
2017-18	7	0	0
2018-19	3	0	0
2019-20	*	*	*

Other fisheries known to entangle large whales include recreational Dungeness crab, gillnet, Rock Crab, Lobster, Spot Prawn (commercial and recreational), Coonstripe Shrimp and Sablefish. Entanglements are summarized by calendar year and species in Table 4-3.

Table 4-3. Confirmed Entanglements in Non-Dungeness Crab Fixed Gear Fisheries, by Year, 2014 to 2017. Information from NOAA 2020 and personal communications from Lauren Saez (2/24/2020) and Justin Greenman (2/26/2020), NMFS.

Year	Humpback Whales	Blue Whales	Pacific Leatherback Sea Turtles
2014	4 spot prawn, 1 sablefish trap	0	0
2015	1 recreational Dungeness crab, 1 salmon troll, 2 net, 1 gillnet, 1 lobster	0	1 trap gear (unknown fishery)
2016	3 spot prawn, 2 gillnet, 2 sablefish trap	0	1 trap gear (suspected crab)
2017	1 net, 1 recreational Dungeness crab, 1 sablefish trap	0	0
2018	4 gillnet, 1 net, 2 spot prawn	0	0
2019	1 recreational Dungeness crab, 1 rock crab	0	1 trap gear (suspected rock crab)

Approximately half of confirmed West Coast entanglements cannot be attributed to a specific fishery; therefore, the numbers in Tables 4-2 and 4-3 should be considered lower estimates of fishery interactions. In addition, the total number of entanglements coastwide (see Chapter 1) may be higher than reported.

4.1.2 Assessing Take Level Goals for Marine Mammals Under the ESA

(Note: The following captures CDFW's considerations on how to analyze appropriate levels of take of marine mammals under the ESA utilizing best available science, including data and science developed by NMFS through implementation of the MMPA. CDFW anticipates further considerations will arise based on NMFS consultation.)

- It is often not possible to identify a humpback whale to its source DPS during an entanglement response, or during post hoc forensic review. Entanglement response safety is a priority and/or available genetic sampling equipment is frequently not available.
- Both ESA and MMPA authorizations are needed for NMFS to complete the Section 10 review process and issue an ITP.
- The ESA analysis looks at whether the activity is likely to jeopardize the continued existence of a listed species; specifically in the Section 10 context, the Secretary must find that the permitted take will not appreciably reduce the likelihood of survival and recovery of the species in the wild.
- The MMPA permit requires a Negligible Impact Determination (NID), which evaluates the impacts of permitted activity to annual rates of recruitment and survival, serious injury and mortality rates, and relies on stock-level analysis using Potential Biological Removal (PBR) calculations.

- PBR for humpback whales is calculated for the CA/OR/WA stock, and takes into account special vulnerabilities of depleted stocks (which is defined to include population stocks listed under the ESA). The PBR and NID calculations for humpback whales already incorporate any disproportionate impacts to the relevant Humpback DPSs (the Central America DPS and the Mexico DPS) due to the at-risk status of those populations.
- It is reasonable to assume that activities that do not reduce rates of recruitment and survival (NID standard) also would not reduce the likelihood of survival and recovery (the ESA standard).

4.1.3 Expected Take Under the Proposed Plan

The ultimate goal of this CP is to reduce the take of Covered Species to near zero, in alignment with Target 3.3.5 of the 2020-2025 Ocean Protection Council's strategic plan (COPC 2020), and in the interim to avoid levels of take which would exceed levels of negligible impact (and its equivalent for Pacific leatherback sea turtle). The Conservation Program described in Chapter 5 includes a suite of precautionary management triggers and measures which are intended to prevent entanglements from occurring. The most stringent tool, offering the strongest protections to Covered Species and resulting in the heaviest economic impacts to the fleet, is fishery closure, either zonal or state-wide. The Conservation Program described in Chapter 5 includes triggers for fishery closure based on a specified number of confirmed entanglements in California commercial Dungeness Crab gear (a) during a single fishing season and (b) averaged over a 3-year period. Closure may also occur if the number of Covered Species detected in California waters reach a number that elevates the risk of entanglement to unacceptable levels.

Once the pertinent thresholds are reached within a fishing season, the fishery would close to prevent additional take. However, entanglements related to the fishery are also known to occur outside the fishing season. For example, entanglements may still occur in lost or abandoned gear after closure of the fishery, or entanglements which occurred during the open season may not be reported, confirmed, or attributed to a specific fishery until days, weeks, or months after the closure. Lastly, results of disentanglement efforts, as well as the official NMFS process for determining mortality and serious injury for confirmed entanglements, may not be completed until after the fishing season. Using a multi-year take allocation allows for more complete accounting of all entanglement impacts, and incentivizes responsible fishing practices and precautionary management actions during subsequent seasons as described in Chapter 5.

CDFW therefore requests annual take limits of 2-6 humpback whales in the California/Oregon/Washington Stock that belong to either the Mexico DPS or the Central America DPS, 1-2 blue whales from the Eastern North Pacific Stock, and 1-2 Pacific leatherback sea turtles.

4.2 Effects on Critical Habitat

4.2.1 Blue Whales

NMFS has not designated critical habitat for endangered blue whales, however the current draft recovery plan (NMFS 2018d) highlights the importance of additional research to document important habitat through satellite tagging, surveys, and environmental modeling.

4.2.2 Pacific Leatherback Sea Turtles

Pacific leatherback sea turtle critical habitat (Figure 4-2) was most recently revised on January 26, 2012 (77 FR 4169). The portion off California includes ocean waters east of the 3,000-meter depth contour from Point Arena to Point Arguello. Critical habitat has also been designated off Oregon and Washington. Oceanographic features which provide consistent foraging areas with sufficient density of preferred prey (Brown Sea Nettles, *Chrysaora fuscescens*) was the primary driver of this designation. There is no evidence trap gear affects the quality or density of Pacific Leatherback prey. However, prey accessibility may be impacted if Pacific Leatherbacks become entangled in fishing gear. Entanglements may limit movement their ability to seek prey resources or feed due to the entanglement. However, the rare occurrence of Pacific Leatherback entanglements in the Dungeness crab fishery arguably indicates this may not be the case. Therefore, CDFW concludes the Dungeness crab fishery is unlikely to negatively impact critical habitat, other than potential for minimal impacts through entanglements, for Pacific leatherback sea turtles, which will be addressed through the measures in Chapter 5 of this CP.

DRAFT

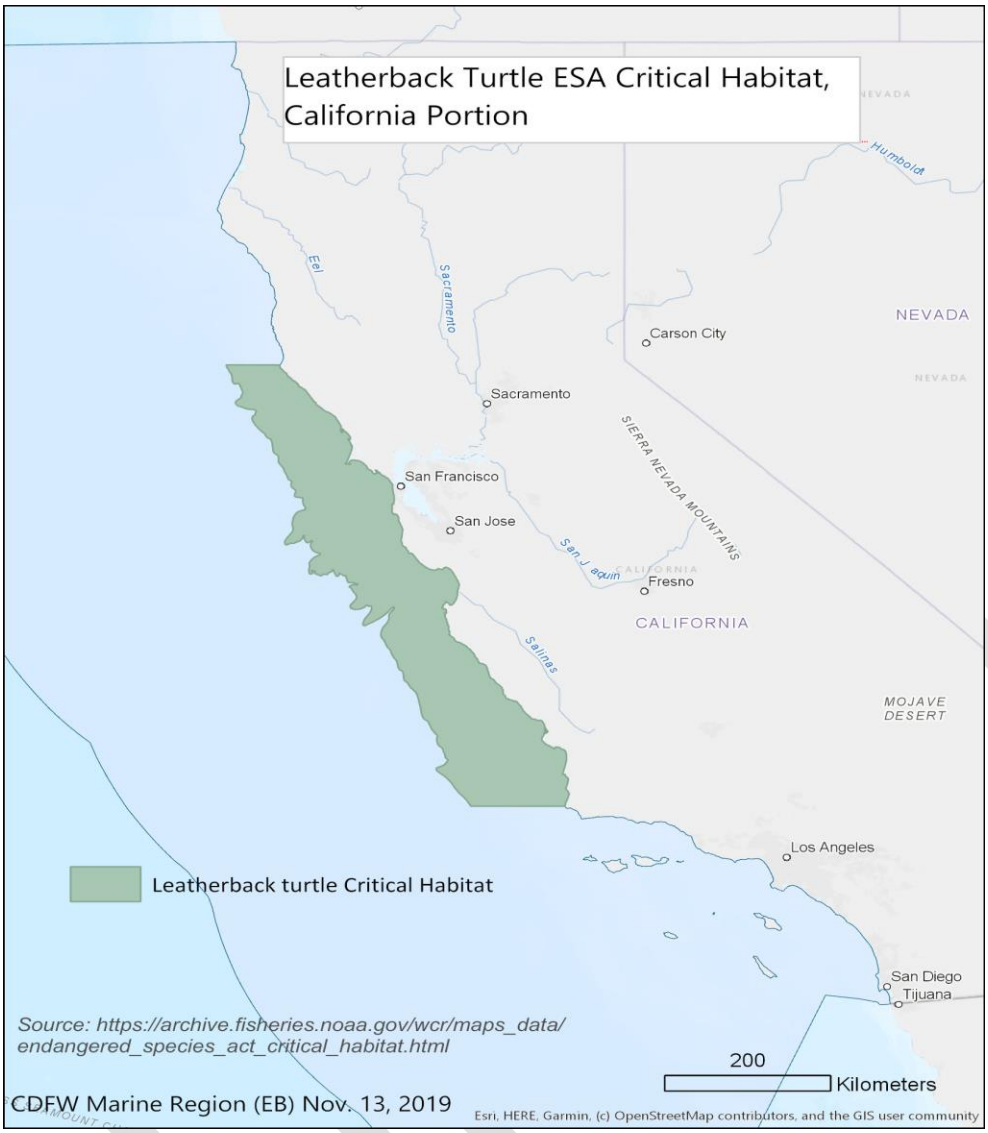

Figure 4-2. Critical Habitat for Pacific Leatherback Sea Turtles off California.

4.2.3 Humpback Whales – Central America DPS and Mexico DPS

Proposed critical habitat designations for three Distinct Population Segments of humpback whales (Western North Pacific, Mexico, Central America) were released for public comment on October 9, 2019 (84 FR 54354). Critical habitat for the Mexico and Central America DPS' includes most waters off California, with nearshore boundaries defined by the 15, 30- or 50-meter isobath and the offshore boundaries defined by the 2,000, 3,000 or 3,700 meter isobath (Figure 4-3). Presence of prey species (euphausiids and small pelagic schooling fishes) of sufficient quality, abundance, and accessibility within known humpback whale feeding areas to support feeding and population growth was the primary driver of this designation. There is no evidence trap gear affects the quality or density of humpback whale prey. Prey accessibility may be impacted if humpback whales become entangled in fishing gear. Entanglements may limit movement, curtailing their ability to seek prey resources, and/or feeding mechanics.

Therefore, CDFW concludes that the California Dungeness crab fishery is unlikely to negatively impact critical habitat for humpback whales, other than through entanglements, which will be addressed through the measures in Chapter 5 of this CP.

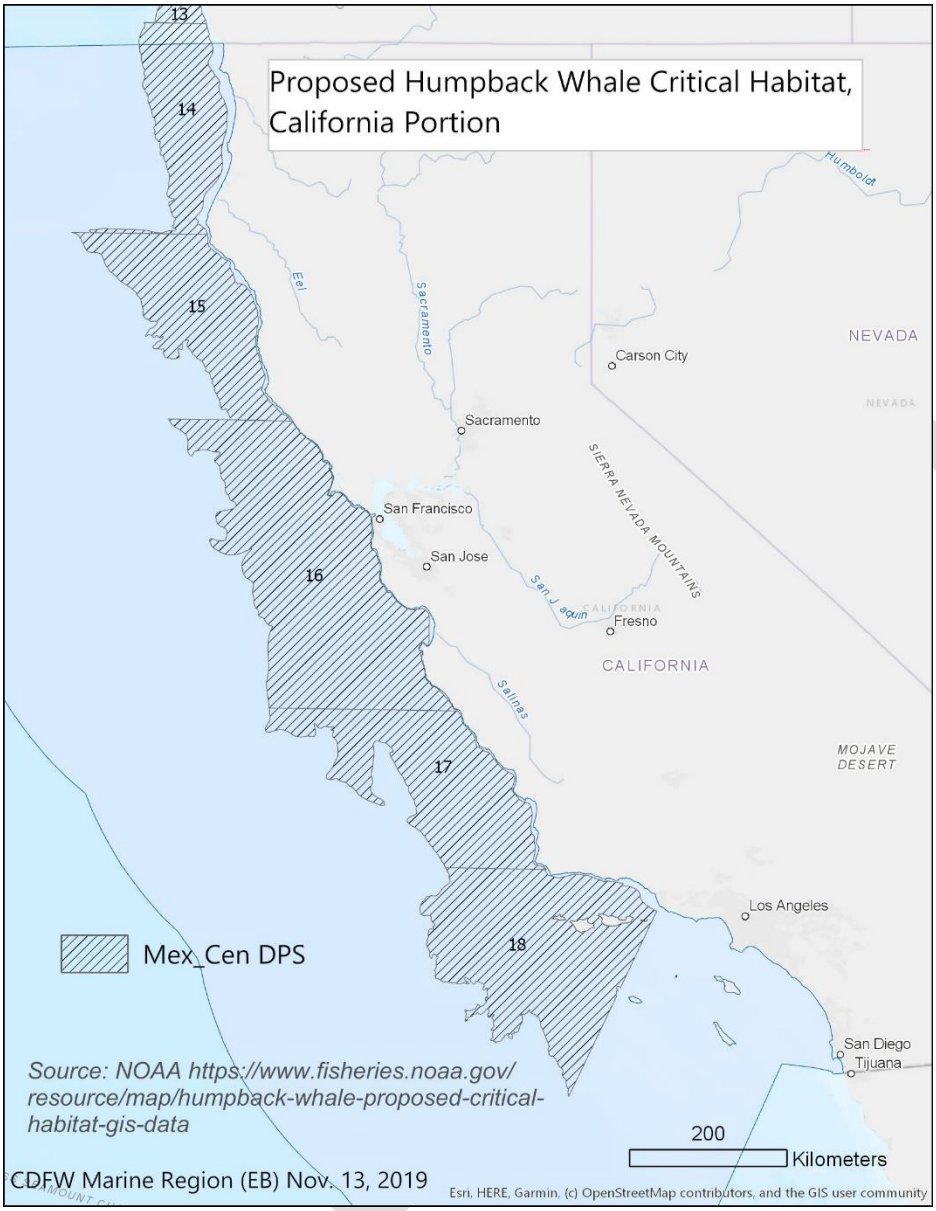

Figure 4-3. Proposed Critical Habitat for Mexican and Central American DPS of Humpback Whales off California.

4.3 Cumulative Impacts

Anthropogenic impacts to the covered cetacean species known to result in take (mortality and serious injury) include ship strikes, fishery impacts, and subsistence harvest (Table 4-4).

Table 4-4. Known sources of anthropogenic mortality for covered cetacean species, from U.S. Pacific Marine Mammal Stock Assessments: 2018 (Caretta et al. 2019).
[Note: Will update from 2019 Stock Assessment Reports prior to final CP submission]

Sector	Humpback Whales	Blue Whales
Ship Strikes (estimated annual M&SI, 2012-2016)	22	18
Subsistence Harvest (mean, 2012-2016)	NA	NA
CA gillnet (2012-2016)	0.04	0
CA spot prawn pot (2012-2016)	0.50	0
Cod pot (2012-2016)	0	0
CA Dungeness (2012-2016)	3.4	0.4
OR Dungeness (2012-2016)	0.15	0
WA Dungeness (2012-2016)	0.15	0
Other pot/trap fisheries, including tribal (2012-2016)	1.6	0.2
Unidentified gillnet (2012-2016)	7.75	0.3
Other fishery interactions, marine debris (2012-2016)	0	0
Total (PBR)	38.45 (16.7)	18.9 (2.3)

The 2018 U.S. Pacific Marine Mammal Stock Assessments (Caretta et al. 2019) also identify anthropogenic impacts to habitat. humpback whales and blue whales are threatened by anthropogenic sound; both species demonstrate some degree of avoidance behavior when exposed to mid-frequency sounds such as those used in active sonar military exercises.

Pacific leatherback sea turtles face a variety of anthropogenic impacts including bycatch in fisheries, direct harvest of eggs and adults, coastal development adjacent to nesting beaches, pollution, marine debris, disease, and climate change (NMFS 2016). The majority of these threats, particularly those affecting nesting beaches in the Western Pacific, occur in areas outside of U.S. jurisdiction. As such, it is difficult to quantify cumulative take across all activities. Within U.S. waters, bycatch in longline and gillnet fisheries is the most severe threat.

The Hawaiian shallow-set longline fishery, which is subject to 100% observer coverage, interacts with Pacific leatherback sea turtles (Table 4-5). Since 2012, the annual interaction limit for Pacific leatherback sea turtles has been 26. Encounter rates have decreased by 84% for

Pacific leatherback sea turtles since regulations requiring use of 18/0 circle hooks and fish-only bait went into place in 2004, although the reduction may be confounded by population declines (Swimmer et al. 2017).

The Hawaiian deep-set longline fishery is subject to 20% observer coverage. Observed interactions are summarized in Table 4-4. Van Houtan (2013) estimates there are 8 Pacific leatherback sea turtle interactions annually, with 42.1% of those interactions resulting in serious injury or mortality. Most interactions are with subadults, and in terms of adult nesting female equivalents, this fishery can be considered to have a negligible impact (Van Houtan 2013).

Table 4-5. Annual observed Pacific Leatherback Sea Turtle interaction totals, Hawaiian Longline fishery, NMFS Observer Data. Provided by Eric Forney (NMFS PIRO), October 23, 2019.

Year	Shallow Set (100% coverage)	Deep Set (20% coverage)
2018	6	2
2017	4	0
2016	5	3
2015	6	4
2014	19	7
2013	7	3
2012	7	1
2011	17	3
2010	7	1
2009	9	1
2008	2	1
2007	5	2
2006	2	2
2005	8	1
2004	1	3
2003	n/a	1
2002	n/a	2

Best available bycatch rates for the California Drift Gillnet fishery are computed by the Southwest Fisheries Science Center using Bayesian regression trees (PFMC 2017). Estimates are produced with a two-year lag; the most recent estimates available when this Conservation Plan was written were through 2017. Pacific leatherback sea turtle bycatch rates dropped significantly after 2001 upon implementation of the Pacific Leatherback Conservation Area (Eguchi et al. 2016). Estimated annual mortality & serious injury rates from 2001 to 2017 ranged

from 0.1 to 1.4, with a total of 7 Pacific leatherback sea turtles estimated taken over this period (Carretta et al. 2019).

[Note: Will update section above with 2020 publication prior to final CP submission].

4.4 Anticipated Impacts of Taking

The take levels proposed above are not expected to appreciably reduce the likelihood of survival and recovery of these Covered Species under the ESA. For Humpback and blue whales, take levels are based on PBR calculations used under the MMPA, and therefore calculated to be at a level which will not reduce rates of recruitment and survival. Documented Pacific leatherback sea turtle interactions with the Dungeness crab fishery are rare; however, the species is critically endangered, and it is possible that even a single anthropogenic-induced mortality each year may be sufficient to impair survival and recovery of the species as a whole (Curtis et al. 2015). Further, review of primary literature indicates that capture studies off central California during 2000-2005 found that 67.5% (27/40) of foraging Pacific leatherbacks were female, although the study did not conclude generally that all Pacific leatherback interactions occurring in fisheries off the coasts of California, Oregon, and Washington were likely female turtles (Benson et al. 2007; Benson et al. 2011). Any take however from the nesting female population will have a disproportionate impact on survival and recovery of the species.

As a result, fishery closure, described in Chapter 5, would be triggered after one confirmed Pacific leatherback sea turtle entanglement in California commercial Dungeness crab gear. Along with other measures described in Chapter 5 expected to further reduce potential interactions, this will keep average annual take levels below one individual per year and avoid jeopardy for this species.

4.5 Natural Events and Uncertainty

Entanglements are a result of co-occurrence between marine life and trap gear, either actively fished or lost or abandoned. The distribution and density of trap gear varies throughout each fishing season. In general, the highest amount of gear is present at the start of the season; when over 70% of the crab is taken within the first two months (Figure 2-2). Fishing activity generally declines after this point, with fewer vessels making landings and a corresponding decrease in the number of actively fished traps.

The California Dungeness crab fishing season opens no earlier than November 15 in the CMA and December 1 in the NMA. Most landings occur within the first two months of the fishery and begin to taper off in late December/early January. There are usually lower levels of fishing effort in the spring months, though some participants are known to target crabs at this time to take advantage of higher market prices typically paid for live crab in the spring. The season opener for the CMA may be delayed due to domoic acid and the opener for the NMA may be delayed due to both domoic acid and crab quality. The season then closes either June 30 (CMA) or July 15 (NMA). The seasonal closure from mid-July through mid-November, combined with low levels of effort in the spring months (February on) dramatically reduces the likelihood of

entanglements by limiting the portions of the year where both Covered Species and trap gear is likely to be present (Table 4-6).

Table 4-6. Covered Species Presence by Month within the Commercial Dungeness Crab Fishing Grounds. Highlighted and labelled cells indicate fishing season and likely species presence. "Presence" is based on historic migratory patterns indicating times when whales and sea turtles are most likely to be encountered in the fishing grounds. Source: Karin Forney, NMFS/NOAA 7/18/2017

Indicator Type	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT
Dungeness Crab Fishing Season	O	O	O	O	O	O	O	O	O*	C	C	C
Humpback Whale Migratory Presence	P*	A	A	A	P*	P	P	P	P	P	P	P
Gray Whale Migratory Presence	A	P	P	P	P	P	P*	A	A	A	A	A
Blue Whale Migratory Presence	P*	A	A	A	A	A	P*	P	P	P	P	P
Pacific Leatherback sea turtle	P*	A	A	A	A	A	P*	P*	P*	P	P	P

* and lighter shading Indicates months where presence is less likely, or season is potentially closed.

[Note: Will revise and format prior to final CP submission]

In the past, fishing effort, as defined by traps deployed in the commercial Dungeness crab fishery generally peaked in November/December before tapering off in the spring. On a few occasions, industry price negotiations delayed the start of fishing activity even after the official season opener. However, for the 2015-16 season abnormal ocean conditions and resulting human health concerns were the primary reason for the extended season delay. The 2015-16 season was delayed until March 26, 2016 in the CMA and the entire NMA did not open until May 26, 2016 due to elevated levels of domoic acid produced by the phytoplankton *Pseudo-nitzschia*. For the 2015-16 season, high levels of landings (presumably accompanied by a large number of pots in the water) did not occur until April, May and June (Figure 4-4).

The restricted upwelling in the 2015-16 period also compressed available forage into a relatively narrow band along the coast (Santora et al. 2020). When large whales arrived off the California coast, their distribution was similarly compressed into nearshore areas where active Dungeness crab fishing grounds are. The convergence of these various factors likely contributed to the record number of confirmed entanglements along the West Coast in 2016 (n = 48), with 16 (33%) confirmed in California commercial Dungeness crab gear.

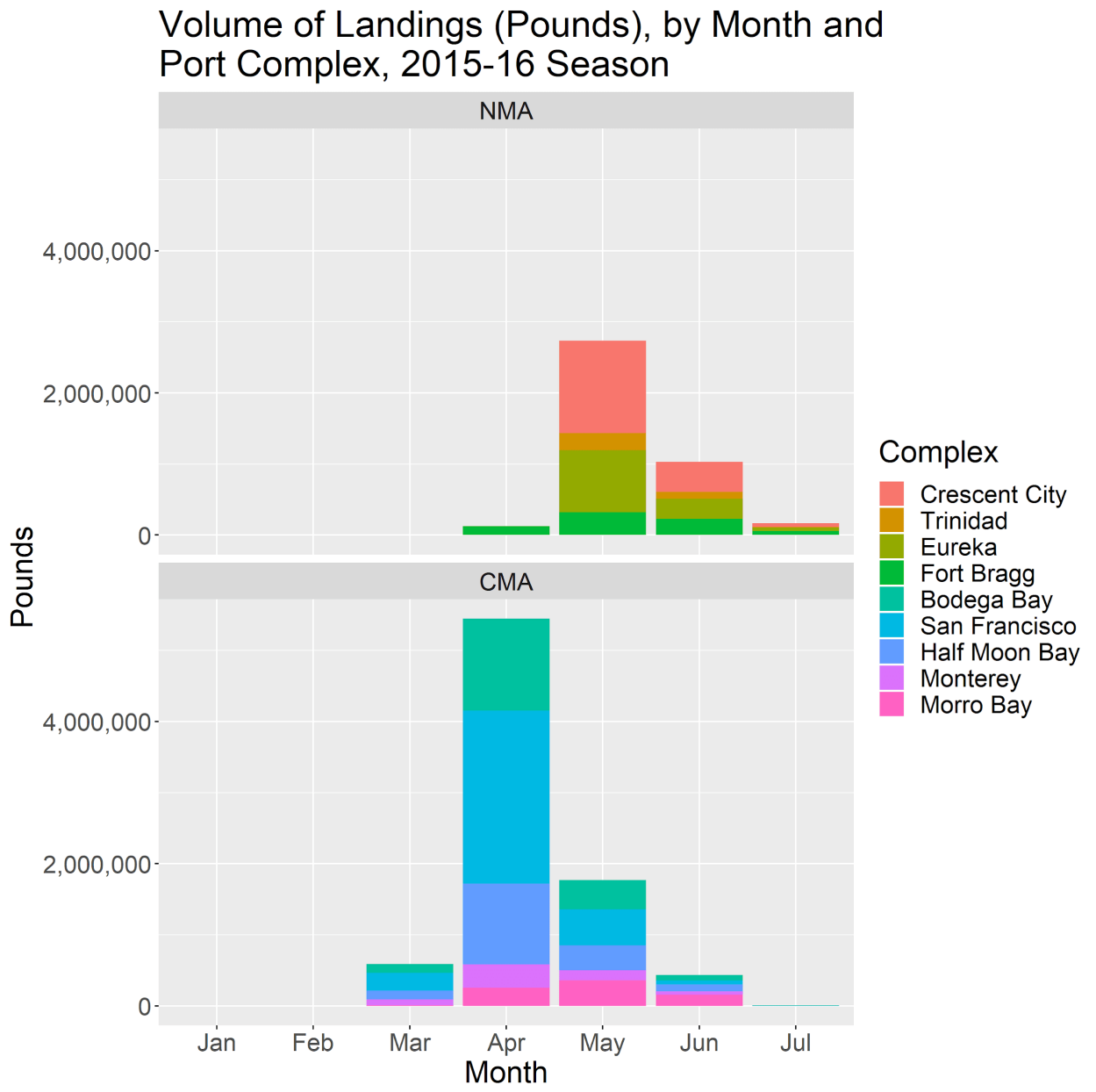

Figure 4-4. Volume of landings (pounds) by month and port complex, 2015-16 season. Source: CDFW Marine Landings Data System, extracted 10/25/2019.

While delays have been less protracted in recent seasons, and confirmed entanglements have similarly declined, these types of warm water phenomena are likely to impact the timing of future fishing seasons. To help cope with increasingly dynamic ocean conditions such as these, the management framework described in Chapter 5 is designed to maximize management flexibility as allowed under California laws.

4.6 Climate Change Considerations

Climate change will likely impact both the distribution of Covered Species and their potential interaction with trap gear, although the exact details of that impact cannot be forecasted at this

time. Physical changes to the foraging grounds within CCLME, as well as other ocean habitats where Covered Species transit, forage, and breed may include increased baseline water temperatures and changes in upwelling patterns. These may then affect ocean productivity, timing of spring phytoplankton blooms, and the abundance and distribution of forage species. Both physical and biological phenological cues are likely to affect the timing of spring and fall migrations for Covered Species, and their movement patterns within CCLME, potentially altering their exposure to Dungeness crab trap gear.

Increased frequency and severity of winter storms may increase the rate of lost and abandoned trap gear, increasing entanglement risk even when the fishery is closed. The same physical and biological signals described above may also alter the timing of Dungeness crab molting and reproduction, affecting crab quality. FGC § 8276.2 currently specifies that the NMA opener cannot be delayed past January 15 due to low crab quality, however persistent, extended periods of low quality early in the season may prompt revisions to that regulation. Warmer nearshore ocean temperatures may drive adult Dungeness crabs to seek deeper-water habitats and incentivize fishermen to move their gear into deeper water, which may further increase exposure to Covered Species. Lastly, new research (Bednaršek et al. 2020) suggests ocean acidification is already having measurable impacts on crab larval survival and shell formation, which may reduce crab availability and have a profound effect on future dynamics of the fishery.

Climate change has been identified as a concern for recovery of the species covered under this Conservation Plan, however the degree to which it will impair CDFW's ability to achieve the biological goals and objectives identified in this CP is unquantified at this time. The future effect of climate change on CCLME is highly uncertain. It has been suggested that CCLME may experience a net increase of available nutrients (Rykaczewski & Dunne 2010). However, the potential nutrient increase may be tampered by the onset of stronger ocean acidification (Bednaršek et al. 2014) and trend of increasingly prevalent hypoxia (Bograd et al. 2008). In addition, it is possible that the Blob condition of 2013-2018 may become more prevalent as changing climate leads to the formation of more high-pressure systems in the Northeast Pacific (Di Lorenzo & Mantua 2016).

DRAFT

CHAPTER 5. CONSERVATION PROGRAM

5.1 Biological Goals and Objectives

Biological goals and objectives are the broad, guiding principles for a CP. They specify parameters and benchmarks for developing and implementing the various conservation measures described in this chapter and the adaptive management strategy described in Chapter 6.

The California Ocean Protection Council (COPC) is charged with coordinating activities of state agencies related to protection and conservation of coastal waters and ocean ecosystems, including CDFW (Public Resources Code Section 35615). In that role, policy statements by the Council and their current strategic plan must considered by CDFW and other agencies, particularly when crafting long-term strategy documents such as this CP. CDFW's short-term goal for the 15-year period proposed for this CP is to reduce take of Covered Species by the commercial Dungeness crab fishery to the level of negligible impact, such that it does not appreciably reduce the likelihood of the survival and recovery of blue whales and humpback whales, and the equivalent for the Pacific leatherback sea turtles. Ultimately, the State's vision is to move toward zero annual mortality and serious injury from entanglement by all state-managed fisheries, which is Target 3.3.5 in the California Ocean Protection Council's 2020-2025 Strategic Plan (COPC 2020). In alignment with this short-term goal and longer-term vision, CDFW identifies the following goals and objectives:

- Reduce fishery interactions with Covered Species through season delay, area closure, Alternative Gear, and other management tools.
- Decrease entanglement risk through removal of lost, abandoned, and otherwise unserviceable trap gear under Sections 132.7 and 132.2, Title 14, CCR.
- Support entanglement reporting efforts through fleet engagement and improve disentanglement response time and resource availability by leveraging commercial fishery assets (vessels, on-the-water reporting, etc.) and State resources.
- Provide technical expertise to NMFS during entanglement confirmation process and forensic review.
- Require baseline use of gear modifications and innovations (in periods/areas of high risk) which meet state criteria outlined in Section 132.8, Title 14, CCR, and are anticipated to reduce entanglement risk or severity.
- Reduce risk and impact from entanglement by proactively working with the fishery to develop and implement best fishing practices through actions such as developing Best Practices Guide with the Working Group and implementing training programs to implement best practices.

5.2 Risk Assessment and Mitigation Program

The Working Group first implemented a risk assessment and mitigation program during the 2017-18 fishing season as a way to evaluate and respond to entanglement risk. This management approach has evolved over time. At first, changes in fishery operations due to elevated entanglement risk were made voluntarily by the fishing fleet. Then the Director of

CDFW (Director) was given the authority through FGC § 8276.1 on January 1, 2019 to implement in-season management measures for the commercial Dungeness crab fishery to mitigate entanglement risk.

FGC § 8276.1 also directed CDFW to formalize the Working Group's risk assessment program through regulation. CDFW first released proposed Risk Assessment and Mitigation Program (RAMP) regulations (Section 132.8, Title 14, CCR) for public comment on May 15, 2020, and subsequently adopted the final language on [*TBD*]. These regulations will govern fishing operations starting with the 2020-21 fishing season, and form the core of this CP. The regulations are written to allow incorporation of new information under the adaptive management framework described in Chapter 6. Additionally, CDFW will update these regulations as needed to align with the final approved Conservation Plan and other requirements of the issued ITP.

As defined in regulation and further described in this Chapter, the RAMP is a dynamic management framework that engages the Working Group and its external advisors in reviewing available data, assessing entanglement risk relative to specific thresholds for identified factors that trigger the appropriate management action. The Director, in consultation with the Working Group, would conduct a minimum of monthly risk assessment, and likely more frequently when new data are available, prior to the start of the season and while the fishing season is open.

5.2.1 Risk Factors

5.2.1.1 Entanglements

Due to the nature of the Dungeness crab fishery, where fishermen set and then periodically return to check their gear, entanglement events are presumed to occur while gear is unattended. Regulations require a 96-hour trap service interval but more time is allowed when weather and sea conditions do not permit safe vessel operations. Unattended gear is of particular concern for cetaceans, because the entangled animal is likely to swim away with the gear still attached. This is a key distinction between the Dungeness crab fishery and other fixed gear fisheries where gear is actively tended (e.g. North Carolina gillnet fishery, Hawaii shallow set longline) and take of protected species can be documented in real time or when gear is serviced.

Entanglements are reported by a variety of sources and confirmed by NMFS staff and affiliates. These confirmed reports represent the best source of information regarding entanglements. Depending on the type of documentation provided, NMFS may be able to determine the fishery sector which contributed to the entanglement, i.e. what type of gear was involved. The trap limit program implemented in 2013 has made California commercial Dungeness crab gear more readily identifiable (see Figure 4-1 and Chapter 2), in some cases to the specific fisherman who set the gear. New regulations requiring unique marking of state-managed commercial trap gear require compliance as of May 1, 2020, which should increase the proportion of entanglements which can be attributed to a given fishery. Accurate identification of the entangled species is a priority, however identifying individuals and their source DPS is not always possible during entanglement response or post-hoc forensic review (personal communication, Pieter Folkens,

May 1 2020). Only four individuals on the West Coast have the permits necessary to collect tissue samples allowing for genetic analysis. High-quality photographs of the flukes or dorsal fins can be compared to identification databases, but are difficult to acquire due to swimming behavior changes from entangled gear and/or poor photographic image quality.

CDFW does not propose duplicating NMFS's entanglement verification process, but it will continue to encourage members of the commercial Dungeness crab fishery, as well as other fishery sectors and interested members of the public, to report sightings of entangled whales to NMFS. CDFW will also distribute outreach materials which highlight key information to include in entanglement reports, including photographs of the surface gear and identifying marks on the animal, to bolster the information available to NMFS when conducting forensic reviews. CDFW will work closely with NMFS to assist in assigning entanglements to specific fisheries whenever possible, and will utilize expertise of whale and sea turtle biologists, the Working Group and other stakeholders when appropriate.

The severity of a given entanglement depends on the type of gear, location of the entanglement, and eventual outcome (self-release, successful intervention by a disentanglement team, or gear persistence). Even if all of the gear is removed from the animal, sublethal impacts may still result in serious injury or mortality. Official determination of an entanglement's mortality and serious injury score is done periodically by NMFS as part of the Stock Assessment Report process. Furthermore, NMFS Procedural Directive 02-03-01 provides relevant guidance when assessing the likelihood that a given entanglement will result in serious injury or mortality. The Directive identifies 4 specific categories relevant to entanglements for large whales, with the following serious vs non-serious injury determinations:

- Ingested gear or hooks: serious injury
- Constricting wrap: serious injury
- Loose wrap: non-serious injury
- External hook: non-serious injury

To help convert the number of confirmed entanglements into thresholds that would trigger management actions, CDFW will calculate an Impact Score based on each entanglement. This Impact Score converts a given entanglement event into an effective amount of take (i.e. the likelihood of that entanglement resulting in mortality or serious injury). Calculation of an Impact Score is determined by the Covered Species entangled, whether the gear is known to be California commercial Dungeness crab or is from an unknown fishery, and (for humpback whales only) whether the entanglement is known to have resulted in mortality. While informed by the official NMFS process for determining mortality and serious injury scores, this calculation is not intended to replace those efforts. Rather, it allows CDFW to rapidly assess the impact of an entanglement. CDFW will calculate Impact Scores for each confirmed entanglement as follows:

- Confirmed entanglements of blue whale and Pacific leatherback sea turtle in California commercial Dungeness crab gear = 1

- Confirmed entanglements of blue whale and Pacific leatherback sea turtle in unknown fishing gear = 0.5
- Confirmed entanglements of humpback whale with no confirmed mortality in California commercial Dungeness crab gear = 0.7
- Confirmed entanglements of humpback whale resulting in confirmed mortality in California commercial Dungeness crab gear = 1
- Confirmed entanglements of humpback whale with no confirmed mortality in unknown gear = 0.35
- Confirmed entanglements of humpback whale resulting in confirmed mortality in unknown gear = 0.5

An impact score of 0.7 is assigned to every humpback whale entangled in California commercial Dungeness crab gear unless it results in a confirmed mortality. This impact score is based on average mortality and serious injury values for humpback whale entanglements in trap or pot gear (personal communication, Penny Ruvelas, NMFS) This discount is a product of in-depth forensic analyses made possible by the large amount of information collected during past humpback whale entanglements. Due to less available information, all blue whale and Pacific leatherback sea turtle entanglements in California commercial Dungeness crab gear will be considered to result in mortality and serious injury and given an Impact Score of 1. At this time, successful disentanglements are not explicitly accounted for when calculating Impact Scores. As additional information from forensic analyses becomes available, CDFW will consult with NMFS regarding potential updates to these calculations.

Entanglements which can be attributed to other fisheries will not lead to a restriction for the commercial Dungeness crab fishery. However, entanglements in unknown fishing gear that may involve commercial Dungeness crab gear will be considered when calculating an impact score. This is based on a recent NMFS summary of entanglements (Saez et al. 2020) which quantified the proportion of entanglements which could be attributed to a gear type or specific fishery. CDFW expects the enhanced gear marking requirements described elsewhere in this CP to reduce the proportion of entanglements after May 2020, which are categorized as unidentified gear, minimizing the potential for commercial Dungeness crab fishery operations to be impacted by entanglements from other fisheries. However, considering the proportion of entanglements of known origin already attributed to commercial Dungeness crab, and the fact that the amount of trap gear deployed by the commercial Dungeness crab fishery is higher than any other state trap fishery, CDFW expects that up to 50% of those entanglements in unknown gear are likely to be from California commercial Dungeness crab gear. In an effort to be precautionary, CDFW's impact score calculations therefore weight such entanglements at 50% of the corresponding entanglement confirmed in California commercial Dungeness crab gear.

For each Covered Species, CDFW has defined both in-season and multi-year triggers that would result in management action:

- In-Season
    - Humpback whales: 1 confirmed entanglement or cumulative Impact Score of 3 or more

    - Blue whales: 1 confirmed entanglement
    - Pacific leatherback sea turtles: 1 confirmed entanglement
- Multi-Year
    - Humpback whales: Average annual Impact Score during previous two calendar years and current calendar year exceeds 2
    - Blue whales: Average annual Impact Score during previous two calendar years and current calendar year exceeds 1
    - Pacific leatherback sea turtles: Average annual Impact Score during previous two calendar years and current calendar year exceeds 1

Under the current RAMP regulations, management actions would be taken when the take of a covered species exceeds an in-season threshold or a three-year threshold. For any of the Covered Species, an entanglement within a fishing zone would lead to that zone's closure, unless the Director determines one of the alternative management response(s) discussed below under 5.2.3 is equally protective of listed species. If an impact score of three has been reached for humpback whale within a season, the fishery closes statewide for the remainder of the season. Furthermore, if the average annual impact score for humpback whale exceeds two, or if the impact score for blue whale or leatherback sea turtle exceed one, CDFW must start consultation with NMFS. Unless a multi-year trigger is reached, a closure based on attainment of an in-season trigger would not carry over to the next season.

Taking action for each entanglement event during the fishing season would reduce the likelihood of additional entanglements occurring, potentially avoiding more restrictive management measures. Triggers based on a three-year rolling average will explicitly account for offseason entanglements, including entanglements that occur during the fishing season but not detected/or confirmed until after a closure, or entanglements that occurred in lost or abandoned fishing gear from a previous season.

Additionally, using a three-year rolling average addresses fishing industry concerns that a single rare entanglement will shut down the fishery. Historical data indicate that encounters with blue whales and Pacific leatherback sea turtles are rare and the improved protective measures in this CP are expected to minimize interactions. Establishing low trigger threshold values over a three-year time period helps ensure that management actions do not, in effect, shut down the fishery and render this CP impracticable.

5.2.1.2 Marine Life Concentrations

Unlike confirmed entanglements, which have both reactionary and precautionary components (in terms of acting to ensure additional entanglements over the allotted take do not occur), the marine life concentration risk factor is fully precautionary. The Director will take management actions when the number of Covered Species in California waters exceeds the specified thresholds. Thresholds are defined for each Covered Species and for two time periods, fall (November 1 – December 31) and spring (March 1 – July 15 or fishery closure). The two time periods are identified because information on marine life concentrations collected during these two periods has different implications for management based on anticipated presence of Covered Species and their respective historic migration data. Whale and sea turtle migration, or

whether they are anticipated to be moving into or out of the Fishing Grounds, in conjunction with the status of the fishing season (open or closed) and potential for overlap between Covered Species and fishing gear warrants identification of distinct triggers and management actions for each time period due to difference in potential co-occurrence.

In the absence of available data, during the fall and spring periods, CDFW would take a precautionary approach and either delay the fishery opener (during the fall) or close it early (in the spring) to avoid entanglement risk from co-occurrence of Covered Species and fishing gear. In the fall, incremental delays (approximately 15 days) reflects an appropriate period in which it is anticipated that additional data can be captured showing a change in the presence of Actionable Species. This delay period also represents a reasonable time window for Department staff to analyze data, provide information to the Director, prepare the necessary management documents, and provide enough time for an orderly and safe implementation of a fishery opener.

If data are unavailable by November 1, the fishery will be delayed in 15-day increments until the end of December. If data are available, and the number of humpback whales is greater than or equal to 20 or there is a running average of five or more animals over a one-week period within a single Fishing Zone (excluding Zone 6), the Director shall implement a minimum of a Fishing Zone closure. The same applies when there is greater than or equal to three blue whales or there is a running average of three or more blue whales over a one-week period within a single Fishing Zone (again excluding Zone 6). For Pacific leatherback sea turtles, any fishing zone found with an animal in it will not open.

If data are unavailable by March 15, the season would close statewide on April 1. If data are available, and the number of humpback whales is greater than or equal to 10 or there is a running average of five or more animals over a one-week period within a single Fishing Zone (excluding Zone 6), the Director shall implement a minimum of a Fishing Zone closure. The same applies when there is greater than or equal to three blue whales or there is a running average of three or more blue whales over a one-week period within a single Fishing Zone (again excluding Zone 6). For Pacific leatherback sea turtles, any fishing zone found with an animal in it would be closed.

The presence of Covered Species can be assessed through multiple data sources. At the time this CP was prepared, CDFW identified aerial surveys, vessel surveys, and satellite tagging data as the primary sources of information; additional details are provided below. However, both NMFS scientists and external scientific partners are actively engaged in work to improve available data for this factor, and CDFW is committed to relying upon the best available science. While not directly included in the current iteration of the RAMP, CDFW will continue to explore additional sources of information and integrate them into the RAMP as appropriate.

5.2.1.2.1 Aerial Surveys

Aerial surveys provide high-resolution information regarding distribution of marine life (i.e. marine megafauna, including Covered Species), forage (i.e. bait balls, *Chrysaora* patches), and observed trap gear. While the number and color of buoys attached to the trap gear may be

recorded, observers generally cannot attribute gear to a particular fishery or distinguish between actively fished and lost or abandoned gear. Systematic surveys designed to provide quantitative estimates of the abundance and density of marine life and trap gear have been conducted 3-4 times per year by NMFS Southwest Fisheries Science Center scientists, contingent upon available funding and suitable weather windows. Reconnaissance surveys designed to get a snapshot of marine life and trap gear co-occurrence have been conducted opportunistically by Working Group members, in partnership with CDFW Law Enforcement Division (LED) and the non-profit group Lighthawk, prior to season openers and during periods of elevated risk in spring months.

The ability to conduct aerial surveys is limited by availability of trained observers and suitable aircraft, as well as weather conditions. During the late summer and early fall (August - September), there are generally one or more multi-day windows suitable for conducting surveys off the central California coast (K. Forney, NMFS SWFSC, personal communication). Spring months in central California generally provide fewer, shorter windows, depending on the frequency and intensity of storms and wind events. Conditions off the North Coast are similarly challenging. While aerial surveys provide high-resolution spatial data on marine life concentration, they cannot be conducted routinely and therefore may not be available in real-time to inform decision making.

5.2.1.2.2 Vessel Surveys

NMFS has several ongoing vessel-based research and monitoring efforts which collect information on the distribution and abundance of marine life off California either as their primary mission or as ancillary data. Examples include the Rockfish Recruitment and Ecosystem Assessment Survey, Applied California Current Ecosystem Studies, and Coastal Pelagic Species Surveys. Location and timing varies between surveys and years, however data is often collected during the spring and summer months and provides real-time information regarding presence and distribution of Covered Species in California waters. Vessel-based surveys are less limited by weather constraints than aerial surveys, although detection decreases in rough seas. However, they also cover far less area per unit time, and so are unable to provide a snapshot of conditions over a large area.

CDFW routinely undertakes vessel-based enforcement patrols. While not the primary mission, LED personnel are able to document sightings of both gear and Covered Species. CDFW will continue to explore other vessel-based surveys to collect information as funding and additional resources become available. CDFW will also consider developing external partnerships with other agencies, research affiliates and fishing associations if they are able to conduct vessel-based research surveys employing reliable, standardized methods.

5.2.1.2.3 Tagging

Ongoing satellite tagging programs targeting blue whales and Pacific leatherback sea turtles also provide information regarding the presence and distribution of Covered Species. Unlike aerial surveys, which quantify presence within a given area and time, tagging data provides long-term tracks of individual animal movements. For species with known migratory patterns,

these index individuals provide a general understanding of when populations begin to arrive or depart, California waters. Deployment of satellite tags requires scientists to locate and then closely approach an individual animal; for cryptic species which spend limited time at the surface (e.g. blue whales) and are difficult to observe even when on the surface (e.g. Pacific leatherback sea turtles), this often results in low sample sizes. Additionally, due to battery life, attachment weakening, or individual mortality, satellite tags generally report for weeks to months after deployment. Therefore, understanding multi-year trends requires routine tagging operations.

5.2.1.3 Fishing Dynamics, Ocean Conditions and Available Forage

Earlier versions of the RAMP included two additional factors: fleet dynamics and ocean conditions/available forage. Fleet dynamics was intended to detect patterns in fishing activity that might lead to higher overlaps between Covered Species and Dungeness crab trap gear. Ocean conditions and prediction of forage occurrence could be of particular value due to its ability to forecast marine life distributions and future co-occurrence of Covered Species and Dungeness crab trap gear. However, at the time the first RAMP regulation was developed, CDFW could not identify any routinely produced, real-time data stream nor objective thresholds for management action. Development of such a data stream would provide CDFW with additional information, and, importantly, additional flexibility and tools for managing the interactions of Covered Species and trap gear. .

For now, fleet dynamics and ocean conditions are considered on a case-by-case basis to inform appropriate action when management responses are triggered by confirmed entanglement or marine life concentration. CDFW will continue to improve the RAMP regulation using the adaptive management framework described in Chapter 6. For CDFW to integrate fleet dynamics and ocean conditions into RAMP as additional risk factors, researchers need to further refine real-time data tools, and CDFW needs more experience with RAMP to identify objective thresholds suitable for regulations. Once ready, CDFW will discuss the applicability of these two additional risk factors with the Working Group and NMFS, among other stakeholders, and undertake a rulemaking process to amend the RAMP regulation.

5.2.2 Other Available Data and Management Considerations

After a threshold is triggered under a risk factor, the Director will implement a management response based on best available science and will, to the maximum extent practicable, rely on best available scientific information relevant to the management issue. Using best available science ensures that any conclusions are reasonably supported and not speculative and using publicly available data ensures transparency in decision making. Information are defined as a Working Group recommendation, information from NOAA, management measure effectiveness, economic impacts, data availability, historic migration patterns, Fishing Season dynamics, forage, ocean conditions, confirmed entanglements, and marine life concentrations.

5.2.2.1 Working Group Recommendation

The Working Group is comprised of individuals who have first-hand knowledge and expertise of the fishery, ocean conditions, and Covered Species. As such, their input will be critical to informing the Director on management decisions.

5.2.2.2 Information from NOAA

There may be instances when CDFW consults with NOAA to determine the need for or appropriateness of a specific management action, given their subject matter expertise and management authority. Those recommendations will be included as a consideration for informing a management action.

5.2.2.3 Management Measure Effectiveness

Management measures that are not effective will reduce species protections and conflict with program goals. The effectiveness of a given management measure will vary based on the time of year, progression of fishing season, and ocean conditions.

5.2.2.4 Economic Impact

Economic impacts will change depending on the timing of the year and progression of the fishing season. Shorter delays have been shown to be less impactful overall to the fishing fleet than delays that go into the late winter or early spring. Historical landings data indicate that while the timing of landings shift when a season is delayed, overall landings and economic impact remained relatively unchanged. Conversely, an early closure in the spring months will have differential impacts to the Fleet depending on the size of their fishing operation and business model. Small boat operators whose business model relies on direct sales to live markets throughout the year would be impacted more by an early closure. Whereas many larger boat operators, who have completed fishing activities and left the fishery to participate in other fisheries may experience less of an impact.

Additionally, it may be that a number of different management responses will provide similar protections to Covered Species by reducing entanglement risk – for example, depending on the circumstances and the time of year, a statewide closure, a Fishing Zone closure, or a depth restriction may provide the same level of protection to Covered Species; in such a case, the impacts of a statewide closure vs a Fishing Zone closure would be considered in determining final management response

[NOTE: Additional economic analysis will be included prior to final CP submission and after consideration of any new economic data provided to CDFW]

5.2.2.5 Data Availability

The availability of data within and across Fishing Zones will be considered when implementing a management action if data are available to inform current conditions (such as fleet behavior or migration patterns). When data are unavailable for an individual Fishing Zone, CDFW may rely on assumed historic patterns or data from an adjacent Fishing Zone. Availability of data within a Fishing Zone may influence the Director's selection of a management measure, for example

more restrictive measures may be implemented for areas without data in order to be more precautionary whereas availability of data in an different area may indicate less restrictive measures are appropriate.

5.2.2.6 Historic Migration Pattern

Historic marine life migration patterns will be an important consideration, especially whether whales are leaving the Fishing Grounds in the fall or returning in the spring. Since risk changes by the time of year, the Director may choose to implement a less restrictive measure on the Fleet in the fall because entanglement risk is decreasing as Actionable Species migrate out of the Fishing Grounds. Whereas, in the spring a more conservative management action may be implemented because it provides greater protections for Actionable Species when entanglement risk is anticipated to be increasing as Covered Species migrate into the Fishing Grounds.

5.2.2.7 Fishing Season Dynamics

As noted above, additional information regarding fishing dynamics would provide important tools for managing whale and sea turtle interactions with fishing gear. Currently, all catch taken under a California commercial fishing license must be reported on a commercial landing receipt (commonly called a "fish ticket"; FGC § 8043). Details include vessel information, permit holder, pounds caught, catch location, and fish business information. These documents are then submitted to CDFW via an electronic platform (eTix, maintained by Pacific States Marine Fisheries Commission) within 3 business days of the landing, allowing managers to have access to near-real time information on fishing dynamics. There are however several limitations to these data, which make relating fishing dynamics and entanglement risk difficult.

Landing receipts require identification of the fishing vessel, which can be combined with license and permitting information from the state's Automatic License and Data System to identify the vessel's trap allotment. However, the number of traps actually deployed is not reported. CDFW analyses of fleet dynamics to date have assumed that a given vessel utilizes their full trap allocation, which may result in overestimates of deployed traps. Additionally, depending on the time period over which fishing activity is being assessed, deployed traps may be underestimated if a vessel has gear deployed but does not make a landing during that period. While this is less of a concern for analyses at the season level, it is a factor when conducting analyses at the weekly or monthly level to support in-season management.

Catch location, which is assumed to correlate to where gear is deployed, is reported by selecting the CDFW fishing block where the majority of the catch was caught (see Figures 5-1 and 5-2). The size of these reporting blocks varies, with smaller blocks nearshore and larger blocks offshore, but in all instances provides a coarse-scale understanding of where gear is deployed. Additionally, there are known reliability issues of this self-reported information due to errors of various types. CDFW will continue to work with the fleet to refine reporting of fishing location data.

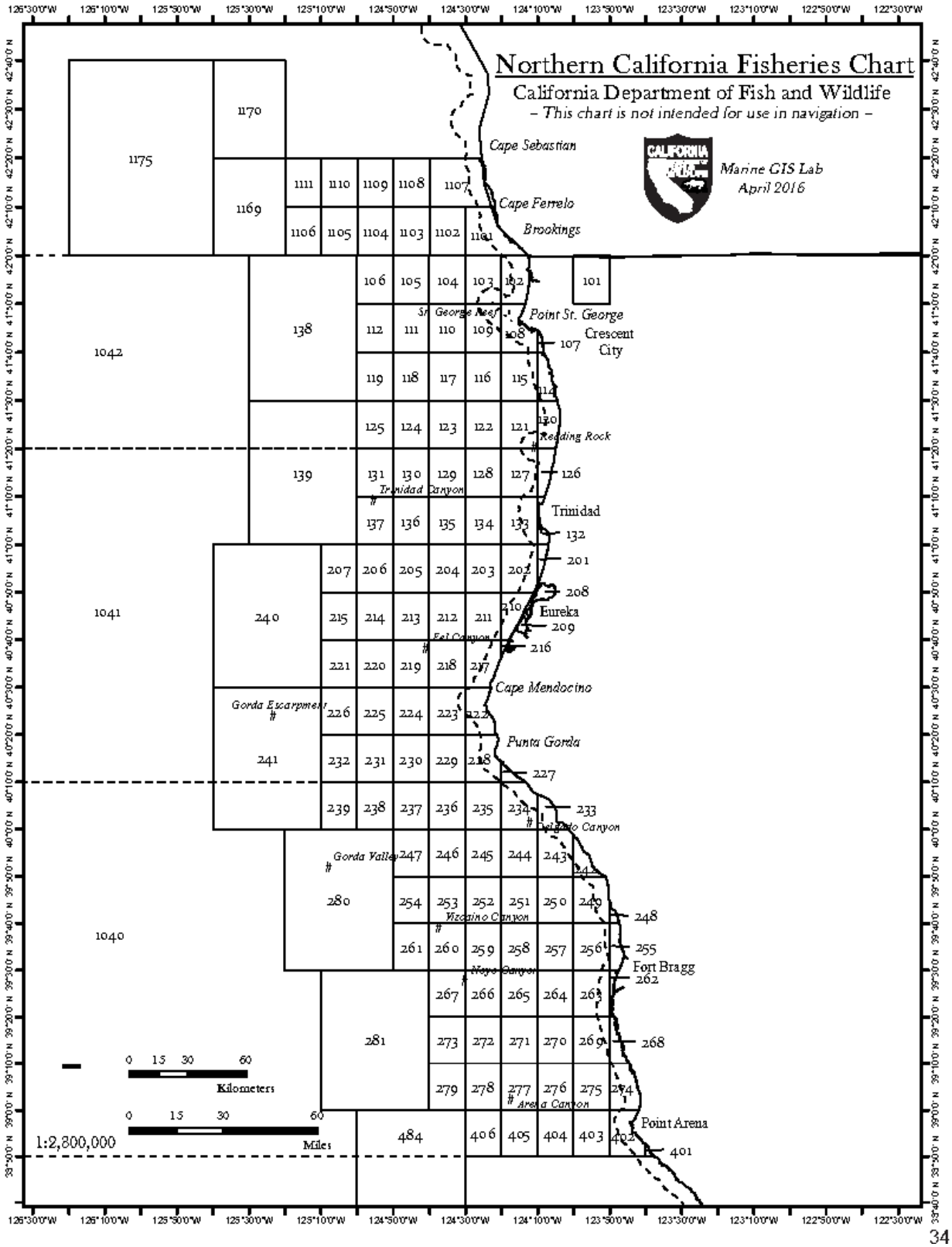

Figure 5-1. CDFW Fishing Blocks, Northern California.

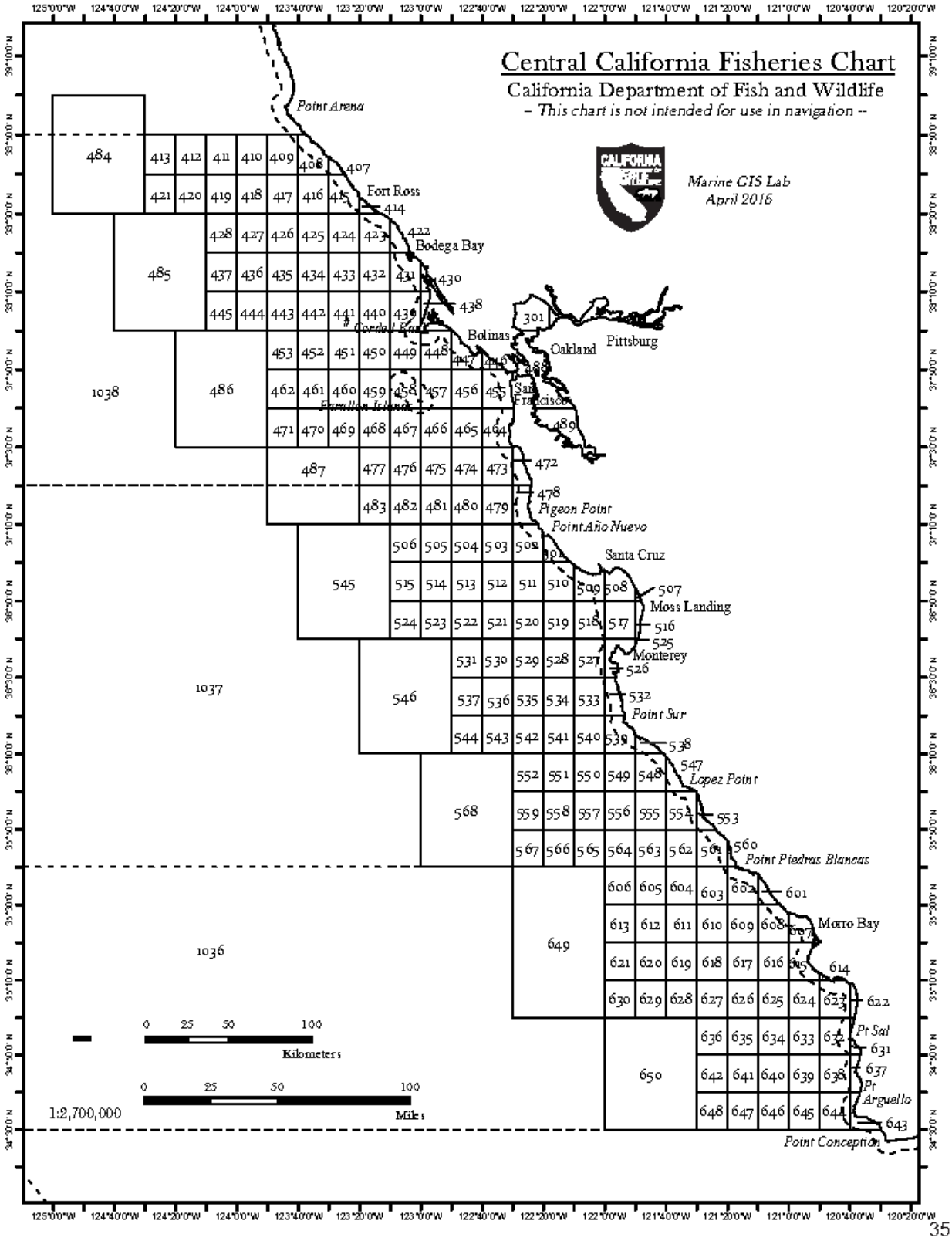

Figure 5-2. CDFW Fishing Blocks, central California.

Due to the caveats above, relying on landings data alone provides an incomplete assessment of gear deployment, and entanglement risk from vertical lines, in this fishery. CDFW has therefore incorporated mandatory reporting requirements into the RAMP.

As part of the RAMP regulations, all fishery participants will be required to submit bi-weekly reports to CDFW which include their vessel permit number, which Fishing Zone (see Figure 5-4) their gear is currently deployed in, and the number and depth range of their currently deployed traps. This formalizes a previous voluntary effort by fishery participants to provide estimates of current fishing effort for risk assessments during the 2019-20 fishing season. Submitting these reports every two weeks will allow CDFW and the Working Group to consider recent information during the routine risk assessment process. While the data is still self-reported, and is likely to contain errors, these reports will nevertheless greatly improve CDFW's ability to quantify near real-time fishing effort and gear deployment.

The RAMP regulations also require electronic monitoring for all Dungeness crab vessels using Alternative Gear (described in more detail below) or when depth restrictions are in place. While CDFW does not specify the type of electronic monitoring systems which must be used, systems must meet the specified minimum ping rate of once per minute and data will be available to CDFW upon request for up to 60 days. This information can be compared with the biweekly reports mentioned above to verify accuracy, and will allow for closer monitoring (i.e. higher spatial resolution information) for compliance with depth restrictions and tracking of Alternative Gear deployment.

The Working Group conducted preliminary testing of three electronic monitoring systems and a paper logbook during the 2016-17 commercial fishing season. Of these, solar-powered vessel tracking systems (colloquially known as "solar loggers") showed the most promise due to their automated operations, which don't require active data entry or logging by the fisherman. Vessel location is reported every few seconds, providing tracking data with a high degree of spatial resolution (Figure 5-3) which would meet CDFW's minimum ping rate requirements. Additional testing during the 2018-19 and 2019-20 fishing seasons have highlighted the potential for solar loggers to provide high-quality, real-time information on vessel activity. To date, solar logger devices, and data storage and processing, have been paid for by grants from the California Ocean Protection Council and participation in the pilot projects has been voluntary. Participation is expected to increase given new electronic monitoring requirements.

DRAFT

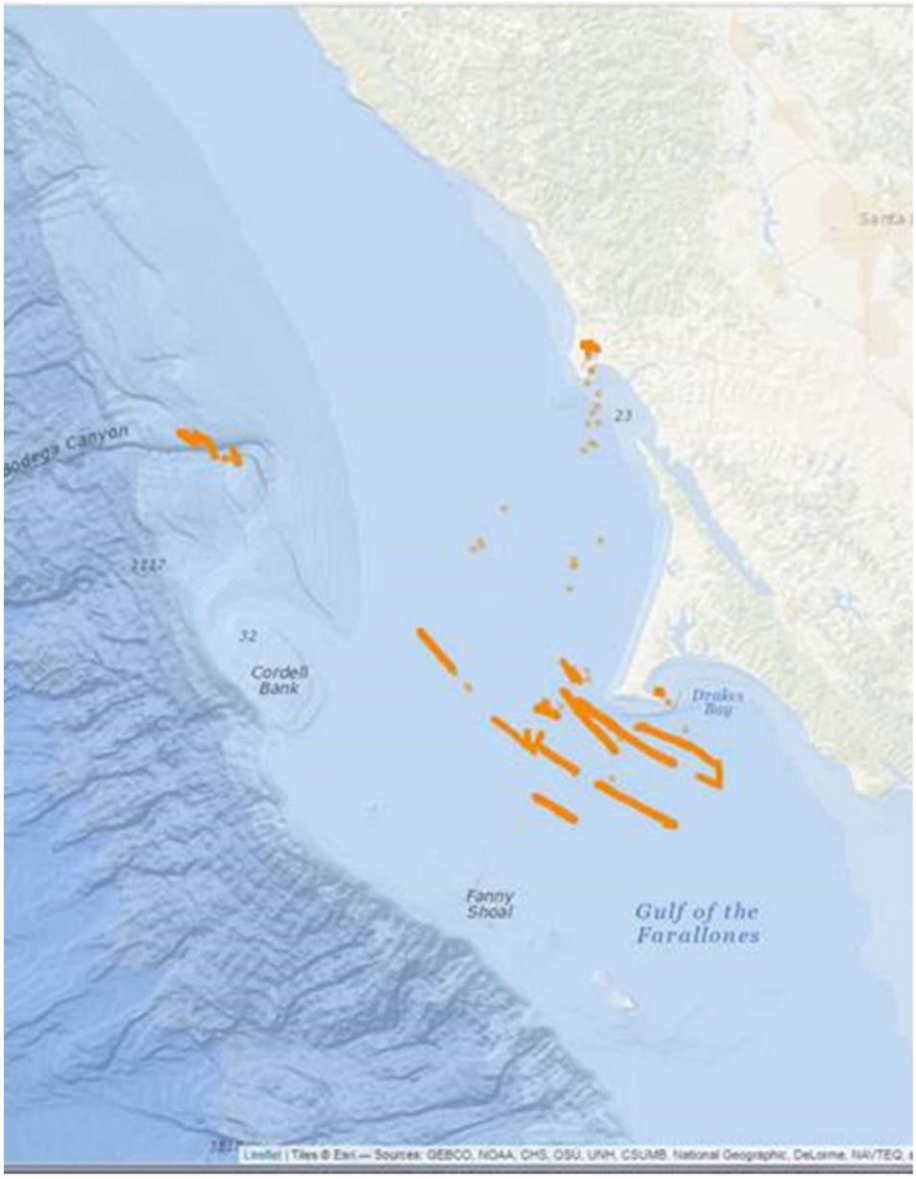

Figure 5-3. Solar logger vessel tracks. Vessel and season information withheld for confidentiality purposes. Source analysis conducted by PSFMC and accessed from Pelagic Data Systems by Christy Juhasz, CDFW.

Another form of electronic monitoring currently required for participation in certain federally-managed fisheries is a Vessel Monitoring System (VMS; see 50 CFR § 660.14 for requirements applicable to West Coast Groundfish fisheries). A mobile transceiver unit detects the vessel's location and transmits it to a communication service provider, who then provides the information to NMFS Office of Law Enforcement. Both the transceiver unit and the service provider must be approved by NMFS. The unit must be operational 24/7 and transmit position information at least once per hour. While Dungeness crab is a state-managed fishery, 30.4% of vessels participate in West Coast groundfish sectors where VMS is required (Feist et al, *in review*). When combined with landings data, VMS tracks can indicate where Dungeness crab fishing activity is occurring. While VMS data include is only available for a portion of the Dungeness crab fleet

and has lower spatial resolution than the CDFW-required systems, this information could supplement required electronic monitoring information by being available in the absence of a depth restriction and for vessels not using Alternative Gear. VMS data are available to NMFS staff in near-real time, however current data processing requirements, integration of landings data, and timeliness of available analyses to CDFW prevent VMS data from being used for in-season management at this time. CDFW will continue to engage with NMFS researchers at the Northwest and Southwest Fisheries Science Centers and explore future uses for this information.

Aerial surveys (described in 5.2.1.2.1) can provide fine-scale information on trap gear distribution, and potentially be used to validate self-reported information on landing receipts and through the bi-weekly reports.

When combined, the available data described above (landing receipts, bi-weekly reports, electronic monitoring) allow the Working Group and CDFW to consider the concentration or geographic location of fishing effort, amount of gear deployed, and progression of the fishing season when determining appropriate management actions. Fishing pressure (number of vessels and amount of gear deployed) is greatest in fall when the fishery opens, and intensity declines significantly in the spring months. Historical migration patterns indicate fewer Covered Species would be expected in the fishing grounds in late fall/early winter as opposed to spring. Therefore, an on-time (November 15 or December 1, depending on location) or marginally delayed fishery opener is associated with lower entanglement risk as compared to an opener later in the Fishing Season (February-April). Historic landings data suggests that over 80% of commercial Dungeness crab landings occur within the first eight (8) weeks of the season (Figure 2-2). The scheduled season openers mean this high level of effort, and large amount of deployed gear, occur when marine life concentrations are decreasing in the Fishing Grounds, and entanglement risk is therefore declining.

In contrast, if the fishery does not open until late winter or spring, the high levels of effort are more likely to overlap with a period of increasing marine life presence as whales and turtles return to the fishing grounds. During a compressed fishing season, fishing effort would likely be higher than normal during the latter part of the season as individuals try to make up for lost fishing opportunities. This would increase the likelihood of co-occurrence between gear and Covered Species, resulting in an increased risk of entanglement.

The location of the fishing fleet in relation to marine life presence (i.e., co-occurrence) will also be an important consideration when assessing risk tolerance. If Covered Species are observed towards the end of a fishing season in locations where fishing activity is decreasing due to progression of the fishing season (late spring/early summer), the Director may choose to implement a less restrictive management action. Conversely, if there is a risk of substantial overlap of fishing activity and Covered Species the Director may choose a more restrictive measure to maximize biological protections.

5.2.2.8 Forage

Distribution and abundance of forage and its effect on feeding behavior of Covered Species will be an important consideration when assessing management actions. Historically, warmer years with higher forage fish abundance correlate with higher entanglement risk compared to cold water years that are dominated by krill. Warmer years tend to bring whales closer inshore, which increases co-occurrence with fishing gear. Understanding the relationship between prey availability (location and abundance) and presence of marine life under differing ocean conditions will be informative for predicting risk of entanglement.

5.2.2.9 Ocean Conditions

Understanding how oceanographic change (warm water events, Pacific Decadal Oscillation, upwelling, acidification etc.) influence the timing and location of Covered Species presence along the coast will be informative for management. Ocean conditions such as high winds or strong currents strongly influence fishing behavior and responsiveness of the Fleet. High wind and strong swell events can affect the Fleet's ability to detect and retrieve gear or be responsive to a management change. Techniques for analyzing the relationship of these factors, in conjunction with forage, to potential presence of Covered Species will be utilized when available.

5.2.2.10 Confirmed Entanglements

Every Confirmed Entanglement and its surrounding circumstances will be evaluated. Entanglements which occur in close spatiotemporal proximity may indicate an even higher entanglement risk in a given fishing area, and may warrant a more precautionary response. In contrast, an entanglement in lost or abandoned gear from a prior season or after the close of the most recent fishing season may not necessitate as strong of a management response.

In addition, the rate at which entanglements are occurring and current impact score will affect the type and severity of management action. For example, in the absence of extenuating circumstances suggesting higher risk, a single confirmed humpback whale entanglement over a three-year period may not warrant a zonal closure. However, if an entanglement occurs at the beginning of a fishing season, and that entanglement is the second one in a three-year period, the Director may implement more restrictive management responses to decrease the likelihood that the fishery exceeds the three-year impact score.

5.2.2.11 Marine Life Concentration

Marine life concentrations and their spatial distribution will be an important consideration when choosing a management response, particularly in determining the area over which that response will apply. More concentrated presence of Covered Species could indicate that management response on a Fishing Zone basis is appropriate, while a more dispersed presence might indicate that management over a larger area is necessary.

In addition to the data streams identified above (aerial surveys, vessel surveys, and satellite tagging data), CDFW and the Working Group may consider other observations or modeled distributions of Covered Species. During preparation of this CP, CDFW received briefings from

NMFS Northwest Fisheries Science Center and Southwest Fisheries Science Center staff regarding predictive models for species distribution currently under development. When complete, and with concurrence from NMFS West Coast Region that they are sufficiently robust for use in decision making, CDFW will work with scientific advisors and members of the Working Group to develop objective thresholds for management action and subsequently incorporate them into regulations in Section 132.8, Title 14, CCR.

5.2.3 Potential Management Responses

The primary management response to prevent and limit entanglements is to close part or all of the state's fishing grounds to commercial Dungeness crab fishing. A closure is the default action that the Director may take when a risk factor is triggered. In most cases, however, the Director may select a range of alternative or additional response(s) as appropriate, based on the best available science as related to specific areas of information relevant to determining potential overlap of fishing activity and species presence. The range of management responses are limited to a fleet advisory, depth constraint, vertical line/gear reduction, fishing area closure(s), and authorizing deployment of Alternative Gear. This forms a flexible approach that allows for review of the above-mentioned data streams when determining appropriate management response to risk factors indicating entanglement risk may be elevated, while still placing boundaries by limiting the types of information considered relevant and the mandate to use best available science, as well as a limited list of management responses that can be implemented. Should best available science be insufficient to support alternative management responses, the default of a partial or statewide closure of the fishing grounds provides a protective threshold to minimize entanglement risk. Compliance will be assessed through a variety of tools including vessel and aerial surveys, electronic monitoring, and dockside inspections (additional details are provided in Chapter 6). Additional information about each of these management responses is provided in 5.2.3.1 – 5.2.3.5.

5.2.3.1 Fleet Advisory

The Director may issue an advisory to the fleet to encourage voluntary efforts if risk is elevated or expected to increase but a more restrictive management response is not necessary. Voluntary actions encouraged by the Working Group during prior seasons have included implementation of Best Practices, as detailed in their annual Best Practices Guide, regarding gear configuration (reducing slack line and minimizing surface gear) and placement (avoiding areas with high concentrations of forage or where Covered Species have been sighted). In some instances, a risk factor may be triggered but management action to reduce entanglement risk is not warranted. For example, the entire fishery may be delayed due to domoic acid, so there would not be a need to implement a management action. Alternatively, if a trigger is hit late in the spring when most of the fleet is no longer fishing, implementing a management action may not be necessary if fishing effort is decreasing rapidly and expected to be at negligible levels prior to Covered Species entering the fishing grounds in large numbers.

5.2.3.2 Depth Constraint

A depth constraint may be implemented to avoid co-occurrence of Covered Species and fishery operations. Using waypoints that approximate a line to define depth contours has been used

routinely in the groundfish fishery for nearly two decades and is familiar to Dungeness crab fishermen because many individuals participate in both fisheries. Waypoints delineating a variety of depth contours are defined in Federal regulation (80 FR 63970, 2018). As discussed in Chapter 3, forage availability for the Covered Species is in part tied to the depth contour of the coast. If best available scientific information indicates that certain depths in certain areas carry a higher risk of entanglement, the Director could implement a depth closure over the fishing grounds. An example could be prohibiting take seaward (deeper) of the 30 or 40-fathom line to protect Pacific leatherback sea turtles by excluding fishing activity from their primary foraging area. Prohibiting take seaward of the 50-fathom line is expected to reduce interactions with blue whales, which are primarily found in deeper depths over the continental shelf. CDFW will consider best available science when determining the particular depths that should be closed.

5.2.3.3 Vertical Line/Gear Reduction

If entanglement risk is elevated, but not yet at a level which would prompt closures, reducing the number of vertical lines or gear in the water can reduce that risk. Based on the availability of Marine Life Concentration data, CDFW could implement a gear reduction to lower the overall risk of entanglement within a fishing area. Such reduction can be achieved by reducing the number of traps individual fishermen can deploy, use of authorized "pop-up" gear, or deploying "trawls" where multiple pots are connected by a common ground line and only one or two of those traps have a vertical line attached.

Trap reductions could in turn be accomplished in a variety of ways:

- Issuance of required buoy tags in multiple colors. During periods of reduced trap use, only specified colors could be used.
- Gear check in. During periods of reduced trap use, fishermen would be required to bring the specified amount of gear ashore, where it is checked-in by CDFW.
- Excess tags on vessel. Require a percentage of issued buoy tags to be on board the vessel, rather than affixed to traps.

Replacing the traditional vertical line and surface gear with a "pop-up" system is another method to reduce the amount of time vertical lines are present in the water. Additional information about this type of gear is provided in 5.2.3.5, Alternative Gear.

FGC § 9012 specifically prohibits the use of trawls (trap strings) in the commercial Dungeness crab fishery in the NMA. Legislative bill analysis of AB 3337 from 1994 indicates there were concerns about overcapitalization and excessive early-season fishing effort. Working Group and other fishery participants have also indicated gear conflict as a reason for banning use of trawls in certain areas. Even though stringing multiple traps to one buoy leads to fewer vertical lines in the ocean, any entanglements which then occur would be more severe than an entanglement with only a single trap.

Multiple stakeholders have expressed interest in allowing use of strings/trawls during periods of high risk as an additional method for reducing vertical lines. Data from experimental use of

trawls in currently prohibited areas, likely authorized under an Exempted Fishing Permit from the Fish and Game Commission, would inform potential changes to this statutory requirement. Should statutory changes occur, trawling traditional pots could be used to achieve specified vertical line reductions while continuing to fish the same amount of trap gear.

5.2.3.4 Closures

Spatiotemporal closures are a key management measure in the spring months when historical migration patterns, surveys, and/or models indicate that Covered Species have begun to arrive in California waters, or during the fall when Covered Species have not yet left California waters. In these instances, the scheduled season opener can be delayed, or the scheduled season closure advanced. When real-time information on marine life concentrations, trap gear, and co-occurrence is available, spatiotemporal closures can also be used to selectively close hotspots with elevated entanglement risk. Regulations under Section 132.8, Title 14, CCR specify that closures can occur by Fishing Zone (Figure 5-4) or statewide. As additional sources of information regarding fishing activity and distribution of Covered Species becomes available, CDFW may determine closures providing equivalent protections for Covered Species could be implemented on smaller spatial scales, reducing economic impacts to fishery participants.

Fishing Zones are selected based on a combination of ecological and fishery characteristics and represents the maximum number of areas that CDFW staff believes can be reasonably covered by survey effort. Fishing Zones have the following latitudinal boundaries:

- Zone 1: From the California/Oregon border (42° N. latitude) to Horse Mountain (40° 05' N. latitude).
- Zone 2: From Horse Mountain to the Sonoma/Mendocino county line (38° 46.125' N. latitude).
- Zone 3: From Sonoma/Mendocino county line to Pigeon Point (37° 11' N. latitude)
- Zone 4: From Pigeon Point to Lopez Point (36° N. latitude)
- Zone 5: From Lopez Point to the U.S./Mexico border
- Zone 6: "Pacific leatherback sea turtle Foraging Area" from Point Arena (38° 57. 5' N. latitude) to Point Pinos (36° 38.314' N. latitude).

DRAFT

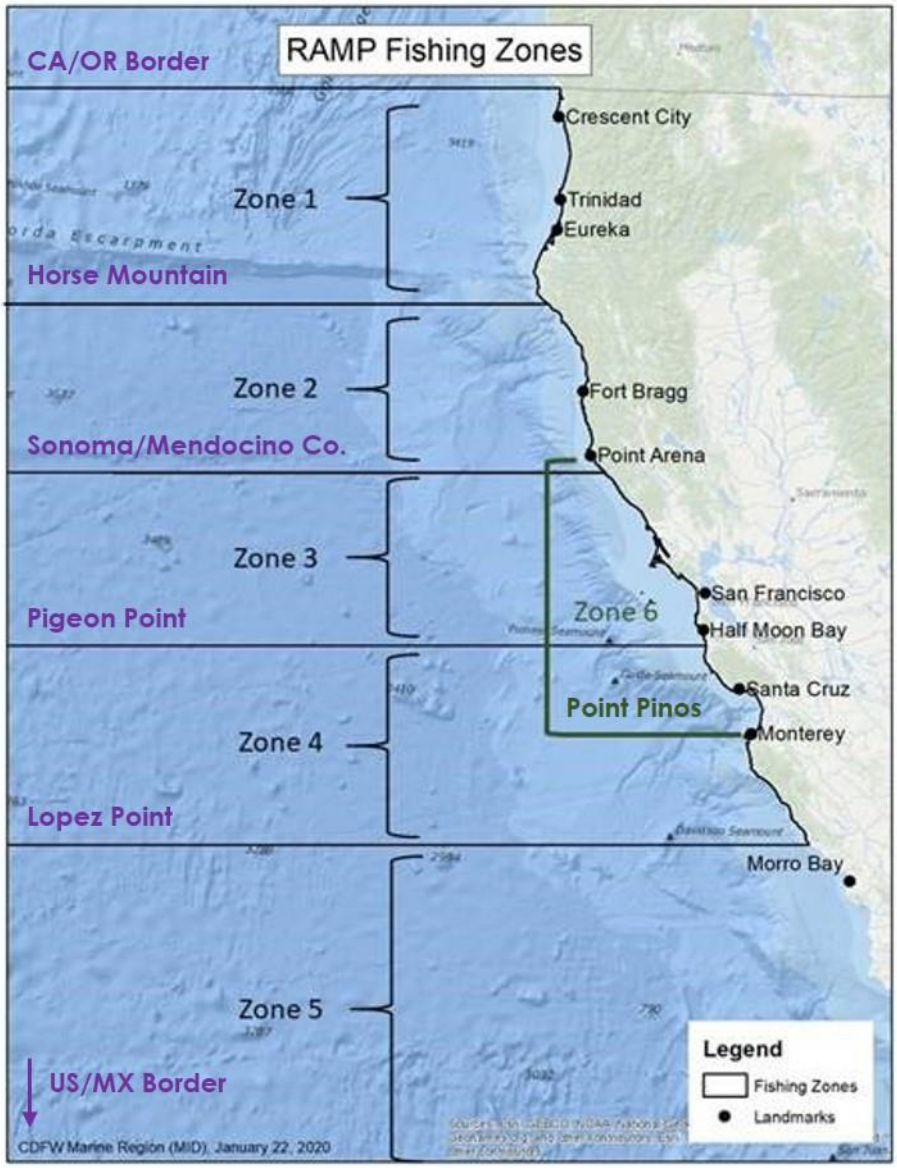

Figure 5-4. RAMP Fishing Zones. Created by CDFW Marine Region.

5.2.3.5 Alternative Gear

Alternative Gear is currently being explored by the Working Group and other stakeholders. This includes "pop-up" gear (commonly called "ropeless gear"). The general principle involves a coil of rope, acoustic receiver (or timer), and buoy attached to the trap. An acoustic signal is sent from the fishing vessel to the receiver, triggering the release of the rope and buoy. Once the buoy "pops up" to the surface of the water, the fisherman can retrieve the gear. Some configurations rely on a galvanic timed release, where a chemical reaction (rather than acoustic signal) results in release of the rope and buoy. Other companies have entirely replaced the rope and buoys, and the acoustic release instead triggers compressed gas canisters to fill large lift bags which bring the entire trap to the surface for retrieval. All of these approaches share the common element of minimizing the amount of time vertical lines and surface gear are present in

the water column or at the surface. This decreases the potential for an adverse encounter between marine life and entangling gear.

Allowing use of Alternative Gear, like pop-up gear, during periods of elevated entanglement risk in areas otherwise closed to commercial Dungeness crab fishing could reduce prevalence of vertical lines while limiting negative impacts to the fishery. However, prior to and during development of this CP, preliminary testing of pop-up gear has highlighted economic and reliability concerns from fishery participants and CDFW concerns regarding gear conflict, gear loss, and enforceability of trap limits, gear configuration, Marine Protected Areas, and other regulations. Like other potential Alternative gear, pop-up gear is expected to reduce the severity and persistence of entanglements, but it is challenging to prove their effectiveness without observational data or experimental studies. Recognizing ongoing development efforts in this area, the limitations of currently available options, and the potential for non-pop-up gear innovations which would similarly decrease entanglement risk to arise at a later time, the RAMP establishes a process for CDFW certification of Alternative Gear, which includes but is not limited to pop-up technologies. This process includes performance standards such as detectability by CDFW, reliable retrieval, easily identified, and confers tangible reduction in entanglement.

5.3 Gear Retrieval Program

As part of the regulations implementing the trap limit program (Section 132.2, Title 14, CCR), CDFW specified that no more than 6 traps could be on a vessel without a buoy tag assigned to that vessel, although an unlimited number are allowed from July 16 - October 31 (during the closed season). This allowance was intended to facilitate good-faith efforts by Dungeness crab vessel permitholders to retrieve lost or abandoned trap gear, while still ensuring CDFW would be able to enforce the trap limit program.

In several ports, local non-profit organizations and fishing organizations have worked with commercial Dungeness crab fishermen to conduct coordinated gear retrieval operations after the close of the fishing season. Since 2014, these operations have removed over 2,000 traps (personal communications: Jennifer Renzullo, Sea Doc Society, 8/10/2015, Oliviya Wyse, Monterey Bay Fisheries Trust, 11/26/2019; Jenn Humberstone, The Nature Conservancy, 3/6/2020).

CDFW adopted new regulations (Section 132.7, Title 14, CCR) in September 2019 implementing a trap gear retrieval program. Under the terms of the program, qualified entities (sport or commercial fishing associations with a board and/or charter, non-profits, and local government agencies or harbor districts) work with commercial trap fishermen to conduct on-the-water retrieval operations from two weeks after the scheduled season closure (FGC Section 8276) to September 30. The Director can authorize retrieval to begin sooner as part of a closure under the RAMP. All retrieved traps are documented in a logbook, which is submitted to CDFW each year. Compensation for retrieval activities is provided either by the Dungeness crab vessel permitholder, in exchange for the retrieved trap, or by CDFW. The guaranteed compensation is one key difference between the formal program and the informal retrieval activities conducted under Section 132.2. CDFW has conducted extensive outreach to potential Retrieval Permittees

to encourage their participation, as well as notifying commercial fishery participants of the program's implications.

[Note: Will provide additional information about the 2020 program prior to final CP submission]

The proportion of entanglements which occur in actively fished rather than lost or abandoned gear is unknown, however it is reasonable to assume that any reduction in vertical lines represents a decrease in entanglement risk. As additional retrieval operations are conducted under Section 132.2 and Section 132.7, in conjunction with additional forensic analyses, CDFW may be able to quantify the risk reduction benefit of these retrieval operations.

5.4 Best Practices and Other Outreach

Outreach to fishery participants is a crucial component of this CP. CDFW will continue routine engagement of key stakeholders on the Working Group and DCTF, as well as encouraging them to share current information with the constituents they represent. Public meetings increase awareness of marine life entanglement issues and management actions by the fleet and broader public.

CDFW will continue to support annual development of a Best Practices Guide by the Working Group, which advocates for widespread use of fishing practices that are likely to reduce entanglements. The Best Practices Guide is finalized prior to the season opener, and copies are given to Working Group members for in-person distribution as well as posted on the Working Group's webpage and distributed through Working Group and DCTF email lists. The Best Practices Guide is also available at CDFW license counters which fall within the range of the Dungeness crab fishery (San Luis Obispo to Oregon). They are also distributed to CDFW staff during recreational fishery sampling and at outreach events, and posted to CDFW's Whale Safe Fisheries webpage.

Future iterations of the Best Practices Guide may recommend use of gear modifications such as yale grip sleeves and kernmantle rope, which have been tested in New England trap fisheries in attempts to decrease anthropogenic mortality of the endangered North Atlantic right whale. Unlike the Alternative Gears described above, these methods could be used under current regulations, without any additional authorization by CDFW. However, while early evidence on these methods show some promise, they have not been tested in fisheries on the West Coast, nor has any study analyzed the potential benefits they may have on the Covered Species under this CP to prevent serious injury or mortality.

Should sufficient evidence accumulate, CDFW may consider requiring incorporation of these types of gear modifications as part of baseline fishing practices. In the interim, CDFW will consider establishing a training and certification program for Dungeness crab vessel captains modeled after similar programs for federal fisheries (e.g. Hawaii shallow set longline). Participants would receive instruction on best management practices intended to reduce the frequency and severity of marine mammal interactions. Certifications would sunset after a specified time period (likely between 2 and 5 years) so CDFW can routinely incorporate new insights and captains receive regular training updates and access to new information.

Yale grip sleeves are a method of splicing rope together where the two butt ends of the rope meet in the middle of the sleeve (Figure 5-2). This sleeve then acts as a weak link. On the East Coast, grip sleeves are manufactured with a 1,700-pound breaking strength, the breaking strength of ropes which have persisted on entangled North Atlantic right whale. Knowlton et al. (2016) showed that, based on observed entanglements in the Atlantic, ropes that are found to have entangled right whales do not differ significantly from ropes that entangled humpback whales in terms of breaking strength. However, while the average breaking strength does not differ significantly between the juveniles of the two species, the average breaking strength for an adult humpback whale is significantly lower than that of an adult right whale. Similar research has not yet been conducted for blue whales, although Arthur et al. (2015) reportedly estimated the force output for large individuals as approximately 60 kN (13.5k pounds of force). Additionally, using yale grip sleeves instead of knotting or splicing means the rope lacks binding points which can get caught up in the baleen (PSMFC 2017), increasing the likelihood an entangled whale can self-release. Due to their smaller size, the benefits for Pacific leatherback sea turtles is unknown but self-release is unlikely.

Figure 5-2. Novabraid Yale grip sleeve, courtesy of Fran Recht (Pacific States Marine Fisheries Commission).

Kernmantle rope doesn't fray as easily as the blue steel rope typically used by commercial Dungeness crab fishermen (PSMFC 2017). As such, if an animal becomes entangled, the rope is less likely to cut through tissue, minimizing the direct physical damage caused by an entanglement. Kernmantle rope is more expensive and harder to splice, so widespread use is unlikely unless required by regulation. However, as entanglements are thought to occur most often in the top portion of the gear, fishermen may not need to fully replace existing line with kernmantle rope to achieve meaningful reductions to the severity of entanglement events.

CDFW will annually distribute a pre-season newsletter in early fall which includes updates regarding implementation of this CP and any new regulatory requirements for the recreational and commercial sectors. If available, the Best Practices Guide will also be included. The newsletter will be mailed to all Dungeness crab vessel permitholders and to recreational participants (as identified by purchase of a crab validation with that year's sport fishing license). The newsletter will also be distributed electronically through CDFW's Marine Management News blog and posted on CDFW's Whale Safe Fisheries webpage.

CDFW will also generate press releases, send updates via a dedicated listserv, and regularly update the Whale Safe Fisheries webpage with new developments related to implementation of the CP. When possible, CDFW will hold in-person meetings in key ports during the spring months.

5.5 Effectiveness Monitoring

The effectiveness of this CP will be assessed through the number of confirmed entanglements in California commercial Dungeness crab gear on an annual basis, both during the open season and during any closed period. Entanglements will be assessed through close communication and coordination with NMFS and included in the annual report described in Chapter 6.

DRAFT

CHAPTER 6. PLAN IMPLEMENTATION

6.1 Coordination and Key Partners

6.1.1 NMFS

Successful implementation of this CP will require continued coordination and collaboration between CDFW and NMFS staff, both within the Protected Resources Division and the Fisheries Science Centers. Key inputs from NMFS for the RAMP include: verification and fishery source of reported entanglements, aerial surveys to quantify distribution and co-occurrence of marine life and trap gear, and provision of cetacean and Pacific leatherback sea turtle tagging data (see Chapter 5 for additional detail).

In addition, as described in Chapters 4 and 5, CDFW will initiate consultation with NMFS upon attainment of specified entanglement triggers.

[Note: Details of the NMFS/CDFW consultation process will be developed prior to final CP submission]

6.1.2 California Ocean Protection Council

COPC was established in 2004 to coordinate the scientific and management activities between California state agencies related to ocean conservation (California Public Resources Code §§ 35600 *et seq.*). As California's lead agency for marine policy issues, COPC strategic plans and policies provide crucial guidance for the ocean conservation activities of state agencies. Of particular relevance to this CP are elements of the current COPC Strategic Plan (COPC 2020) which discuss sustainable fisheries and anthropogenic impacts to marine life, including entanglements. COPC also provides financial resources (from bond funds and legislative appropriations) to state agencies and external parties which enhance the quality and quantity of scientific information upon which state management decisions are made. In November 2019, COPC approved an investment strategy to guide allocation of approximately $5.3 million in general funds for projects reducing marine life entanglements (COPC 2019).

Along with CDFW and NMFS, COPC was instrumental in organizing the initial public meeting on marine life entanglements in August 2015, shortly after convening the Working Group. Since the Working Group's inception, COPC has provided financial support for Working Group operations, strategic guidance regarding Working Group activities, and staff resources to organize meetings and document outcomes of Working Group discussions. CDFW intends to continue this collaborative relationship with COPC when implementing this CP.

6.1.3 Tri-State

Washington and Oregon are currently preparing CPs and have indicated that they plan to submit applications for ITPs providing coverage for their commercial Dungeness crab fisheries. While differences in each state's regulatory environment and fishery operations will be reflected in each CP, California will continue routine data-sharing with the other two states, particularly with regard to forensic review of entanglements, gear innovations, and emerging science.

California will also continue participating in the Tri-State Agreement overseen by Pacific States Marine Fisheries Commission, through which the three states routinely discuss and coordinate management actions regarding domoic acid and quality of Dungeness crab as well as marine life entanglement efforts undertaken by each state's Working Group, industry, and management agency.

6.1.4 State Advisory Bodies

The Working Group will be a key partner for CDFW during implementation of this CP. The expertise of Working Group members and advisors is crucial to gathering and reviewing available information and making management recommendations to the Director under the RAMP (Section 132.8, Title 14, CCR), as described in Chapter 5. The Working Group also provides a forum for discussion of Alternative gear that may reduce entanglement risk, which may be adopted by the fleet as best practices or required by CDFW.

While not exclusively focused on entanglement issues, the DCTF is charged with making recommendations to the California Legislature, Fish and Game Commission, CDFW, and other state institutions regarding the need for changes in management of the Dungeness crab fishery. As such, CDFW will keep the DCTF informed regarding implementation of this CP and may request DCTF review of adaptive management measures under consideration.

6.1.5 Fishing and Port Associations

Fishing and Port Associations will also be key partners for communication of the CP's goals and working with CDFW to implement minimization measures. Fishing Associations will be particularly important to inform the RAMP program and its various elements. Associations will also provide key insight into fishery operations and markets. They will also be important to help with other programs aimed at reducing marine life entanglements including the lost gear recovery program.

6.2 Conservation Program Implementation

6.2.1 Data and Records Management

CDFW will make publicly available any information on entanglements, marine life abundance, and any other non-confidential information relied upon by the Working Group or CDFW Director during decision-making on the Whale Safe Fisheries Page for a minimum of 5 years. Additionally, risk assessment and management recommendation memos produced by the Working Group and CDFW staff recommendations transmitted to the Director will be made available online for at least 5 years. All information will be provided and archived in accordance with CDFW's Scientific Integrity Policy (CDFW 2017).

6.2.2 Annual Reporting Requirements

CDFW will submit a report to NMFS regarding implementation of this CP on or around September 1 each year. At a minimum, this report will include the following elements:

- Number of confirmed humpback whale, blue whale, and Pacific leatherback sea turtle entanglements in California commercial Dungeness crab gear during the previous fishing season
- Cumulative number of confirmed humpback whale, blue whale, and Pacific leatherback sea turtle entanglements in California commercial Dungeness crab gear relative to the take limits identified in Chapter 4, as well as outcomes of any disentanglement efforts
- Results of each risk assessment by the Working Group during the previous fishing season, including data relied upon during the risk assessment, and any in-season management actions taken by CDFW to mitigate risk
- New or amended regulations governing Dungeness crab fishing activity
- CDFW outreach efforts during the previous fishing season encouraging implementation of best fishing practices, reporting entangled whales, and removing lost or abandoned fishing gear
- Enforcement efforts taken to ensure compliance with any conservation actions taken during the prior fishing season
- Amount and locations of gear retrieved under the Trap Gear Retrieval Program
- Additional management actions contemplated for the upcoming fishing season, under the adaptive management framework as described in Chapter 5

Reports will be transmitted via email to West Coast Region Protected Resources Staff, and other employees as directed by NMFS. Either CDFW or NMFS may request a meeting to discuss the annual report.

6.2.3 Enforcement

Enforcement of California fishing regulations fall primarily under the responsibility of CDFW's LED. Fish and Wildlife officers are responsible for ensuring compliance with management measures enacted under this CP, including time/area closures, vertical line reductions, and gear modifications.

[Note: LED to provide additional language for this section prior to final CP submission]

6.3 Adaptive Management

Adaptive management is a key element of the management framework described in Chapter 5 and underlying RAMP regulations. During the first five years of Working Group operations, members have identified several research topics and data improvements which could greatly enhance the effectiveness of the RAMP, providing equivalent protection for Covered Species while minimizing adverse economic impacts to the fishing community. By building as much flexibility as possible, the current RAMP regulations serve as a baseline to which improvements can be made through an adaptive management process.

For example, in addition to the predictive models (e.g. species distribution) and future management measures (ropeless gear, trawls, electronic monitoring) highlighted in Chapter 5,

temporal elements of the RAMP may be updated in light of new biological information. Habitat use or migration patterns of Covered Species may change such that the season delay and closure dates specified in RAMP no longer provide the intended protective benefits. If robust information is available, CDFW would amend this CP and the RAMP regulations in consultation with NMFS and other stakeholders as appropriate to account for the changes. In the event of significant uncertainties, the Director would implement the CP and RAMP regulations to develop tailored management response.

As another example, CDFW anticipates that populations of some Covered Species (particularly humpback whales) will continue to increase, making encounters with fishing gear and subsequent entanglements more likely. Both the 3-year take caps (Chapter 4) and annual triggers for fishery closure (Chapter 5) were predicated upon the current population levels. Should new scientific information (including updated stock assessment reports) become available about population size or trends, CDFW will consult with NMFS regarding potential changes to the annual triggers or overall take limits, and amend the CP and the RAMP regulations accordingly.

CDFW will continue to analyze the number of confirmed entanglements in the context of emerging analyses and information, as well as the changing stock status of the Covered Species. The agency will make the necessary adjustments to regulatory actions based on these ongoing analyses and continue to conduct outreach with affected stakeholders.

6.4 Amendments

6.4.1 Minor Amendments to the CP

Minor amendment of this CP or the associated ITP may be made by CDFW in consultation with NMFS without any notice to the public or comment period. The following changes are considered minor amendments, provided they do not change the intended meaning of the amended text:

- Correction of typographical, grammatical, and similar editing errors
- Correction of maps, numbers, and similar substantive error that deviate from the references they are pulled from
- Minor changes to survey, monitoring, reporting, or analytical protocols

NMFS may not approve a minor amendment if it determines that such amendment would:

- Result in operations under the CP that are significantly different from those analyzed in connection with the original CP
- Result in adverse effects on the environment that are significantly different from those analyzed in connection with the original CP
- Result in adverse economic effects on the fishing industry that are significantly different from those analyzed in connection with the original CP
- Allow significant additional take not analyzed in connection with the original CP.

For every minor amendment, CDFW shall provide NMFS with a written statement describing reason for the amendment, its effect on the CP's implementation, and its effect on the Covered Species. The amendments shall become effective after 45 days of such transmission, unless NMFS objects, and the modification will be posted on CDFW's Whale Safe Fisheries website.

6.4.2 Major Amendments to the CP

An amendment is considered a major amendment if it is not a minor amendment. CDFW shall provide a notice on any major amendment on its Whale Safe Fisheries website followed by a 45-day comment before submitting the proposed amendment to NMFS for approval.

6.4.3 Amendments to RAMP Regulations

FGC § 8276.1 provides CDFW with the authority to develop and amend regulations implementing the RAMP. The amendment process for RAMP will adhere to the California APA. At a minimum CDFW must provide a notice to the public through the California Notice Register which includes the amended text of the regulations and a statement of reasons providing rationale for the proposed changes. The public must be afforded at least 45 calendar days to provide comments before the amendment can be adopted.

Given public interest in marine life entanglement issues, CDFW has historically gone beyond the requirements of California APA when adopting such regulations and conducted outreach with key stakeholder groups prior to commencing the formal regulatory processes. The gear retrieval program (Section 132.7, Title 14, CCR) did not enter the formal regulatory process until stakeholders conducted pilot efforts for multiple years and provided invaluable insight and feedback to CDFW. Likewise, the fishing community was contacted, and potential solutions scoped for the gear marking program months before it entered formal rulemaking. Adoption of the current RAMP regulations involved multiple rounds of pre-review of draft regulatory text by the public before the official public comment period began. CDFW will continue to proactively engage with stakeholders when contemplating changes to the RAMP regulations.

6.5 Suspension/Revocation, Renewal

NMFS may suspend or revoke the permit if CDFW fails to implement the CP in accordance with the terms and conditions of the permit or if suspension or revocation is otherwise required by federal law. Suspension or revocation of a Section 10(a)(1)(B) permit, in whole or in part, must be in accordance with 50 CFR 13.27-29, 17.22 (b)(8), and 17.32 (b)(8).

6.6 Funding Sources and Assurances

6.6.1 Estimated Cost

Successful implementation of this CP will require substantial investment of state resources, as well as engagement with federal partners (NMFS and U.S. Coast Guard), fishery industry participants, and non-governmental organizations. Primary costs of the CP will be salaries and benefits for CDFW staff, as described below, in three areas: RAMP, aerial survey data acquisition, and law enforcement and compliance monitoring.

[Note: Additional funding information will be provided prior to final CP submission]

Beginning with the 2018-19 fiscal year, CDFW has three full time staff within the Marine Region dedicated to marine life entanglement issues. Upon issuance of the ITP, their primary duties will be ensuring implementation of the CP. CDFW has additional staff who actively manage the Dungeness crab fishery and will also support CP implementation. Senior management within the Marine Region will also be highly engaged. Duties of Marine Region staff include:

- Participation in, and oversight of, constituent groups (e.g. Working Group, DCTF)
- Routine monitoring of available data streams
- Research and development to improve RAMP performance
- Providing aggregated data to the Working Group during RAMP risk assessments
- Administering the Trap Gear Retrieval Program
- Close communication with NMFS regarding reported entanglements
- Coordination with Oregon and Washington regarding entanglement mitigation efforts
- Oversight and coordination of Alternative Gear testing
- Outreach to Dungeness crab fishery participants and other trap fisheries

Personnel costs for the above staff and program elements are provided in Table 6-1.

[Note: Personnel estimated costs will be added prior to final CP submission]

Table 6-1. Estimated Staffing Costs for Whale Safe Program and RAMP Implementation (FY 2020-21)

Staff from other areas of CDFW, including Data and Technology, Office of Communication, Education and Outreach, License and Revenue Branch and Office of General Counsel will also play key roles. Cost estimates from those other areas of CDFW will be variable and difficult to estimate until implementation of the CP

As described above, CDFW's LED is responsible for enforcement of any management measures enacted under this CP. Both LED and Office of the General Counsel staff will be extensively involved in promulgation of new regulations, or amendment of any existing regulations, necessarily to implement this CP.

In addition to personnel, collection and provisioning of some data streams will incur direct expenses. Entanglement reports are provided by NMFS, with no direct costs to CDFW. Domoic acid and quality testing for Dungeness crab, as well as QA/QC of commercial landings data, would occur without this CP, therefore costs are considered part of baseline operations for this fishery and not detailed here. To date, electronic monitoring has been covered by grant funding, however future costs will likely be borne by the fishing fleet. While CDFW intends to work closely with NMFS to coordinate aerial surveys to inform risk relative to marine life concentrations, the state will provide primary aerial survey support. Estimated annual costs for aircraft time, equipment, and personnel (pilots and observers) for 6-12 state-funded aerial surveys are provided in Table 6-2.

[Note: Add aerial surveys (table 6-2) costs prior to final CP submission]

Table 6-2. Estimated Annual Costs for Aerial Surveys (FY 2020-21)

The most substantial future resource needs are continued funding of satellite tag data collection, vessel-based surveys, expansion of aerial surveys, as well as continued refinement of species distribution models and other predictive elements.

Compliance monitoring by CDFW LED personnel will incur additional costs (Table 6-3). This involves CDFW resources including large patrol vessels, crews, aircraft patrol, lieutenants and wildlife officers. These patrol costs are estimated per-management action, rather than on a seasonal or calendar year basis. On average, CDFW anticipates 2 – 4 management actions would occur per year.

[Note: Add LED costs (table 6-3) and additional operations costs prior to final CP submission]

Table 6-3. Law Enforcement Patrol Costs per Management Action Implemented (2-day aerial patrols, 3-day large vessel patrols)

6.6.2 Program Funding

California's 2018-19 budget included a one-time general fund allocation to the COPC to address marine life entanglement risk. At the November 13, 2019 meeting, the COPC approved a spending plan to guide investment of approximately $5.4 million over the next 5 years (funds must be spent by July 1, 2024). This funding is available to support a variety of projects, including development of predictive models to inform real-time assessment of entanglement risk, and testing of gear innovations.

Allocation of CDFW staff resources is predicated upon annual appropriation of funds by the State Legislature, and cannot be guaranteed throughout the duration of the ITP. However, to the extent practicable, CDFW will direct staff resources as described above.

In-kind contributions from NMFS, Working Group members, and other entities are a key component of the overall funding plan for the CP. Additionally, CDFW may utilize available aerial survey resources from non-profit partners such as Lighthawk, USCG and the USCG Auxiliary.

The California Commercial Dungeness crab fishing industry will also likely need to allocate funding to cover program costs through increased permit fees. Implementation of aerial and vessel-based surveys are particularly costly and CDFW will likely need to secure additional long-term funding sources to allow the fleet to operate during elevated periods of entanglement risk.

6.6.3 Section 6 Grants

As a state wildlife management agency, CDFW is eligible to apply for federal funds under Section 6 of the ESA to support voluntary species conservation actions. CDFW submitted two

applications in Fall 2019, one for expanded aerial surveys of large whales and one for additional satellite tagging of leatherback sea turtles. While neither of these projects were selected for funding, CDFW will continue to apply for grant support during future funding cycles to expand resources available to implement this CP.

DRAFT

CHAPTER 7. ALTERNATIVE

7.1 Permanently Shortened Season

The management program described in Chapter 5 requires routine monitoring and data synthesis and results in a large amount of ongoing within and between-season uncertainty for fishery participants. Restricting fishery operations to periods of extremely low entanglement risk, as defined by historic patterns, would be significantly easier for the CDFW to implement and enforce, reduce CDFW's reliance on data collection efforts by outside partners, and provide market stability. CDFW considered changing the season to a historically low risk period of late December through March.

The negative impacts of this alternative, however, exceeded the potential conservation and efficiency gains. California fishery operations would no longer be aligned with Oregon and Washington, as required under the Tri-State Agreement. Additionally, while season delays and early closures as described in Chapter 5 may result in some fishing seasons which are only open during winter months, hardwiring those dates would greatly reduce fishing opportunity during otherwise low risk years. Most importantly, restricting operations to only two or three months would render the fishery incredibly fragile. Since that is the bare minimum of time the fishery needs to maintain its economy, any further shock (e.g., adverse climate, harmful algal bloom, trade dispute) could undermine the entire fishery.

[Note: CDFW will continue to update this alternative and background material prior to final CP submission]

DRAFT

Works Cited:

Abrahms, B., Hazen, E. L., Aikens, E. O., Savoca, M. S., Goldbogen, J. A., Bograd, S. J., Jacox, M.G., Irvine, L.M., Palacios, D.M. & Mate, B. R. (2019). Memory and resource tracking drive blue whale migrations. Proceedings of the National Academy of Sciences, 116(12), 5582-5587.

Arthur, L. H., Mclellan, W. A., Piscitelli, M. A., Rommel, S. A., Woodward, B. L., Winn, J. P., Potter, C. W., and Pabst, D. A. (2015). Estimating maximal force output of cetaceans using axial locomotor muscle morphology. *Marine Mammal Science*, *31*(4), 1401-1426.

Bailey, H., Mate, B. R., Palacios, D. M., Irvine, L., Bograd, S. J., & 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, 10, 93-106.

Bakun, A., & Parrish, R. H. (1982). Turbulence, Transport, and Pelagic Fish in the California and Peru Current Systems. California Cooperative Oceanic Fisheries Investigations, 23, 99-112.

Bednaršek, N., Feely, R. A., Reum, J. C. P., Peterson, B., Menkel, J., Alin, S. R., & Hales, B. (2014). *Limacina helicina* shell dissolution as an indicator of declining habitat suitability owing to ocean acidification in the California Current Ecosystem. *Proceedings of the Royal Society B: Biological Sciences*, *281*(1785), 20140123.

Bednaršek, N., Feely, R. A., Beck, M. W., Alin, S. R., Siedlecki, S. A., Calosi, P., Norton, E. L., Saenger, C., Štrus, J., Greeley, D., Nezlin, N. P., Roethler, M., and Spicer, J. I. (2020). Exoskeleton dissolution with mechanoreceptor damage in larval Dungeness Crab related to severity of present-day ocean acidification vertical gradients. Science of the Total Environment.

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 US, 105: 337–347

Benson, S. R., Eguchi, T., Foley, D. G., Forney, K. A., Bailey, H., Hitipeuw, C., ... & Pita, J. (2011). Large-scale movements and high-use areas of western Pacific leatherback turtles, *Dermochelys coriacea*. Ecosphere, 2(7), 1-27.

Benson, S.R. (2019). Biology of Leatherback Turtles off California: Movements, Forage Ecology, Abundance, and Status, Presentation to the California Dungeness Crab Fishing Gear Working Group, 23 April 2019.

Black, N., Ternullo, R., Schulman-Janiger, A., Hammers, A. M., & Stap, P. (2001). Occurrence, behavior, and photo-identification of killer whales in Monterey Bay, California. In 14th Biennial Conference on the Biology of Marine Mammals, Vancouver, British Columbia. Society for Marine Mammalogy, San Francisco, California.

Bograd, S. J., Castro, C. G., Di Lorenzo, E., Palacios, D. M., Bailey, H., Gilly, W., & Chavez, F. P. (2008). Oxygen declines and the shoaling of the hypoxic boundary in the California Current. *Geophysical Research Letters*, *35*(12).

Bograd, S. J., Schroeder, I., Sarkar, N., Qiu, X., Sydeman, W. J., & Schwing, F. B. (2009). Phenology of coastal upwelling in the California Current. Geophysical Research Letters, 36(1).

Brinton, E. (1976). Population biology of *Euphausia pacifica* off southern California. Fishery Bulletin, 74(4), 733-762.

Calambokidis, J., G.S. Schorr, G.H. Steiger, J. Francis, M. Bakhtiari, G. Marshal, E.M. Oleson, D. Gendron and K. Robertson. (2008). Insights into the underwater diving, feeding, and calling behavior of blue whales from a suction-cup-attached video-imaging tag (CRITTERCAM). Marine Technology Society Journal 41:19-29.

Calambokidis, J., G.H. Steiger, C. Curtice, J. Harrison, M.C. Ferguson, E. Becker, M. DeAngelis and S.M. Van Parijs. (2015). Biologically important areas for selected cetaceans within U.S. waters – West Coast region. Aquatic Mammals 41:39-53.

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

California Department of Fish and Wildlife (2017). Department of Fish and Wildlife Scientific Integrity Policy. Department of Fish and Wildlife Departmental Bulletin 2017-02.

California Department of Fish and Wildlife (2019a). Dungeness Crab, *Metacarcinus magister*, Enhanced Status Report.

California Department of Fish and Wildlife (2019b). Final California Commercial Landings for 2018.

California Ocean Protection Council (2019). Strategy for Protecting Whales and Sea Turtles & Ensuring Thriving Fisheries: Reducing the Risk of Entanglement in California Fishing Gear.

California Ocean Protection Council. (2020). Strategic Plan to Protect California's Coast and Ocean 2020-2025.

Carr, M. E., & Kearns, E. J. (2003). Production regimes in four Eastern Boundary Current systems. Deep Sea Research Part II: Topical Studies in Oceanography, 50(22-26), 3199-3221.

Carretta, J. V, Moore, J. E., & Forney, K. A. (2019). Estimates of Marine Mammal, Sea Turtle, and Seabird Bycatch from the California Large-Mesh Drift Gillnet Fishery: 1990-2017. NOAA Technical Memorandum.

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

Chavez, F. P., Ryan, J., Lluch-Cota, S. E., & Ñiquen, M. (2003). From anchovies to sardines and back: multidecadal change in the Pacific Ocean. science, 299(5604), 217-221.

Clapham, P. J., Leatherwood, S., Szczepaniak, I., & Brownell Jr, R. L. (1997). Catches of humpback and other whales from shore stations at Moss Landing and Trinidad, California, 1919–1926. Marine Mammal Science, 13(3), 368-394.

California Ocean Protection Council (2020). Strategic Plan to Protect California's Coast and Ocean 2020-2025.

Croll, D. A., Acevedo-Gutiérrez, A., Tershy, B. R., & Urbán-Ramírez, J. (2001). The diving behavior of blue and fin whales: is dive duration shorter than expected based on oxygen stores?. Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology, 129(4), 797-809.

Curtis, K. A., Moore, J. E., & Benson, S. R. (2015). Estimating Limit Reference Points for Western Pacific Leatherback Turtles (*Dermochelys coriacea*) in the U.S. West Coast EEZ. PLOS, 1–24.

Demer, D. A., Zwolinski, J. P., Byers, K. A., Cutter, G. R., Renfree, J. S., Sessions, T. S., & Macewicz, B. J. (2012). Prediction and confirmation of seasonal migration of Pacific sardine (*Sardinops sagax*) in the California Current Ecosystem. Fishery Bulletin, 110(1), 52-70.

Di Lorenzo, E., & Ohman, M. D. (2013). A double-integration hypothesis to explain ocean ecosystem response to climate forcing. Proceedings of the National Academy of Sciences, 110(7), 2496-2499.

Di Lorenzo, E., & Mantua, N. (2016). Multi-year persistence of the 2014/15 North Pacific marine heatwave. *Nature Climate Change*, *6*(11), 1042-1047.

Doniol-Valcroze, T., D. Berteaux, P. Larouche and R. Sears. (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.

Eguchi, T., Benson, S. R., Foley, D. G., & Forney, K. A. (2016). Predicting overlap between drift gillnet fishing and leatherback turtle habitat in the California Current Ecosystem. Fisheries Oceanography, 1–17. https://doi.org/10.1111/fog.12181

Fiedler, P., S. Reilly, R. Hewitt, D. Demer, V. Philbrick, S. Smith, W. Armstrong, D. Croll, B. Tershy and M. B. (1998). Blue whale habitat and prey in the Channel Islands. Deep Sea Research Part II-Topical Studies in Oceanography 45:1781-1801.

Fleming, A. H., Clark, C. T., Calambokidis, J., & Barlow, J. (2016). Humpback whale diets respond to variance in ocean climate and ecosystem conditions in the California Current. Global change biology, 22(3), 1214-1224.

Forney, K. A., & Barlow, J. (1998). Seasonal patterns in the abundance and distribution of California cetaceans, 1991–1992. *Marine Mammal Science*, *14*(3), 460-489.

Graham, W. M., Field, J. G., & Potts, D. C. (1992). Persistent "upwelling shadows" and their influence on zooplankton distributions. Marine Biology, 114(4), 561-570.

Graham, W. M., & Largier, J. L. (1997). Upwelling shadows as nearshore retention sites: the example of northern Monterey Bay. Continental Shelf Research, 17(5), 509-532.

Graham, W. M., Pagès, F., & Hamner, W. M. (2001). A physical context for gelatinous zooplankton aggregations: a review. In Jellyfish Blooms: Ecological and Societal Importance (pp. 199-212). Springer, Dordrecht.

Hanson, B.M., Emmons, C. K., Ward, E. J., Nystuen, J. A., & Lammers, M. O. (2013). Assessing the coastal occurrence of endangered killer whales using autonomous passive acoustic recorders. The Journal of the Acoustical Society of America, 134(5), 3486-3495.

Harvey, C., Garfield, T., Williams, G., & Tolimieri, N. (2020). California Current Integrated Ecosystem Assessment (CCIEA) California Current Ecosystem Status Report, 2020. A report of the NOAA CCIEA Team to the Pacific Fishery Management Council, March 5, 2020.

Hatfield, B. B., Ames, J. A., Estes, J. A., Tinker, M. T., Johnson, A. B., Staedler, M. M., & Harris, M. D. (2011). Sea otter mortality in fish and shellfish traps: Estimating potential impacts and exploring possible solutions. Endangered Species Research, 13(3), 219–229.

Hazen, E. L., Jorgensen, S., Rykaczewski, R. R., Bograd, S. J., Foley, D. G., Jonsen, I. D., Shaffer, S.A., Dunne, J.P., Costa, D.P., Crowder, L.B. & Block, B. A. (2013). Predicted habitat shifts of Pacific top predators in a changing climate. Nature Climate Change, 3(3), 234.

Kieckhefer, T.R., J. Calambokidis, G.H. Steiger and N.A. Black. (1995). Prey of humpback and blue whales off California based on identification of hard parts in feces. Pages 62 Eleventh Biennial Conference on the Biology of Marine Mammals. Orlando, Florida.

Knowlton, A. R., Robbins, J., Landry, S., McKenna, H. A., Kraus, S. D., & Werner, T. B. (2016). Effects of fishing rope strength on the severity of large whale entanglements. *Conservation Biology*, *30*(2), 318-328.

Lluch-Belda, D. A. N. I. E. L., Lluch-Cota, D. B., Hernandez-Vazquez, S. E. R. G. I. O., Salinas-Zavala, C. A., & Schwartzlose, R. A. (1991). Sardine and anchovy spawning as related to temperature and upwell in the California current system. CalCOFI Rep, 32, 105-111.

Magel, C. L., Lee, E. M.J., Strawn, A. M., Swieca, K., and Jensen, A. D. in review Connecting crabs, currents, and coastal communities: examining the impacts of changing ocean conditions on the distribution of U.S. west coast Dungeness Crab commercial catch.

Marchesiello, P., McWilliams, J. C., & Shchepetkin, A. (2003). Equilibrium structure and dynamics of the California Current System. Journal of physical Oceanography, 33(4), 753-783.

Martin SL, Siders Z, Eguchi T, Langseth B, Ahrens R, Jones TT. (2020). Assessing the

Mate, B.R., B.A. Lagerquist and J. Calambokidis. (1999). Movements of North Pacific blue whales during the feeding season off southern California and their southern fall migration. Marine Mammal Science 15:12.

McKibben, S. M., Peterson, W., Wood, A. M., Trainer, V. L., Hunter, M., & White, A. E. (2017). Climatic regulation of the neurotoxin domoic acid. *Proceedings of the National Academy of Sciences*, *114*(2), 239-244.

Mills, C. E. (2001). Jellyfish blooms: are populations increasing globally in response to changing ocean conditions? Hydrobiologia, 451(1-3), 55-68.

National Marine Fisheries Service. (2016). Species in the Spotlight: Priority Actions, 2016-2020. Pacific Leatherback Turtle, *Dermochelys coriacea*. National Marine Fisheries Service, Office of Protected Resources, Silver Spring, MD.

National Marine Fisheries Service (2018a). Blue Whale (*Balaenoptera musculus musculus*): Central North Pacific Stock- 2017.

National Marine Fisheries Service. (2018b). Fisheries Economics of the United States, 2016. U.S. Dept. of Commerce, NOAA Tech. Memo. NMFS-F/SPO-187, 243 p.

National Marine Fisheries Service (2018c). Killer Whale (*Orcinus orca*): West Coast Transient Stock- 2017.

National Marine Fisheries Service (2018d). Recovery Plan for the Blue Whale (*Balaenoptera musculus*).

National Marine Fisheries Service (2019a). 2018 West Coast Whale Entanglement Summary.

National Marine Fisheries Service (2019b). Blue Whale (*Balaenoptera musculus musculus*): Eastern North Pacific Stock-2018.

National Marine Fisheries Service (2019c). Humpback Whale (*Megaptera novaeangliae*): California/Oregon/Washington Stock- 2018.

National Marine Fisheries Service (2019d). Killer Whale (*Orcinus orca*): Eastern North Pacific Southern Resident Stock- 2018.

National Marine Fisheries Service (2020). 2019 West Coast Whale Entanglement Summary.

Peterson, W. T., Emmett, R., Goericke, R., Venrick, E., Mantyla, A., Bograd, S. J., Schwing, F.B., Hewitt, R., Lo, N.A.N.C.Y., Watson, W. & Barlow, J. (2006). The state of the California Current, 2005-2006: warm in the north, cool in the south. California Cooperative Oceanic Fisheries Investigations Report, 47, 30.

Peterson, W., Robert, M., & Bond, N. (2015a). The warm blob-Conditions in the northeastern Pacific Ocean. PICES Press, 23(1), 36.

Peterson, W., Robert, M., & Bond, N. (2015b). The warm blob continues to dominate the ecosystem of the northern California current. PICES Press, 23(2), 44.

Peterson, W. T., Fisher, J. L., Strub, P. T., Du, X., Risien, C., Peterson, J., & Shaw, C. T. (2017). The pelagic ecosystem in the Northern California Current off Oregon during the 2014–2016 warm anomalies within the context of the past 20 years. Journal of Geophysical Research: Oceans, 122(9), 7267-7290.

Pacific Fishery Management Council (2017). Regression Tree and Ratio Estimates of Marine Mammal, Sea Turtle, and Seabird Bycatch in the California Drift Gillnet Fishery: 1990-2015. PFMC March 2017 Agenda Item J.1.b. population-level impacts of North Pacific loggerhead and western Pacific leatherback turtle interactions in the Hawaii-based shallow-set longline fishery. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-95, 183 p. doi:10.25923/ydp1-f891

Pacific States Marine Fisheries Commission (2017). Workshop on Gear Innovations and Practices to Reduce Whale Interactions Day 1 Notes.

Purcell, J. E. (2005). Climate effects on formation of jellyfish and ctenophore blooms: a review. Journal of the Marine Biological Association of the United kingdom, 85(3), 461-476.

Reilly, S.B. and V.G. Thayer. (1990). Blue whale (*Balaenoptera musculus*) distribution in the eastern tropical Pacific. Marine Mammal Science 6:265-277

Rykaczewski, R. R., & Dunne, J. P. (2010). Enhanced nutrient supply to the California Current Ecosystem with global warming and increased stratification in an earth system model. *Geophysical Research Letters*, *37*(21).

Saez, L., D. Lawson, and M. DeAngelis. (2020). Large whale entanglements off the U.S. West Coast, from 1982-2017. NOAA Tech. Memo. NMFS-OPR-63, 48 p.

Santora, J. A., Sydeman, W. J., Schroeder, I. D., Wells, B. K., & Field, J. C. (2011). Mesoscale structure and oceanographic determinants of krill hotspots in the California Current: Implications for trophic transfer and conservation. Progress in Oceanography, 91(4), 397-409.

Santora, J. A., Mantua, N. J., Schroeder, I. D., Field, J. C., Hazen, E. L., Bograd, S. J., Snydeman, W.J., Wells, B.K., Calambokidis, J., Saez, L., Lawson, D., and Forney, K. A. (2020). Habitat compression and ecosystem shifts as potential links between marine heatwave and record whale entanglements. Nature Communications 2020 11:1, 11(1), 1–12.

Schoenherr, J.R. (1991). Blue whales feeding on high concentrations of euphausiids around Monterey Submarine Canyon. Canadian Journal of Zoology 69:583-594.

Starbird, C. H., Baldridge, A., & Harvey, J. T. (1993). Seasonal occurrence of leatherback sea turtles (*Dermochelys coriacea*) in the Monterey Bay region, with notes on other sea turtles, 1986-1991. California Fish and Game, 79(3), 54-62.

Stinson, M.L. 1984. Biology of sea turtles in San Diego Bay, California, and in the northeastern Pacific Ocean. Master's Thesis, San Diego State University. 578 pp.

Swimmer, Y., Gutierrez, A., Bigelow, K., Barceló, C., Schroeder, B., Keene, K., Shattenkirk, K. & Foster, D. G. (2017). Sea Turtle Bycatch Mitigation in U.S. Longline Fisheries. Frontiers in Marine Science, 4 (August).

Sydeman, W. J., García-Reyes, M., Szoboszlai, A. I., Thompson, S. A., & Thayer, J. A. (2018). Forecasting herring biomass using environmental and population parameters. Fisheries Research, 205, 141-148.

Talley, L. D. (2011). Descriptive physical oceanography: an introduction. Academic press.

Thomas, A., & Strub, P. T. (2001). Cross-shelf phytoplankton pigment variability in the California Current. Continental Shelf Research, 21(11-12), 1157-1190.

US Fish and Wildlife Service (2017). Marine Mammal Stock Assessment Report- SOUTHERN SEA OTTER (Enhydra lutris nereis).

Van Houtan, Kyle S. (2013). Assessing the impact of the Hawaii deep-set longline fishery to marine turtle populations in the North Pacific Ocean. Pacific Islands Fishery Science Center Internal Report IR-13-019, issued 17 September 2013.

Wade, P. R., Quinn, T. J., Barlow, J., Baker, C. S., Burdin, A. M., Calambokidis, J., Clapham, J.P., Falcone, E., Ford, J.K.B., Gabriele, C.M. & Leduc, R. (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 Report SC/66b/IA/21.

Wild, P. W. and Tasto R. N. 1983. Life History, environment, and mariculture studies of the Dungeness Crab, Cancer magister, with emphasis on the central California fishery resource. California Department of Fish and Game. Fish Bulletin 172. 352 p.

Yochem, P.K. and S. Leatherwood. (1985). Blue whale Balaenoptera musculus (Linnaeus, 1758). Pages 193-240 in S.H. Ridgway and R. Harrison eds. Handbook of Marine Mammals. Academic Press, London.

DRAFT