OCEAN PROTECTION COUNCIL

Strategy for Protecting Whales and Sea Turtles & Ensuring Thriving Fisheries: Reducing the Risk of Entanglement in California Fishing Gear

California Ocean Protection Council
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LIST OF ACRONYMS AND ABBREVIATIONS

CDFW: California Department of Fish and Wildlife
COPA: California Ocean Protection Act
DCTF: Dungeness Crab Task Force
ESA: Endangered Species Act
FGC: California Fish and Game Commission
ITP: Incidental Take Permit
MLMA: Marine Life Management Act
MMHSRP: Marine Mammal Health and Stranding Response Program
MMPA: Marine Mammal Protection Act
NMFS: National Marine Fisheries Service
NOAA: National Oceanic and Atmospheric Administration
OPC: California Ocean Protection Council
PSMFC: Pacific States Marine Fisheries Commission
RAMP: Risk Assessment and Mitigation Program
TNC: The Nature Conservancy
USCG: United States Coast Guard
USFWS: United States Fish and Wildlife Service
Working Group: California Dungeness Crab Fishing Gear Working Group

I. PURPOSE OF THE STRATEGY

California's coastal waters include some of the most productive and diverse ecosystems in the world. To conserve this biodiversity and the coastal economies and communities that rely on a healthy ocean, OPC is committed to protecting endangered and threatened whale and sea turtle species as well as supporting thriving commercial and recreational state-managed fisheries. This strategy outlines investment priorities to reduce the risk of entanglement in California fishing gear and is one component of a more comprehensive effort to protect whales and sea turtles in California. This is consistent with Target 3.3.5 of OPC's draft *Strategic Priorities to Protect California's Coast and Ocean* for 2020-2025:[1]

***"3.3.5:** Develop a statewide whale and sea turtle protection plan by 2022 with a Vision Zero target of zero mortality. As a component of this overall plan, develop and initiate a funding strategy to reduce the risk of entanglement in California fishing gear by 2020.*
Actions:

- *Collaborate with the California Dungeness Crab Fishing Gear Working Group to reduce the risk of whale entanglement in California fishing gear; fund priority projects recommended by the Working Group to address data gaps and enhance results.*
- *Provide funding for the state's drift gillnet transition program (consistent with SB 1017) and work towards the target of elimination of large mesh drift gillnets off the California coast by 2024.*
- *Support research and analysis of impacts of whale strikes from the shipping industry and other sources of whale and turtle mortality, including noise and marine debris from land-based sources."*

This investment strategy focuses on a comprehensive approach to reduce the risk of entanglement in California fishing gear through advancing collaborative partnerships, best available science, gear innovation, as well as response and outreach. The strategy aims to build on the success of the California Dungeness Crab Fishing Gear Working Group and could support other fixed-gear state-managed fisheries in addition to commercial and recreational Dungeness crab. This is the first critical component of California's Whale and Sea Turtle Protection Plan.

THREATS TO WHALES AND SEA TURTLES

Ship strikes (vessel collision), marine debris, entanglement,[2] anthropogenic sound, chemical pollution, and climate change have all been identified as threats to whales across the globe.[3,4] However, globally and on the West Coast, vessel collisions and fishing gear entanglements have been identified as the two primary sources of human-caused mortality for whale populations.[5,6] In NOAA's *Sources of Human-Related Injury and Mortality for United States Pacific West Coast Marine*

[1] Strategic Plan to Protect California's Coast and Ocean, OPC 2019
[2] Entanglement is considered to be within "bycatch" in the International Whaling Commission's Conservation Committee Strategic Plan for 2016-2026.
[3] International Whaling Commission: Conservation Committee Strategic Plan for 2016-2026
[4] NOAA West Coast Large Whale Entanglement Response Program
[5] Berman-Kowalewski M et. al (2010)
[6] NOAA Entanglement of Marine Life: Risks & Responses

Mammal Stock Assessments for 2012-2016, 39 large whale records were reviewed involving animals found dead, of which 23 were determined to be due to vessel strikes, 15 due to fishery-related entanglements, and 1 related to entanglement in marine debris.[7] On the West Coast, vessel collisions with Blue whales, Humpback whales and Fin whales were major causes of mortality for those species.[8,9]

Entanglement in Fishing Gear

In recent years, there has been an increase in the number of confirmed reports of entanglement in fishing gear on the West Coast since NOAA Fisheries record keeping began in 1982.[10] Whales may become inadvertently entangled in active or derelict (lost or abandoned) fishing gear, or in other marine debris containing ropes/lines in the marine environment. Some whales that become entangled are able to discard the fishing gear on their own, while others may be unable to discard the gear and may carry it for days, months or years. Survival times if entangled vary based on the location of the entanglement and the whale's body condition.[11]

Humpback whale entangled in fishing gear. Photo: Duke University. NMFS, MMHSRP Permit 18786-03.

A variety of factors may contribute to the increase in the number of reported entanglements, including a complex relationship between the distribution, abundance and behavior of whales, environmental variability and prey distribution, and fishing effort distribution, as well as an increase in public awareness and reporting[12]. Whale species reported as entangled include Humpback whales, Gray whales, Blue whales, Fin whales, Minke whales, Sperm whales, and Orca whales.[13,14] Humpback whales have been the predominant species reported as entangled in recent years. The first confirmed Blue whale entanglement was report in 2015, with three reported in 2016, and three reported in 2017. Although there are many unknowns, multiple fisheries have been identified as having inadvertently entangled whales.[15] In 2018, there were 46 whales confirmed as entangled by NOAA off the West Coast, and seven were confirmed as dead (five Humpback whales and two Gray whales). In 2017, there were 31 whales confirmed as entangled by NOAA off the West Coast, and two of the confirmed entanglements involved Gray

[7] Carretta J V. et. al (2015)
[8] Carretta J V. et. al (2015)
[9] Rockwood RC, Calambokidis J, Jahncke J (2018)
[10] NOAA West Coast Large Whale Entanglement Response Program
[11] NOAA West Coast Large Whale Entanglement Response Program
[12] NOAA: Entanglements of Large Whales along the US West Coast (September 2019)
[13] Forensic Review Workshop Report: Reviewing the Gear Involved in West Coast Entanglements; Appendix B (August 2018)
[14] NOAA West Coast Large Whale Entanglement Response Program
[15] NOAA West Coast Large Whale Entanglement Response Program

whales that were found dead. In 2016, there were 48 whales confirmed as entangled and the majority of the reports had an unknown outcome; none of the entangled whales were originally reported as dead or later discovered to have died.[16]

Sea turtle entanglement is rarer and there are limited reports of sea turtle entanglement in California fishing gear. Globally, Leatherback sea turtles, which are listed as endangered under the Endangered Species Act (ESA), are threatened by fisheries bycatch, egg predation, egg harvesting, and beach erosion. Regarding confirmed fishery-related entanglement in California, one Leatherback was confirmed as dead in unidentified fixed gear in September 2015; one Leatherback was released alive from California Dungeness crab gear by a fisherman in April 2016,[17] and one Leatherback was confirmed as dead in unidentified fishing gear in October 2019.

Improved documentation and increasing response has increased NOAA Fisheries' ability to identify gear involved in entanglements; however, the source of entangling gear is unknown for the majority of whale entanglement reports.[18] From 2015 to 2017, 67 out of 129 -- or 52% -- of confirmed entanglement reports involved gear of unknown origin. From 2013 to 2018, when the source of entangling gear is identifiable, the majority of West Coast entanglement reports involve the commercial Dungeness crab fisheries in California, Oregon and Washington.[19] In California, commercial Dungeness crab gear has required gear marking which facilitates its identification when involved in entanglement reports.

ADDRESSING THE ENTANGLEMENT RISK

Dungeness Crab Fishing Gear Working Group

In response to an increase in the number of confirmed whale entanglements in recent years, a Dungeness Crab Fishing Gear Working Group (Working Group)[20] was convened in September 2015 by CDFW, in partnership with OPC and NMFS, to reduce the risk of entanglement in commercial and recreational Dungeness crab fishing gear. The Working Group developed a Risk Assessment and Mitigation Program (RAMP)[21] to assess circumstances where entanglement risk may be elevated and, as needed, identify potential management measures for the CDFW Director's consideration (see Section IV for more detail on the Working Group and RAMP).

Settlement Agreement and Incidental Take Permit

In October 2017, the Center for Biological Diversity sued CDFW regarding entanglement of protected species in commercial Dungeness crab fishing gear. The Pacific Coast Federation of Fishermen's Associations later intervened. On November, 26, 2018, CDFW announced its intent to apply for an Incidental Take Permit (ITP) under Section 10 of the federal ESA. CDFW is currently developing a draft Conservation Plan as part of an ITP application, which will address endangered species interactions in the Dungeness crab fishery. On March 26, 2019, CDFW announced the

[16] 2016 West Coast Whale Entanglement Summary; 2017 West Coast Whale Entanglement Summary; 2018 West Coast Whale Entanglement Summary
[17] Biology of Leatherback Turtles off California: Movements, Foraging Ecology, Abundance and Status (Benson, April 2019)
[18] Forensic Review Workshop Report: Reviewing the Gear Involved in West Coast Entanglements; Appendix B (August 2018)
[19] NOAA West Coast Large Whale Entanglement Response Program
[20] California Dungeness Crab Fishing Gear Working Group
[21] Risk Assessment and Mitigation Program

settlement[22] of the lawsuit brought by the Center for Biological Diversity against CDFW. While the Working Group was not a party to the litigation nor the settlement terms, as noted in the Working Group's March 29, 2019 statement,[23] Working Group members understand they will have a role in advising the state in the evaluation of entanglement risk using the RAMP, which is a foundational component of the settlement agreement.

Other West Coast fisheries and fishing gear types involved in entanglements, when identifiable by NOAA Fisheries, include sablefish, commercial and recreational spot prawn, lobster, gillnet, and drift gillnet.[24]

$7.5 million General Fund Appropriation
The 2018-2019 Governor's Budget[25] included a $7.5 million General Fund appropriation to OPC to address whale and sea turtle entanglement. Of the $7.5 million appropriated to OPC, $1 million was directed toward supporting sea lion and seal stranding rescue and rehabilitation activities. In addition, Public Resources Code (PRC) Section 35651,[26] as amended through Senate Bill (SB) 1017 (Allen, 2018), directed $1 million to fund the drift gillnet transition program established by CDFW pursuant to Fish and Game Code Section 8583. CDFW recently finalized their agreement with the fiscal agent, the Pacific States Marine Fisheries Commission (PSMFC), to support this program and OPC will work with CDFW and PSMFC to provide up to $1 million consistent with the law. This effort corresponds with an action in OPC's draft 2020-2025 strategic plan to provide funding to support the phase out of large mesh, drift gillnets by 2024. OPC has approximately $5.3 million of this General Fund appropriation remaining[27] to address whale and sea turtle entanglement[28]. This investment strategy focuses on a comprehensive approach to reduce the risk of entanglement in California fishing gear.

California envisions thriving marine ecosystems which support the coexistence of marine life, including whales, sea turtles and commercial and recreational fisheries, in the face of a changing climate. OPC engages with agency partners, fishermen, conservation organizations, disentanglement response network members, and others to collaboratively reduce the risk of entanglement in fishing gear and ensure thriving fisheries and marine ecosystems in California. This investment strategy advances OPC's goal to enhance coastal and marine biodiversity through supporting thriving fish populations and sustainable marine fisheries. This strategy is the first element of California's Whale and Sea Turtle Protection Plan. The strategy focuses on a comprehensive approach to reduce the risk of whale and sea turtle entanglement in California fishing gear.

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[22] CDFW settlement announcement
[23] Working Group's March 29, 2019 statement
[24] NOAA: Entanglements of Large Whales along the US West Coast (September 2019)
[25] 2018-2019 Governor's Budget
[26] Public Resources Code (PRC) Section 35651
[27] At the October 25, 2018, OPC meeting, the Council approved disbursement of $1 million to the University of California Davis Wildlife Health Center to fund California Marine Mammal Stranding Network member activities for sea lion and seal rescue and rehabilitation. At the October 25, 2018 meeting, the Council also approved a $170,000 project to deploy solar loggers (solar-power vessel tracking systems) on Dungeness crab commercial fishing and whale watching vessels to collect fishing activity and whale population density data. This information will inform the Working Group's RAMP to reduce the risk of entanglement in fishing gear, in alignment with their Recommendations Memo.
[28] Projects supported by this funding source may be approved via discretionary or competitive processes and must be set aside for projects by June 30, 2022 and spent by June 30, 2024.

II. STRATEGY FOR PROTECTING WHALES AND SEA TURTLES & ENSURING THRIVING FISHERIES THROUGH REDUCING THE RISK OF ENTANGLEMENT IN CALIFORNIA FISHING GEAR

Protecting whales and sea turtles through reducing the risk of entanglement in California fishing gear may be achieved through implementing a comprehensive strategy that includes the following four components:

1. COLLABORATIVE PARTNERSHIPS

Advance collaborative, multi-stakeholder processes to identify and develop solutions to reduce the risk of entanglement in fishing gear.

2. BEST AVAILABLE SCIENCE

Develop improved data streams and collaborative research to provide comprehensive information on key factors of entanglement risk across state-managed fisheries in order to inform adaptive risk mitigation.

3. GEAR INNOVATION

Support innovative research and development of fishing gear modifications that would reduce entanglement risk while allowing for safe, efficient, enforceable and cost-effective harvesting operations with minimal adverse impacts to marine life.

4. RESPONSE & OUTREACH

Conduct outreach and improved entanglement monitoring, documentation, analysis and response efforts.

The following section provides additional detail and rationale on each of the strategy components to reduce the risk of entanglement in California fishing gear.

1. COLLABORATIVE PARTNERSHIPS

Advance collaborative, multi-stakeholder processes to identify and develop solutions to reduce the risk of entanglement in fishing gear.

Initiation and facilitation of multi-stakeholder working groups has proven to be effective in identifying, prioritizing and addressing fishery-specific issues related to entanglements, as well as developing feasible, collaborative solutions to reduce entanglement risk. Supporting coordination to align and improve data streams as well as to increase accessibility and transparency of best available science may also be effectively advanced through collaborative partnerships.

Reducing entanglement risk is a complex issue which necessitates diverse expertise including state and federal fishery managers, commercial and recreational fishermen, scientific experts, conservation organizations, members of the disentanglement response network, and state legislators. The California Dungeness Crab Fishing Gear Working Group (Working Group) has demonstrated the value of a collaborative, multi-stakeholder process in informing adaptive management with the shared goal of thriving whale and sea turtle populations and a thriving Dungeness crab fishery off California. Established in September 2015, the 25-member Working Group is a unique coalition of diverse stakeholders, convened by the California Department of Fish and Wildlife (CDFW), in partnership with OPC and the National Marine Fisheries Service (NMFS). OPC and The Nature Conservancy (TNC) have partnered to fund the Working Group's operations and information gathering efforts since its inception. The Working Group has taken a collaborative approach to this dynamic issue and has developed an array of initiatives aimed at understanding, assessing and reducing entanglement risk as well as effective entanglement response. The Working Group and its Risk Assessment and Mitigation Program (RAMP) are described in more detail in Section IV.

Other commercial and recreational fixed-gear state-managed fisheries may benefit from similar collaborative, multi-stakeholder partnerships, with opportunities to leverage lessons learned from the Dungeness crab fishery's approach when considering entanglement concerns in other fixed-gear fisheries. For example, improved knowledge of whale and sea turtle species' population densities, distributions, and movement will inform adaptive management across state-managed fisheries that may interact with these protected species. This is consistent with a Working Group recommendation that, "CDFW, fishermen, and others consider the tools developed by the Working Group to date, including best fishing practices concepts, surface gear rulemaking concepts, gear marking ideas (e.g., double-sided tags, rope markings, buoy markings, etc.), and RAMP concepts to help other fisheries develop tools that are specific to their fishing practices."[29]

This component of the strategy aims to build on the success of and provide support for collaborative solutions identified by the Working Group and could support collaborative partnerships for other fixed-gear state-managed fisheries in addition to commercial and recreational Dungeness crab. The inclusion of this component will support the state in addressing fishery-specific questions for other state-managed fisheries known to be involved in entanglements, as well as to ensure that solutions for reducing entanglement risk across state-managed fisheries are collaboratively developed. Any collaborative partnership will be advanced in coordination with CDFW, the California Fish and Game Commission (FGC), NMFS, fishermen, and others, as appropriate.

[29] Working Group recommendation

Figure 1. California Dungeness Crab Fishing Gear Working Group member, Calder Deyerle, a commercial fishermen out of Moss Landing, demonstrates best practices for Dungeness crab fishing gear buoy set up with other members from the Working Group. Photo credit: R. Fisher

2. BEST AVAILABLE SCIENCE

Develop improved data streams and collaborative research to provide comprehensive information on key factors of entanglement risk across state-managed fisheries in order to inform adaptive risk mitigation.

Advancing the best available science is well aligned with Section 35510 (4) of the California Ocean Protection Act (COPA), which states that, "a goal of all state actions shall be to improve monitoring and data gathering, and advance scientific understanding, to continually improve efforts to protect, conserve, restore, and manage coastal waters and ocean ecosystems."

This component of the strategy aims to provide support, as appropriate, for priority collaborative research projects related to the work of the Working Group to implement the RAMP. Additionally, this component of the strategy is intended to be informative for mitigating entanglement risk across a range of fixed-gear state-managed fisheries. Improving understanding of how the various risk factors interact with each other to influence overall entanglement risk, and gathering information to refine the objectivity of risk assessment may provide an opportunity for consideration of more fine-scale management measures.

Developing the best available science can enhance adaptive risk mitigation. Through the Working Group, risk factors such as oceanographic and forage patterns, fishery dynamics, and whale and sea turtle population densities and spatial distribution were identified as key elements to inform fishermen and managers in tracking, assessing, and mitigating entanglement risk through a variety of management measures. These measures range from continuing to implement best fishing practices -- including keeping taut vertical lines and eliminating excess lines floating at the surface -- to adjusting or removing the amount of vertical lines in an area, or delay or area closures. The Working Group has implemented various collaborative pilot projects, such as electronic monitoring using a solar logger tool to provide enhanced information on fishery dynamics. Scientific experts have provided synthesized analyses of oceanographic and forage patterns, as well as whale and

sea turtle population densities and spatial distributions, to inform the Working Group's collaborative assessment of entanglement risk.

The Working Group's collaborative process and approach to assessing and mitigating risk based on best available science may serve as a model for other state-managed fisheries in analyzing and reducing the risk of entanglement in California fishing gear. Certain risk factors that the Working Group has identified may be applicable across a range state-managed fisheries. Fishery dynamics will likely be specific to each fishery. Improving the best available science for these risk factors is critical. The Working Group has identified a need for improved forecasting and near-real time monitoring to increase the collective ability of fishermen and managers to more adaptively mitigate risk within the Dungeness crab fishery. Improved predictive modeling will also be essential for informing entanglement risk mitigation in any other state-managed fisheries.

The importance of best available science for informing management decisions was highlighted in the Working Group's Guiding Principles for RAMP Management Measures,[30] which states that management measures will be fact-based, science driven, and proportional to elevated risk conditions; updated as new information becomes available; and narrowly focused in geographic area and timeframe, among other criteria such as ensuring fishermen's safety, enforceability, and minimizing economic impacts.

Accurately assessing risk at the time scales appropriate for management requires robust data inputs that are considered credible by scientists, managers, fishermen, conservation groups, and other stakeholders. These inputs inform risk assessment by predicting or indicating times and places where there may be significant overlap between fishing activity and whale or sea turtle occurrence, and risks of entanglements appear to be increased. Best available science can also be used to evaluate the efficacy of management measures in reducing entanglement risk, and ultimately to prevent or minimize entanglements. Through a combination of improved data streams, predictive tools and real-time observations, risk assessment and mitigation can become increasingly robust.

CRITICAL DATA

OCEANOGRAPHIC AND FORAGE PATTERNS

Oceanographic information is an important habitat indicator for forage species (e.g. anchovy, krill, jellyfish, etc.) – whale and sea turtle prey – and can indicate which species may be favored by whales and sea turtles, and where the forage species may be located off the California coast. Systematic monitoring, analysis and prediction of oceanographic patterns, such as El Niño or anomalous warm water events, and forage patterns can inform whale and sea turtle movement, population densities, and spatial distributions. Developing an improved understanding of the abundance and dynamics of different prey species throughout the year, or fishing seasons, combined with improved understanding of whale and sea turtle distribution and behavior in relation to the prey availability, will better inform adaptive management approaches across state-managed fisheries.

Prey is specific to the particular whale and sea turtle species; for example; Humpback whales prey switch between anchovies and krill; however, Blue whales depend on krill as their main food source. Gray whales primarily depend on invertebrates and feed on or near the seafloor.

[30] Working Group's Guiding Principles for RAMP Management Measures

Leatherback sea turtles primarily forage on jellyfish.[31] Assessment of oceanographic and forage patterns may be informed by data from vessel cruises and monitoring data from the National Oceanic and Atmospheric Administration. (NOAA). Combining data from observations with expansion and validation of ecosystem predictive modeling regarding prey distribution will improve risk assessment. The Working Group recommended improved predictive modeling of forage/ocean conditions to better understand predicted and current whale distribution patterns.[32] The Working Group also recommended to, "further define and quantify the objective criteria to guide the RAMP, expedite the process to analyze and share available data, and increase transparency within the fleet regarding how the evaluation of this risk factor is conducted."

Humpback whale, Gray whale, Blue whale, and Leatherback sea turtles have been identified as key species based on CDFW and NOAA Fisheries priorities, and based on NOAA West Coast Whale Entanglement Summaries as the species most often reported as entangled in fishing gear. Therefore, key forage for these species is a high priority for improved information streams. Data on additional whale and sea turtle species' prey may be important for further mitigation of entanglement risk.

A hatching Leatherback sea turtle. Photo credit: NOAA.

FISHERY DYNAMICS

Fishery dynamics includes any change in fishermen's behavior or movement patterns due to timing of a season opener, ocean conditions, alternative fishing opportunities, management measures, or other socioeconomic or environmental considerations. Improved fishery dynamics information such as enhanced understanding of spatial and temporal resolution of gear distribution and density will provide a foundational understanding of entanglement risk assessment and mitigation solutions. Additionally, any delays in fishing season opener(s) due to considerations such as crab quality, health and safety (e.g., toxic harmful algal blooms that result in elevated domoic acid levels), or markets may increase entanglement risk. More sustained toxic harmful algal blooms (e.g., elevated levels of domoic acid) may result in a delayed fishing season opener, which could increase the overlap with when whale species are present in higher densities. Developing an increased understanding of the relationship between occurrences of toxic harmful algal blooms, market delays and/or quality delays, and the extent of fishery closures that may occur will improve assessment of entanglement risk as it relates to fishery dynamics.

Aerial and vessel surveys have been the primary tool used to provide snapshots of fishing effort in the Dungeness crab fishery to date. However, fishing patterns can be highly dynamic and innovative tools and technology have the potential to provide more information on finer-scale gear locations and movement patterns over a broader spatial scale. The Working Group has conducted

[31] NOAA Species Directory
[32] Working Group recommendation

collaborative research projects to gain a more comprehensive understanding of fishing dynamics, while ensuring fishermen's data and privacy is protected, specifically through a solar logger pilot project (see Section IV for additional details). A refined understanding of whether a fleet-wide or representative subset of a fleet's fishing effort distribution and density is needed for risk assessment and mitigation will inform cost-effectiveness, management decisions, and harvesters' business planning considerations.

Improving fishery dynamics information will depend on a collaborative approach between fishermen and managers, as fishermen's expertise is essential in informing this factor.

WHALE AND SEA TURTLE POPULATION DENSITIES & DISTRIBUTIONS

Fishing activity, whales and sea turtles often co-occur without resulting in entanglement; however, entanglement risk is considered to increase as the overlap between fishing activity and population densities of whales or sea turtles increases. Systematic monitoring and analysis, as well as improved prediction of whale and sea turtle population densities, spatial distribution and behavior, will result in enhanced accuracy of entanglement risk assessment and mitigation.

Humpback whales are frequent visitors to the California coast. Photo credit: NOAA, MMHSRP Permit# 18786.

The Working Group identified improving the whale and sea turtle population densities and spatial and temporal distributions factor as a priority for assessing and mitigating risk. Additional key informational needs include verifiable data that improves understanding of whale and sea turtle movement and migration in relation to other risk factors; synthesis of available data sets to improve upon predictions of whale distributions in response to ecosystem variables; as well as whale behavior studies in the presence of fishing gear. Community science data, such as that collected by whale watching boats, may help inform population densities and distributions. The Working Group recommended synthesis of available whale watch data and comparison of this information with other whale sighting datasets to evaluate the utility of whale watch data in informing risk assessment and mitigation.[33] Improved fine-scale information on whale and sea turtle population densities and distribution can inform spatial and temporal scales of potential mitigation measures. As this data will be informative across other state-managed fisheries that may interact with whale and sea turtle species, it is important to develop this information from an annual or species-specific perspective to inform the management of fisheries other than Dungeness Crab.

[33] Working Group recommendation

NOAA Fisheries is partnering with the Bureau of Ocean Energy Management for a pilot study assessing the efficacy of using passive acoustic monitoring (Drifting Acoustic Spar Buoy Recorders) to quantify the spatial distribution and population densities of nearby whales. If scaled, this approach may provide informative data on whale population densities and distributions.

TRANSPARENT & CENTRALIZED PLATFORM FOR INFORMATION SHARING
Incorporating best available science into a newly developed or existing centralized online platform may help support information sharing and decision-support processes. This also may allow for more streamlined, and continually updated data streams informing fisheries managers and fishermen of the level of entanglement risk. This platform, in conjunction with existing resources, could also serve to support outreach and response efforts to further reduce the risk of entanglement.

This component aligns with a requirement in COPA for OPC to, "support public agencies' collaborative management and use of scientific and geospatial information relevant to ecosystem-based management," as well as to "help identify decision-support tools relevant to ecosystem-based management, and, where appropriate, support the adaptation of those tools or the creation of new tools to serve the state's needs," (Section 35620(3-4)).

3. GEAR INNOVATION

Support innovative research and development of fishing gear modifications that would reduce entanglement risk while allowing for safe, efficient, enforceable, and cost-effective harvesting operations with minimal adverse impacts to marine ecosystems.

Reducing the risk of entanglement in fishing gear may be achieved through collaborative research and pilot projects to test gear modifications and technology solutions to decrease interactions with whales and sea turtles and/or to improve the response of certified disentanglement teams. Entanglement curtailment must be achieved while maintaining the efficiency, productivity, and safety of current fishing practices. Supporting gear innovation is consistent with two previous OPC resolutions in 2006 and 2013 which highlight the importance of advancing innovative approaches to sustainable fisheries, supporting cooperative research, and promoting economic opportunities in fishing communities.[34,35] This component of the strategy is well aligned with COPA, particularly advancing, "collaborative research and demonstration projects between fishery participants, scientists, and other interested parties," (Section 35650(C)(iii)).

NOAA Fisheries and the Pacific States Marine Fisheries Commission (PSMFC) convened fishermen, entanglement responders, scientists and managers to conduct "forensic review and analysis"[36] to improve collective understanding of the common characteristics of whale entanglements in fixed-gear fisheries, including Dungeness crab gear. Ongoing efforts to conduct forensic review and analysis may help inform potential gear innovations and modifications to mitigate entanglement risk across fixed-gear fisheries.

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[34] OPC Resolution 2006
[35] OPC Resolution 2013
[36] Forensic review and analysis means an "organized evaluation of various characteristics of entanglement reports from individual case studies, including the type of gear involved, the nature of how that gear is entangled on or around a whale, and what additional information can be gleaned from the available documentation to better understand the origins of entanglements and how they can progress over time."

It is likely that gear innovation will need to be fishery-specific; however, there may be opportunities to leverage applicable lessons learned across state-managed fisheries. Additionally, California seeks to leverage lessons learned from other U.S. states and regions around the world addressing similar entanglement issues. It is important that gear innovation testing or pilot projects abide by collaboratively identified guiding criteria to ensure the safety of testing participants, and to reduce adverse impact to marine ecosystems. For example, the Working Group has developed Guidelines for Research and Development Projects,[37] with a focus on "pop-up" fishing gear. These guidelines are intended to inform at-sea testing of technologies or pilot projects, and the criteria are as follows: enforceable, economical, fishable, reliable, safe, and minimizes adverse impacts on marine life. CDFW provided additional guidance for testing trap gear modifications,[38] with a priority on enforceability and minimizing impacts to marine life. This guidance states that, "prior to widespread adoption, or mandatory use, of any fishing gear modifications, additional testing and refinement must be conducted." This guidance outlines how testing may be incorporated as modification into legal fishing gear in both commercial and recreational fisheries. It also states that new or innovative gears, including "pop-up" gear, can only be tested under certain conditions.

In addition, Fish and Game Code Section 1022,[39] as added through AB 1573 (Bloom, 2018), allows FGC to authorize experimental fishing permits for "research, educational, limited testing, data collection, compensation fishing, conservation engineering, or exploratory fishing" which could facilitate gear innovation testing onboard fishing vessels. CDFW is developing a programmatic rulemaking for an experimental fishing permit program pursuant to Fish and Game Code Section 1022.

Encouraging gear innovations that abide by collaboratively identified guidelines to reduce entanglement risk is a priority supported by the Working Group in their Recommendations Memo.[40] Any testing advanced in subsequent years must be in alignment with ongoing CDFW guidance and protocols. Gear innovation for state-managed fisheries other than Dungeness crab would need to abide by similar collaboratively developed guidelines to ensure safe, efficient, enforceable, and cost-effective harvesting operations with minimal adverse impacts to marine ecosystems.

4. RESPONSE & OUTREACH

Conduct outreach and improved entanglement monitoring, documentation, analysis and response efforts.

Observed and reported entanglements provide important information on current and future risk of entanglement, as well as the origins and causes of entanglements. Details on current response and outreach efforts are provided below. Additional initiatives to support entanglement prevention and response efforts may include but are not limited to disentanglement trainings; improved monitoring for entanglements and the overall effectiveness of any entanglement mitigation measures, enhanced documentation and response efforts; and outreach to other state-managed fisheries. These activities may provide a better understanding of entanglement occurrence and resolution as well as contribute to reducing overall risk of entanglement in California fishing gear.

[37] Guidelines for Research and Development Projects
[38] CDFW additional guidance for testing trap gear modifications
[39] Fish and Game Code Section 1022
[40] Recommendations Memo

Response

In the case that a whale is unintentionally entangled, expert first responders, who are authorized under a permit held by NOAA Fisheries' Marine Mammal Health and Stranding Response Program (MMHSRP), will respond and approach the whale to attempt disentanglement. These responders operate as part of the West Coast Large Whale Entanglement Response Network[41] which is overseen by NOAA West Coast Region's Protected Resources Division. In the case that a sea turtle is unintentionally entangled, a Large Whale Entanglement Response Team or a member of NOAA's West Coast Region's Marine Mammal and Sea Turtle Stranding Network may respond.[42]

The West Coast Large Whale Entanglement responders participate in comprehensive training and apprenticeship to use appropriate techniques and abide by protocols to ensure their personal safety and the safety of the animals. In February 2019, NOAA Fisheries and TNC partnered to produce an online training course[43] for recreational and commercial boaters to provide guidance on how to respond to an entangled whale. The course serves as an introduction to the entanglement response program and includes an overview on how to identify whale species, observe whale behavior, and assess and document the entanglement through photographs and videos. While additional, extensive training is required to operate as part of the Large Whale Entanglement Response Network teams, this online course expands the knowledge of boaters on the water and increases the standardization of monitoring and entanglement documentation.

Trained disentanglement response team. Photo: NOAA, MMHSRP Permit# 18786-03.

Outreach

Conducting outreach to the fishing industry, state and federal fishery managers, other ocean users and the public to increase awareness of the issue, promote collaborative development of solutions to mitigate entanglement risk, and improve entanglement reporting is essential to addressing whale and sea turtle entanglement.[44] Supporting outreach on how, where and what to include when reporting entanglements, in addition to where to access outreach and reporting information will facilitate improved entanglement documentation and response efforts. NOAA Fisheries states that

[41] West Coast Large Whale Entanglement Response Network
[42] NOAA
[43] Online Training Course
[44] NOAA Outreach

prompt reporting is the best way to help entangled whales.[45] To report an entanglement, the public should immediately call the NOAA Fisheries response hotline or hail the United States Coast Guard on Channel 16 and provide the date, time, location, of the entanglement, and take a photograph, if possible. Members of the public reporting an entanglement should standby for responders while maintaining a distance of 100 yards to ensure personal safety and the safety of the marine life, and should not attempt to disentangle the whale or sea turtle.

III. BACKGROUND: PROTECTING WHALES AND SEA TURTLES IN CALIFORNIA'S OCEAN WATERS

The National Oceanic and Atmospheric Administration, the Endangered Species Act & the Marine Mammal Protection Act

Over 30 species of marine mammals inhabit the oceans waters off of the California, Oregon, and Washington coasts. NOAA works to protect whale and sea turtle species populations, conduct research on their health and habitat, and evaluate and monitor human activities that might affect them.[46] NOAA shares responsibility with the United States Fish and Wildlife Service (USFWS) for implementing the Endangered Species Act (ESA). NOAA also shares responsibility with USFWS and the Marine Mammal Commission for implementing the Marine Mammal Protection Act (MMPA). NOAA Fisheries has listed 22 species of marine mammals under the ESA, including ten endangered[47] and/or threatened[48] cetacean species.[49,50] West Coast waters also support five species of endangered and/or threatened sea turtles. Both whales and sea turtles, depending on the specific species and its distinct population segment,[51] migrate from foraging areas to breeding areas or nesting beaches, respectively, and may travel hundreds or thousands of miles each way.[52] The five species of sea turtles off the California coast are protected by the ESA. All whale species are protected by the MMPA, and some are protected by both the MMPA and ESA.

California Fisheries Management & the Marine Life Management Act

California supports thriving commercial and recreational fisheries from Crescent City to San Diego. The overall California ocean economy represents $44.2 billion, or 2%, of California's gross domestic product (GDP), spanning tourism, recreation, commercial and recreational fishing, shipping, and other industries. Within commercial fisheries in 2014, California fishermen landed 358 million pounds of fish and shellfish for which they were paid $235 million. Within recreational fisheries in 2011, a USFWS survey reported 775,000 saltwater anglers in California, representing

[45] NOAA Fisheries
[46] NOAA Fisheries: Protecting Marine Life
[47] Under the federal Endangered Species Act, "endangered" means if it is in danger of extinction throughout all or a significant portion of its range. NOAA Glossary: Endangered Species Act
[48] Under the Endangered Species Act, "threatened" means if it is likely to become endangered in the foreseeable future throughout all or a significant portion of its range. NOAA Glossary: Endangered Species Act
[49] NOAA: Marine Mammals on the West Coast
[50] NOAA Species Directory: ESA Endangered & Threatened, West Coast
[51] "Distinct Population Segment" as defined under the Endangered Species Act means a vertebrate population or group of populations that is discrete from other populations of the species and significant in relation to the entire species. The ESA provides for listing species, subspecies, or distinct population segments of vertebrate species. NOAA Glossary: Endangered Species Act
[52] NOAA Species Directory: ESA Endangered & Threatened, West Coast

almost 7.2 million fishing days. Saltwater recreational fisheries provided 12,134 jobs and over $1.7 billion in revenue in California in 2012, according to NOAA's *Fisheries Economics of the United States* report.[53] While there are hundreds of marine species under state jurisdiction, 36 finfish and invertebrate species that are the target of 45 distinct fisheries[54] represent the majority of commercial landings value, as well as commercial and recreational participation.[55] The Marine Life Management Act (MLMA) applies to all marine wildlife and is California's primary fisheries management law, including goals for conserving entire ecosystems, non-consumptive values, sustainability, habitat conservation, restoration, bycatch and fishing communities.[56] Depending on the species, management may involve the California State Legislature, FGC and/or CDFW.

Increase in Confirmed Fishing Gear Entanglement Reports on the West Coast in Recent Years
In recent years, there has been an increase in the number of confirmed reports of entanglement in fishing gear on the West Coast since NOAA Fisheries started keeping records in 1982.[57] Entanglements have been reported off the coasts of California, Oregon and Washington. It's important to note that entanglement report locations may not reflect where the entanglement initially occurred. Entanglement reports are from a variety of opportunistic sightings from sources including boaters, fishermen, law enforcement, marine resources agencies, and the public, and likely underestimate the total number of entanglements.[58,59] Related initiatives reiterate the importance of addressing marine debris and lost or abandoned fishing gear, such as the 2018 California Ocean Litter Prevention Strategy goal three, "to reduce debris from fishing and aquaculture-related activities in the ocean,"[60] as well as CDFW's Trap Gear Retrieval Program for Dungeness crab traps which is discussed in more detail in Section IV.

NOAA West Coast Entanglement Summary Reports
Since 2016, NOAA Fisheries West Coast Region has been publishing an annual summary of West Coast entanglement reports.[61] NOAA includes both confirmed and unconfirmed entanglement reports, where reports are confirmed based on a set of criteria.[62,63] In 2018, the majority of the confirmed reports involved live whales. NOAA Fisheries includes additional details regarding

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[53] Guide to California's Marine Life Management Act, Second Edition
[54] The 45 fisheries include specific gear types targeting a single species.
[55] 2018 Master Plan for Fisheries: A Guide for Implementing the Marine Life Management Act
[56] California Department of Fish and Wildlife: Marine Life Management Act
[57] NOAA West Coast Large Whale Entanglement Response Program
[58] Forensic Review Workshop Report: Reviewing the Gear Involved in West Coast Entanglements; Appendix B (August 2018)
[59] 2015 Whale Entanglements off the West Coast (NOAA); 2016 West Coast Whale Entanglement Summary; 2017 West Coast Whale Entanglement Summary; 2018 West Coast Whale Entanglement Summary
[60] 2018 California Ocean Litter Prevention Strategy
[61] 2015 Whale Entanglements off the West Coast (NOAA); 2016 West Coast Whale Entanglement Summary; 2017 West Coast Whale Entanglement Summary; 2018 West Coast Whale Entanglement Summary
[62] "Criteria used to deem a report "confirmed" include:
• Photos or video of the gear on the whale.
• NOAA Fisheries staff has direct visual observation.
• The report came from a trusted source (trained or professional reporting party).
• An experienced member of our West Coast Region Marine Mammal Stranding Network or NOAA Fisheries expert interviewed the reporting party and the information provided is detailed and specific enough to confirm entanglement.
• Multiple sources providing reports with detailed descriptions of the animal and the entanglement."
[63] 2018 West Coast Whale Entanglement Summary

entanglement response and outcomes in the annual summary report. Figure 2 depicts confirmed United States West Coast whale entanglements by year and species from 2000 to 2018. Between 2000 and 2018, there were 345 confirmed reports of entangled whales, including 192 Humpback whales, 110 Gray whales, 7 Blue whales, and 36 whales that were either unidentified whales or whale species other than Humpback, Gray, or Blue whales.[64] There was an increase in confirmed reports particularly since 2015.

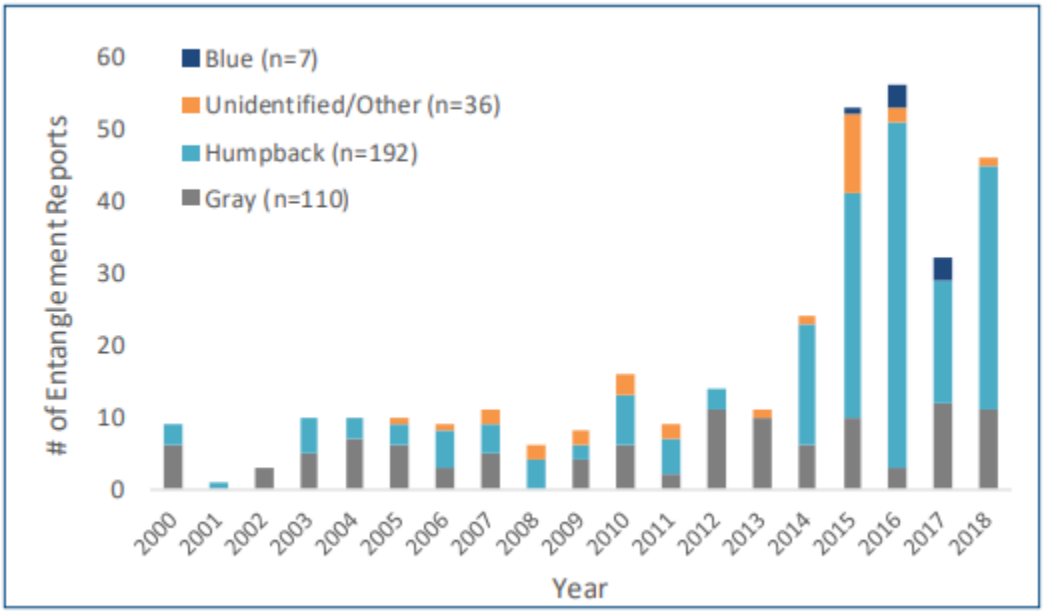

Figure 2. Confirmed United States West Coast whale entanglements by year and species from 2000 to 2018, where n represents the number of total species confirmed entanglements in the 19-year period. Grey bars indicate confirmed Gray whale entanglements; teal bars indicate Humpback whales, navy blue bars indicate Blue whales, and orange bars indicate unidentified whales or whale species other than Gray, Humpback or Blue whales. Source: NOAA 2018 West Coast Whale Entanglement Summary report.

Blue whales and the Western North Pacific distinct population segment of Gray whales occur on the West Coast and are listed as endangered under the ESA. Three distinct population segments of Humpback whales (Central America, Western North Pacific, and Mexico) occur on the West Coast and are listed as endangered under the ESA.[65] NOAA Fisheries published a proposed rule to designate critical habitat for the three distinct population segments of Humpback whales under the ESA on October 9, 2019. Areas proposed as critical habitat include marine areas off of the California, Oregon, Washington and Alaska coasts. Public hearings on this proposed rule will be held in 2019.[66]

NOAA Fisheries also includes information regarding confirmed and unconfirmed reports by month and species, as well as confirmed sources of entanglement, and geographic location of entanglement reports in the annual West Coast whale entanglement summary report.

[64] 2018 West Coast Whale Entanglement Summary
[65] NOAA Species Directory: ESA Endangered & Threatened, West Coast
[66] Federal Register: Proposed Rule to Designate Critical Habitat and Public Hearings

Origins of Entanglement on the West Coast

Improved documentation and increasing response has increased NOAA Fisheries' ability to identify gear involved in entanglements; however, the source of entangling gear is unknown for the majority of whale entanglement reports.[67] From 2015 to 2017, 67 out of 129 -- or 52% -- of confirmed entanglement reports involved gear of unknown origin.[68] In 2018, 24 of 46 confirmed reports on the West Coast were identified as associated with a specific fisheries or gear type.[69] When the source of entangling gear is known, the majority is identified as originating from fixed-gear fisheries.[70,71] Figure 3 depicts the origins of entangling gear from 2013 to 2018 for West Coast confirmed reports.[72]

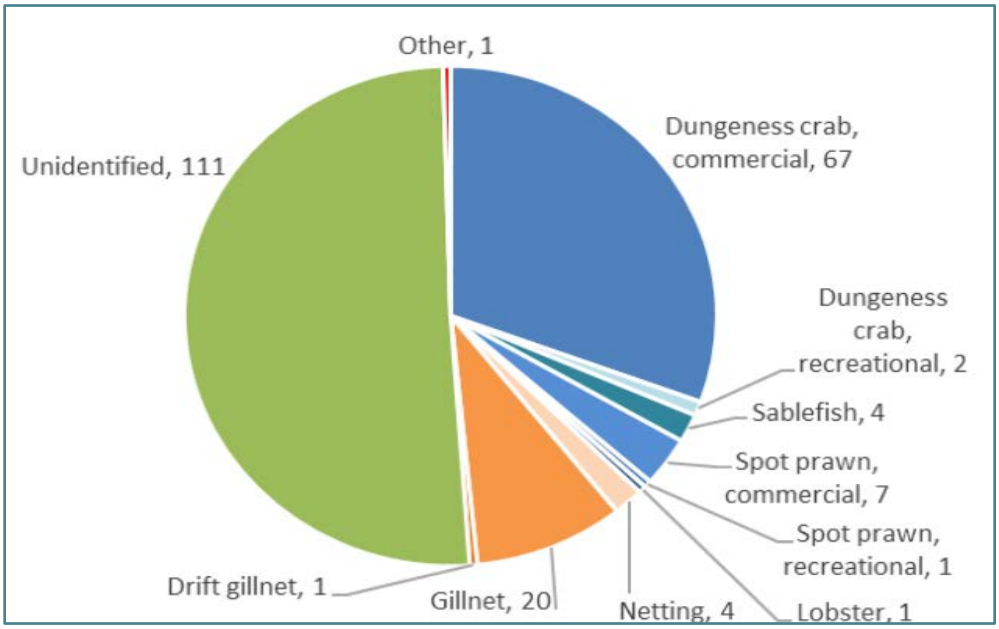

Figure 3. Origins of entanglement from 2013-2018 for West Coast confirmed entanglement reports. Source: NOAA: Entanglements of Large Whales along the US West Coast (September, 2019)

From 2013 to 2018, when the source of entangling gear is identifiable, the majority of West Coast entanglement reports involve the commercial Dungeness crab fisheries in California, Oregon and Washington. In California, commercial Dungeness crab gear has required gear marking which facilitates its identification when involved in entanglement reports. The Working Group was convened in 2015 to collaboratively reduce the risk of entanglement in commercial and recreational California Dungeness crab fishing gear. In their January 2018 Memo,[73] the Working Group recommended that, "CDFW and the Pacific Fishery Management Council, in partnership with the Legislature, work with other fixed-gear fisheries and fisheries known to be involved in whale entanglements to establish standardized gear marking" for all California fixed-gear fisheries in order to decrease the number of unidentified gear types involved in entanglements and to

[67] Forensic Review Workshop Report: Reviewing the Gear Involved in West Coast Entanglements; Appendix B (August 2018)
[68] NOAA West Coast Large Whale Entanglement Response Program
[69] 2018 West Coast Whale Entanglement Summary
[70] NOAA: Entanglements of Large Whales along the US West Coast (September 2019)
[71] Forensic Review Workshop Report: Reviewing the Gear Involved in West Coast Entanglements; Appendix B (August 2018)
[72] NOAA: Entanglements of Large Whales along the US West Coast (September 2019)
[73] January 2018 Memo

encourage implementation of collaborative solutions to reduce risk of entanglement in other fixed-gear fisheries. Additionally, in their October 2018 Memo,[74] the Working Group recommended, "CDFW work with other fixed-gear fisheries (both commercial and recreational) to address the complex issue of wildlife entanglements," including support for sharing information and lessons learned. See Section IV for additional information specific to the Working Group.

Figure 3 depicts other West Coast fisheries and fishing gear types involved in entanglements, when identifiable, include sablefish, commercial and recreational spot prawn, lobster, gillnet, and drift gillnet, as well as netting and one other origin. NOAA Fisheries *Fixed Gear Guide* provides detailed information on California, Oregon, and Washington commercial fisheries gear, including trap/pot, gillnet, and longline/set line.[75]

Sea Turtle Entanglement Reports
Entanglement reports involving sea turtles on the West Coast are limited. Globally, Leatherback sea turtles, which are listed as endangered under the ESA, are threatened by fisheries bycatch, egg predation, egg harvesting, and beach erosion. Leatherback sea turtles are present off of the California coast primarily from May through November. Regarding confirmed fishery-related entanglement in California, one Leatherback was confirmed as dead in unidentified fixed gear in September 2015; one Leatherback was released alive from California Dungeness crab gear by a fisherman in April 2016,[76] and one Leatherback was confirmed as dead in unidentified fishing gear in October 2019.

IV. CALIFORNIA DUNGENESS CRAB FISHING GEAR WORKING GROUP & THE RISK ASSESSMENT AND MITIGATION PROGRAM

THE FORMATION OF THE DUNGENESS CRAB FISHING GEAR WORKING GROUP

The Working Group supports thriving whale and sea turtle populations and a thriving and profitable Dungeness crab fishery. The Working Group was convened by CDFW in partnership with OPC and NMFS in September 2015 in response to an increase in the number of confirmed whale entanglements in recent years. This 25-member, multidisciplinary group includes commercial and recreational Dungeness crab fishermen, environmental organization representatives, members of the disentanglement network, and state and federal agencies. Scientists, legislative staff, and expert advisors further support and inform Working Group discussions. OPC and TNC have partnered to fund the Working Group's operations and information gathering efforts since its inception.

The Working Group's role is to collaboratively develop strategies to reduce the risk of entanglement in Dungeness crab fishing gear. The Working Group provides guidance and makes recommendations to the state of California (CDFW, OPC, FGC and the Legislature), federal agencies (NMFS, United States Coast Guard (USGC)), and the Dungeness crab fishing industry, including the Dungeness Crab Task Force (DCTF), regarding how to avoid or minimize entanglements. The Working Group developed a RAMP to assess circumstances where

[74] October 2018 Memo
[75] NOAA West Coast Fixed Gear Guide (2011)
[76] Biology of Leatherback Turtles off California: Movements, Foraging Ecology, Abundance and Status (Benson, April 2019)

entanglement risk may be elevated and, as needed, identify potential management measures for the CDFW Director's consideration. Working Group members also provide their peers, interest groups, and/or organizations with information about the Working Group process, discussions, and recommendations. Oregon and Washington have convened similar Dungeness crab working groups to address the recent increase in entanglement reports and discuss potential solutions to the problem.

DUNGENESS CRAB FISHING GEAR WORKING GROUP PRODUCTS & OUTCOMES

Best Fishing Practices Guide

The Working Group has developed valuable products, including a best fishing practices guide which is updated annually for each fishing season, and numerous recommendations memos to the state of California. The Working Group's 2019-2020 Best Practices Guide[77] was developed as part of a comprehensive approach to minimize whale and sea turtle entanglements in Dungeness crab fishing gear. The Best Practices Guide highlights important actions such as keeping the line between the crab pot and main buoy taut and vertical, reducing slack surface line, and retrieving lost or abandoned crab pots. The guide also includes information on how to immediately report entanglements to NMFS and USGC. Taking these important steps will help maintain the Dungeness crab fleet's access to this valuable marine resource as well as protect whales and sea turtles.

Surface Gear Limitations

CDFW advanced a rulemaking to limit the amount of surface line and buoys from Dungeness crab traps and improve the ability to remove possible whale entangling gear from the ocean. This surface gear rulemaking[78] was informed by the voluntary Best Practices Guides that were in place during the 2016-17 and 2017-18 Dungeness crab fishing seasons. These regulations to limit Dungeness crab trap surface gear and clarify the end of season gear removal time, became effective on October 30, 2018.

Dungeness crab are one of the top three fisheries in terms of both landings and value in California. Photo: NOAA National Marine Sanctuaries.

Lost or Abandoned Trap Gear Retrieval Program

Additionally, the Working Group has made specific recommendations that have resulted in important regulatory and management changes. In their October 2016 Memo,[79] the Working Group supported "the efforts by the DCTF and CDFW to design and implement [a statewide lost fishing gear recovery] program as an important step towards reducing the risk of whale entanglements in lost Dungeness crab fishing gear." SB 1287 (McGuire, 2016), with revised and recast provisions via SB 1309 (McGuire, 2018), amends Fish and Game Code Section 9002 to require CDFW, in consultation with the DCTF, to establish a retrieval program to provide for the retrieval of lost or abandoned commercial Dungeness crab traps by June 30, 2019. CDFW's Trap Gear Retrieval

[77] 2019-2020 Best Practices Guide
[78] CDFW: Surface Gear Rulemaking
[79] October 2016 Memo

Program[80] (Section 132.7, Title 14, California Code of Regulations) was effective as of September 20, 2019 and will be in force for the 2019-20 commercial Dungeness crab fishing season. The Trap Gear Retrieval Program creates a program under which qualified individuals can retrieve lost or abandoned commercial Dungeness crab traps, and the accompanying surface lines and buoys, and be reimbursed for costs incurred during retrieval operations. The program permits a broader range of individuals to retrieve trap gear, which reduces the risk of whale entanglement with lost or abandoned trap gear as well as removes the navigational and aesthetic impacts of persistent marine debris.

Standardized Commercial Trap Marking
In their January 2018 Memo,[81] the Working Group recommended that managers, in partnership with the Legislature, work with other fixed-gear fisheries and fisheries known to be involved in whale entanglements to establish standardized gear marking for all California fixed-gear fisheries. SB 1309 (McGuire, 2018) amended Fish and Game Code Section 9005 to direct CDFW to implement regulations by January 1, 2020, to require standardized gear marking such that every trap or string of traps be marked with a buoy for those fisheries which CDFW determines it is appropriate. In June 2019, CDFW published a notice[82] of this proposed rulemaking regarding standardized gear marking, stating that the "goal of this program is to establish a standardized framework for marking commercial fishing gear to better identify the commercial trap fisheries involved in marine life entanglement events." Additional information regarding the status of this rulemaking is available on the CDFW Standardized Commercial Trap Marking webpage.[83]

Collaborative Research Projects
In addition to developing effective communications materials like the Best Practices Guide and recommendations memos, the Working Group has supported the implementation of collaborative projects to collect new information and synthesize existing information to enhance understanding of whale distribution and fishing dynamics, and test gear modifications. Collaborative projects have included aerial and vessel surveys to document the distribution of whales and crab fishing gear and testing electronic reporting tools — including eCatch and solar loggers — to gain a more comprehensive understanding of fishing dynamics, among others. Working group members have also participated in related initiatives such as Bycatch Reduction Engineering Program projects, disentanglement trainings, and forensic review of confirmed entanglements to improve understanding of entanglement origins as well as understanding of gear configurations involved in entanglements and how configurations affect entanglement. Collaborative research projects are intended to inform the four priority risk factor data streams of the RAMP.

RISK ASSESSMENT AND MITIGATION PROGRAM (RAMP)

The RAMP includes four priority factors—forage/ocean conditions, whale concentrations, fishing dynamics, and number of entanglements. The working group piloted a draft RAMP during the 2017-2018 Dungeness crab fishing season in California to support the state in working with experts — agencies, fishermen, researchers, representatives from environmental organizations, and others — to identify and assess elevated levels of entanglement risk, explore information needs, and determine the need for voluntary and/or mandatory management measures that could be recommended to CDFW. The Working Group continued to utilize and refine the RAMP during the

[80] CDFW: Trap Gear Retrieval Program
[81] January 2018 Memo
[82] CDFW Notice
[83] CDFW: Standardized Commercial Trap Marking webpage

beginning of the 2018-2019 Dungeness crab fishing season. The RAMP's whale density and distribution factor initially focused on Humpback whales and has since broadened to include other marine life including Blue whales and Leatherback sea turtles, based on the best available scientific information to inform risk assessment. The RAMP provides a collaboratively developed risk assessment and mitigation tool and framework which can inform adaptive management of California's marine resources when advanced through a partnership-based approach with the Working Group.

SB 1309 (McGuire, 2018) codified the Working Group and RAMP in Fish and Game Code Section 8276.1, as well as required CDFW, in consultation with the Working Group and other stakeholders, to adopt regulations, including but not limited to the risk assessment and mitigation program, establishing criteria and protocols to evaluate and respond to the potential risk of marine life entanglement by November 1, 2020. SB 1309 (McGuire, 2018) also provided authority to the CDFW Director to restrict the take of Dungeness crab in a timely manner— and lift any restrictions in a similar manner once significant risk has abated—in areas where the fishery is posing significant risk of marine life entanglement, as determined in consultation with the Working Group. CDFW is currently developing regulations to codify the RAMP. More information is available on the California Department of Fish and Wildlife's Whale Safe Fisheries webpage.[84] The RAMP developed by the Working Group is intended to guide this regulatory process being advanced by CDFW.

V. CONCLUSION & NEXT STEPS

This strategy provides a comprehensive approach for reducing the risk of entanglement in fishing gear. OPC is partnering closely with CDFW, FGC, and NMFS to ensure that this strategy can be effectively implemented in alignment with California management priorities. All components of this strategy will be advanced in coordination with these state and federal agencies, along with fishermen and other partners, as appropriate. OPC also will continue to support and collaborate with the Working Group.

OPC staff plans to advance a competitive request for proposals process in 2020 to solicit projects that improve data streams for enhanced adaptive risk management, consistent with the best available science component of this strategy. OPC staff will also develop projects related to the collaborative partnerships, gear innovation and response and outreach components of this strategy for Council consideration of approval.

Reducing the risk of whale and sea turtle entanglement in fishing gear is important to ensure marine conservation of these species on a global scale. Simultaneously, ensuring thriving commercial and recreational fisheries is essential for providing locally-caught seafood, supporting coastal economies, and maintaining California's marine identity and coastal heritage of working waterfronts and sustainable fishing communities. Collaborative implementation of this strategy will support vibrant marine ecosystems that support California's unique biodiversity and sustainable fisheries.

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[84] CDFW: Whale Safe Fisheries webpage