Appendix C: Risk Assessment and Mitigation Program Operations

This appendix contains additional details about the Risk Assessment and Mitigation Program (RAMP) including the schedule of risk assessments each season, explanations of the management considerations, and the aerial survey protocol to inform management decisions.

E.1 Enabling Statute and Regulatory Framework

The Working Group first piloted a version of the RAMP during the 2017-18 fishing season. Initially, any changes in fishery operations due to elevated entanglement risk were made voluntarily by the fishing fleet, with no metrics for CDFW to directly assess industry adherence to Working Group guidance.

In addition to granting interim authority to implement in-season management measures, Fish & G. Code § 8276.1 directed CDFW, in consultation with the Working Group, to adopt regulations formalizing the RAMP. CDFW released proposed regulations (Cal. Code Regs., Tit. 14 § 132.8) for public comment on May 15, 2020, and subsequently adopted the final language on October 19, 2020, with an effective date of November 1, 2020.

Under the 2018 MLMA Master Plan, CDFW defines best available science as that which is relevant, inclusive, objective, open, and timely. CDFW uses these standards when determining whether information should be considered as best available science. The Working Group plays a key role in RAMP implementation by independently evaluating available data and recommending management actions to the CDFW Director based on the Working Group members' relevant expertise.

E.2 Evaluating Risk: Confirmed Entanglements

An entanglement of a Covered Species confirmed in California commercial Dungeness crab gear (reported from any location) or Unknown Fishing Gear (reported within the Plan Area) is considered an indicator of elevated risk. Entanglements reported in unidentified gear are classified as Unknown Fishing Gear if available documentation indicated the gear could have originated from the California commercial Dungeness crab fishery. Unlike thresholds related Marine Life Concentrations, which forecast future risk based on potential overlap with the Covered Activities, confirmed entanglements in California commercial Dungeness crab gear indicate overlap has occurred and management actions are needed to prevent additional entanglements.

CDFW has therefore assigned the following Impact Scores, with pre-determined measures taken following attainment of specified cumulative total Impact Scores:

- Humpback whales

    - Confirmed entanglement in California commercial Dungeness crab gear = 0.75
    - Confirmed entanglement in California commercial Dungeness crab gear, deceased = 1
    - Confirmed entanglement in Unknown Fishing Gear = 0.38
    - Confirmed entanglement in Unknown Fishing Gear, deceased = 0.5
- Blue whales and leatherback sea turtles
    - Confirmed entanglement in California commercial Dungeness crab gear = 1
    - Confirmed entanglement in Unknown Fishing Gear = 0.5

As of the time of writing, pending regulation updates may change the numerical value of these scores, however confirmed entanglements still represent an indication of elevated entanglement risk.

E.3 Management Considerations

CDFW implements management actions which reduce marine life entanglement risk within portions of the fishing grounds where Covered Species presence exceeds the thresholds defined in in the RAMP regulations. However, evaluating marine life entanglement risk requires a dynamic, flexible approach rather than relying on historical patterns alone.

Therefore, following the attainment of a Marine Life Concentration trigger (and in most cases, following attainment of a Confirmed Entanglement trigger), the Director implements a management response based on the best available science and will, to the maximum extent possible, rely on relevant and publicly available information. The types of information that can be considered include a Working Group recommendation, information from NMFS, management measure effectiveness, total economic impacts, historical migration patterns, fishing season dynamics, forage, ocean conditions, and cumulative confirmed entanglements. Further details regarding the current management considerations and those that were utilized prior are provided in the following sections.

3.1 Working Group Recommendation

The Working Group and its Advisors are comprised of individuals who have expertise regarding the Covered Activities, oceanography, and Covered Species. As such, their input is critical to informing the Director when selecting and implementing appropriate management actions. Once CDFW determines a trigger has been met, at least 24-hours' notice is provided to the Working Group and public prior to the Director's final determination. CDFW then convenes the Working Group to discuss available data and solicit its management recommendation(s). Soliciting feedback from the Working Group provides an opportunity to reflect on management strategies, share findings, and modify management recommendations as necessary. The specific process by which the Working Group arrives at its recommendation(s) is specified in its most recent charter, available on CDFW's Whale Safe Fisheries webpage, and not described in detail here. However, the Working Group generally strives to make recommendations

by consensus that reflect expert input from its Advisors as well as the full range of stakeholders represented on the Working Group. All Working Group recommendations are carefully evaluated by the Director, particularly those which are made by consensus and firmly grounded in best available science related to the other management considerations described below.

During the 2020-21 through 2024-25 fishing seasons, CDFW prepared and shared interim documents which conveyed MR staff's initial evaluation of entanglement risk and preliminary recommendation regarding appropriate management actions prior to meeting with the Working Group. The intention of producing this document was to increase transparency and focus the Working Group's discussion and recommendations on suitable options. Following the Working Group's meeting, CDFW prepared an additional interim document which conveyed MR staff's final evaluation of entanglement risk and recommendation regarding appropriate management actions. This document was an opportunity for MR staff to convey updated thinking and additional information which would inform the Director's decision. In the event the Working Group elected not to produce a formal recommendation memo, this document also provided a way to capture Working Group input for the Director's consideration. The process of soliciting input from the Working Group represents a key step in an adaptive management – sharing recommendations and modifying management actions if necessary.

3.2 Information from NOAA

CDFW may consult with NOAA to determine the need for or effectiveness of a specific management action, given their subject matter expertise regarding Covered Species and management authority under the ESA and MMPA. Consultation will occur with WCRO, Protected Resources Division (PRD), or other units within NOAA as appropriate. Any recommendations will be considered when selecting a management action.

3.3 Management Measure Effectiveness

The RAMP regulations require CDFW to consider the effectiveness of a given management measure, but do not specify a particular method for doing so. This allows CDFW to continually review and incorporate the best available science related to this aspect of the RAMP.

A basic premise of the measures described in Chapter 5, including the RAMP, is that co-occurrence of vertical lines and Covered Species is an appropriate measure of, and proportional to, entanglement risk. Given this assumption, when evaluating management measure effectiveness, the fundamental question is whether it will meaningfully reduce co-occurrence. This is expected to vary based on the time of year, progression of the fishing season, ocean conditions, and gear configuration. For example, a depth restriction may be more effective if the distribution of Covered Species and available forage is constrained to a certain depth range. If the distribution of Covered Species or available forage is more widespread across a range of depths

within a particular Fishing Zone, a season delay/closure or vertical line reduction may be more effective. This consideration is evaluated based on expert input from the Working Group and its Advisors, as well as any other information made available to CDFW through the RAMP process.

Another aspect of effectiveness is the degree to which this type of management measure has been successfully implemented during prior periods. Was there high compliance by the fleet the last time this management measure was implemented? Are there known enforcement challenges that would require dedicated resources to effectively implement this management measure? This is evaluated based on routine compliance checks by CDFW. Additionally, reviewing historical compliance of various management measures provides CDFW an opportunity to adaptively manage the fishery to effectively minimize co-occurrence.

3.4 Economic Impact

CDFW also considers total economic impact on the fleet and fishing communities. The regulations do not specify a particular method for determining the relative amount of economic impact for a given management measure, although they do reflect the fact that for the fleet, the number of vessels impacted is higher for delays in the fall than for early closures in the spring (CDFW 2020b). Historical landings data also indicate that total landings and economic value are similar for seasons with and without fall delays. However, an early closure during the spring will have different impacts on fleet sectors depending on their reliance on the fishery throughout the season. Operators who have completed Dungeness crab fishing activities for the season and transitioned to other fisheries may experience less of an impact.

During the permit term, CDFW will strive to improve the ability to conduct assessments of economic impact through utilizing the full range of management action options described in Sections 5.2.2, as appropriate; establishing and monitoring metrics which more fully characterize economic viability of the fleet and relevant sectors; and integrating outcomes from decision-support tools such as trade-off analyses and management strategy evaluations. CDFW will work closely with the Working Group and its Advisors, industry organizations, economists, social scientists, and other individuals with relevant expertise to identify additional metrics. These metrics should enhance CDFW's ability to assess impacts on the fleet as a whole, as well as on different sectors within the fishery.

3.5 Historical Migration Patterns

Given the challenges associated with collecting Marine Life Concentrations data, robust, real-time survey or tagging information to evaluate against the triggers are not always available for each Covered Species across all Fishing Zones. Even if a substantial amount of information is available, relying on these snapshots of abundance and distribution alone fails to take advantage of multi-year (and even decadal)

perspectives regarding what these point-in-time abundances suggest about broad-scale entanglement risk.

Evaluating current survey information in the context of historical migration patterns can address these questions and allows CDFW to consider the degree to which Marine Life Concentrations data collected in one Fishing Zone may, or may not, be indicative of Covered Species presence and distribution within another Fishing Zone.

However, the availability of historical migration information will not negate the need for protective management actions in the absence of current Marine Life Concentration survey information. That survey information can be bolstered by review and consideration of other sources of Marine Life Concentrations data. This includes systematic shore-based visual surveys conducted by Point Blue Conservation Science staff and trained volunteer biologists from the Farallon Island lighthouse and opportunistic surveys by the Channel Island Naturalist Corps aboard multiple vessel platforms transiting the Santa Barbara Channel including whale watch tours, natural history tours, and island landings (Jahncke and Howar 2022). CDFW also considers findings from Species Distribution Models (SDMs), including an experimental blue whale SDM which predicts daily suitable blue whale habitat throughout the Plan Area (WhaleWatch 2.0) hosted on the NOAA CoastWatch website.

3.6 Fishing Season Dynamics

Starting with the 2020-21 fishing season, the RAMP regulations also require electronic vessel location monitoring for all Dungeness crab vessels using Alternative Gear (see Section 5.2.2.4) or operating under a depth constraint (see Section 5.2.2.1). While CDFW does not specify the type of vessel monitoring systems that must be used, systems must meet the specified minimum ping rate of once per minute and data must be available to CDFW upon request for up to 60 days. This information can be compared with the bi-weekly reports to verify accuracy, and will allow for closer monitoring (i.e., higher spatial resolution information) for compliance with depth restrictions or fishery closures, as well as tracking Alternative Gear deployment. This requirement was expanded to all vessels starting with the 2023-24 season.

During the phased implementation period, an OPC-funded pilot program to test solar provided additional information regarding fishing activity. A total of 47 solar loggers were used by fishing vessels during the pilot program, which spanned the 2018-19 through 2021-22 fishing seasons, and participation increased substantially after the electronic vessel location monitoring requirements described above went into place in November 2020 (personal communication, Kathi George, September 7, 2022).

Another form of electronic vessel location 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 via satellite to a communication service provider, which then provides the information to the NOAA

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 location information at least four times per hour. While Dungeness crab is a state managed fishery, some Dungeness crab vessels participate in federally managed fisheries where VMS is required. Around 35% of total annual Dungeness crab landings are made from vessels with VMS, and about 30% of vessels that participate in the fishery have VMS (Feist et al. 2021). When combined with landings data, VMS tracks can indicate where Dungeness crab fishing activity occurred. While VMS data are only available for a portion of the Dungeness crab fleet and have lower resolution than the CDFW-required systems, this information provides a valuable resource for hindcast analyses. VMS data are available to select NMFS staff in near-real time, however CDFW's inability to access and utilize these data for state managed fisheries prevents their use for in-season management at this time.

When combined, available data described above (landing receipts, bi-weekly reports, and electronic vessel location monitoring) allow CDFW to consider the concentration and 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 declines substantially during the spring months. Historical migration patterns indicate fewer Covered Species are in the fishing grounds in late fall and early winter as opposed to spring. Therefore, an on-time (November 15 or December 1, depending on location) or slightly delayed fishery opening is associated with lower entanglement risk than an opening late in the fishing season (February-April). Historical landings data suggests that more than 80% of commercial Dungeness crab landings occur within the first eight weeks of the season (Figure 2-8). The scheduled season openings 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 effort period is more likely to overlap with a period of increasing Covered Species presence as whales and turtles return to the fishing grounds. Additionally, 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 increased entanglement risk.

The location of the fleet in relation to Covered Species presence (i.e., co-occurrence) will therefore be an important consideration when assessing appropriate management responses. If Covered Species are observed towards the end of a fishing season in locations where fishing activity is decreasing, 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 enhance protections.

3.7 Available Forage

Distribution and abundance of forage can have a profound impact on movement patterns and concentrations of Covered Species (Santora et al. 2020). While specific thresholds have not yet been defined, CDFW considers available information regarding forage species presence in the Plan Area when assessing relative risk of marine life entanglement. Relative abundance of krill and anchovy are assessed during the annual NMFS SWFSC Rockfish Recruitment and Ecosystem Assessment Surveys. Midwater trawls are deployed during the spring and early summer at defined sampling stations which cover both coastal and offshore waters. Data for central California are available from 1990 on, allowing for comparison of current values with historical conditions and trends.

Higher coastal abundance of forage species increases entanglement risk by increasing the probability that large whales will congregate in nearshore areas and overlap with fishing activity. Conversely, abundant offshore or widespread foraging opportunities are associated with reduced entanglement risk.

3.8 Ocean Conditions

A variety of oceanographic conditions influence the distribution of key prey species (see Chapter 3), with direct consequences for co-occurrence between Covered Species and fishing gear. During the 2019-20 through 2024-25 fishing seasons, CDFW considered available information regarding habitat compression, coastal upwelling, NPH, and LMH events to predict distributions of Covered Species. Additionally, conditions at sea such as high winds or strong currents strongly influence fishing behavior and responsiveness of the fleet. High winds and swell events can affect the fleet's ability to detect and retrieve gear or be responsive to a management directive.

3.9 Confirmed Entanglements and Cumulative Take

At the time the initial RAMP regulations were developed, CDFW anticipated take levels of up to six humpback whales (with no apportionment to the Mexico and Central America DPS), up to two blue whales, and up to two leatherback sea turtles every three years. Since the specific levels authorized under a future permit had not yet been determined, CDFW relied upon informal consultation with NMFS WCRO to set the following targets:

- Average total annual Impact Score Calculation during the previous two calendar years and the current calendar year exceeds:
    - Two humpback whales
    - One blue whale
    - One leatherback sea turtle

As the number of confirmed entanglements approaches the above levels, CDFW implements increasingly precautionary management actions. The higher levels for humpback whales provide CDFW the opportunity to transition from less restrictive to more restrictive actions with each additional confirmed entanglement. For example, if

the management considerations identified above suggest a gear reduction is the best approach to reduce entanglement risk and the cumulative total number of entanglements during the current three-year period is three, CDFW might implement a 25% gear reduction. Should additional entanglements occur during that same season, CDFW might implement a 50% or 75% gear reduction, and ultimately consider closure of one or more Fishing Zones. Given the low limits for blue whales and leatherback sea turtles, CDFW would implement a restrictive management action following a single confirmed entanglement of these species. For example, if the entanglement is confirmed during the open fishing season, CDFW might close one or more Fishing Zones for the remainder of the season to prevent continued co-occurrence.

In all instances, CDFW considers the potential for unintended consequences when implementing a management action which could displace, rather than remove, fishing effort. Given differences in migration patterns, habitat utilization, and forage needs of the Covered Species (see Chapter 3), it is possible that management actions taken in response to elevated risk for one species could lead to increased take of another species. Therefore, CDFW selects the type, spatial extent, and temporal duration of any management action to minimize take of each Covered Species.

3.10 Fleet Advisory

Through the 2023-24 fishing season, the Director could issue a Fleet Advisory which allowed the fleet to encourage voluntary efforts if risk was elevated. These advisories raised awareness and encouraged vessel operators to avoid areas where entanglement risk might be elevated due to recent observations or other management considerations as described in RAMP. Voluntary actions encouraged by the Working Group have included implementation of Best Practices, as detailed in the Best Practices Guide, regarding gear configuration (e.g., reducing slack line and minimizing surface gear) and placement (e.g., avoiding areas with high concentrations of forage or where Covered Species have been sighted). The updated regulations will be effective November 2025, removing Fleet Advisory prior to the 2025-26 fishing season.

E.4 Risk Assessment Schedule

During the 2022-23 fishing season, CDFW piloted the following milestones approach for the season opener:

- On or before November 1, evaluate risk and implement management actions regarding the scheduled November 15 opener in Fishing Zones 3-5
    - If a management action is implemented for one or more of these Fishing Zones, the management action will be in place until at least December 1
- On or before November 22, evaluate risk and implement management actions regarding the scheduled December 1 opener in Fishing Zones 1-2. Additionally, evaluate risk and determine whether to maintain, modify, or lift any management action currently in place for Fishing Zones 3, 4, and/or 5 beyond December 1.

    - If a management action is implemented for one or more of these Fishing Zones, the management action will be in place until at least December 16
- On or before December 7, evaluate risk and determine whether to maintain, modify, or lift any management action currently in place for any Fishing Zone
    - If a management action is implemented for one or more of these Fishing Zones, the management action will be in place until at least December 31
- On or before December 22, evaluate risk and determine whether to maintain, modify, or lift any management action currently in place for any Fishing Zone
    - If a management action is implemented for one or more of these Fishing Zones, the management action duration will be selected on a case-by-case basis

The number and timing of risk assessments may vary between years, but will generally adhere to the process described below and illustrated in Figure E-1:

- First risk assessment to determine whether Fishing Zones 3-5 will open as scheduled (November 15) and if so, under what conditions
    - If a management action is implemented, it will be in place until after the second risk assessment has occurred
- Second risk assessment to determine whether Fishing Zones 1-2 will open as scheduled (December 1) and if so, under what conditions; whether to maintain, modify, or lift any management actions currently in place for Fishing Zones 3-5
    - If a management action is implemented for any Fishing Zone, it will be in place until after the third risk assessment has occurred
- Third risk assessment to determine whether management actions currently in place should be maintained, modified, or lifted
    - If a management action is implemented for any Fishing Zone, it will be in place until either a specified date or after the fourth risk assessment has occurred
- Subsequent risk assessments would occur on an as-needed basis

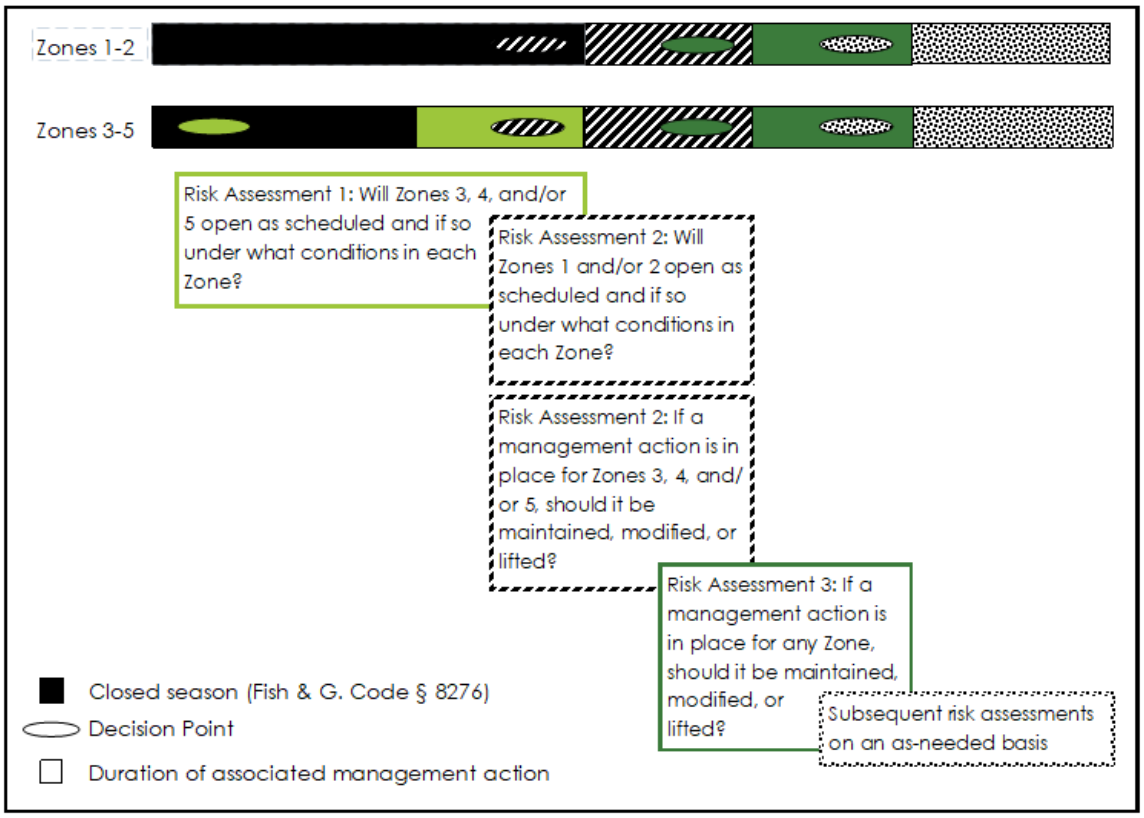

Figure E-1. Milestones approach to the season opener. The closed season (as defined by F & G. Code § 8276) extends to November 15 for Fishing Zones 3-5 and December 1 for Fishing Zones 1-2, and is signified by a black bar. Each risk assessment consists of a decision point (during which CDFW will determine whether a management action is necessary) and the time period during which the associated management action would be in place. Decision points are signified by ovals and the timing and duration of the associated management action are signified by horizontal bars. Within a given risk assessment, the color and pattern of each shape are consistent.

E.5 Marine Life Concentration Surveys

5.1 CDFW Aerial Survey Protocols

CDFW typically uses a Partenavia P-68, King Air, or Cessna for RAMP aerial surveys. While departure airport is subject to change, the primary hangar locations are at the Watsonville Municipal Airport or the Sacramento Executive Airport. Other airport locations include Sacramento, Monterey, Novato, Santa Rosa, and Half Moon Bay.

Aerial surveys are conducted by CDFW staff on a monthly or bi-monthly basis to inform the Whale Safe Fisheries' Risk Assessments and Management Program. Aerial surveys aim to record Actionable Species concentrations, specifically leatherback sea turtles and blue and humpback whales, within the Dungeness crab fishing grounds. Surveys may also record other marine species and trap gear concentrations. Below is a general

outline of how to perform a RAMP aerial survey, a list of necessary supplies, and contact information for all relevant staff.

5.1.1 Survey Conditions

Ideal flying conditions are between 700-1,000 ft in altitude and between 95-100 knots. Survey speed should begin at 95 knots and be adjusted up or down as directed by observer(s). The goal is to fly as quickly as possible while allowing observer(s) sufficient time to accurately document lost pot locations, which will vary based on survey altitude and weather conditions (especially sea state). Beaufort conditions of three or less are preferred, with unlimited visibility or limited fog and low clouds.

Two types of survey transects are conducted depending on which Fishing Zones are being surveyed and other considerations such as time and survey conditions. Depending on conditions and transect type, an aerial survey will take between 3.5-6 hours. The East-West transect pattern is conducted in Fishing Zones 3 and 4, which run inshore to offshore perpendicular to the coast (Figure E-2).

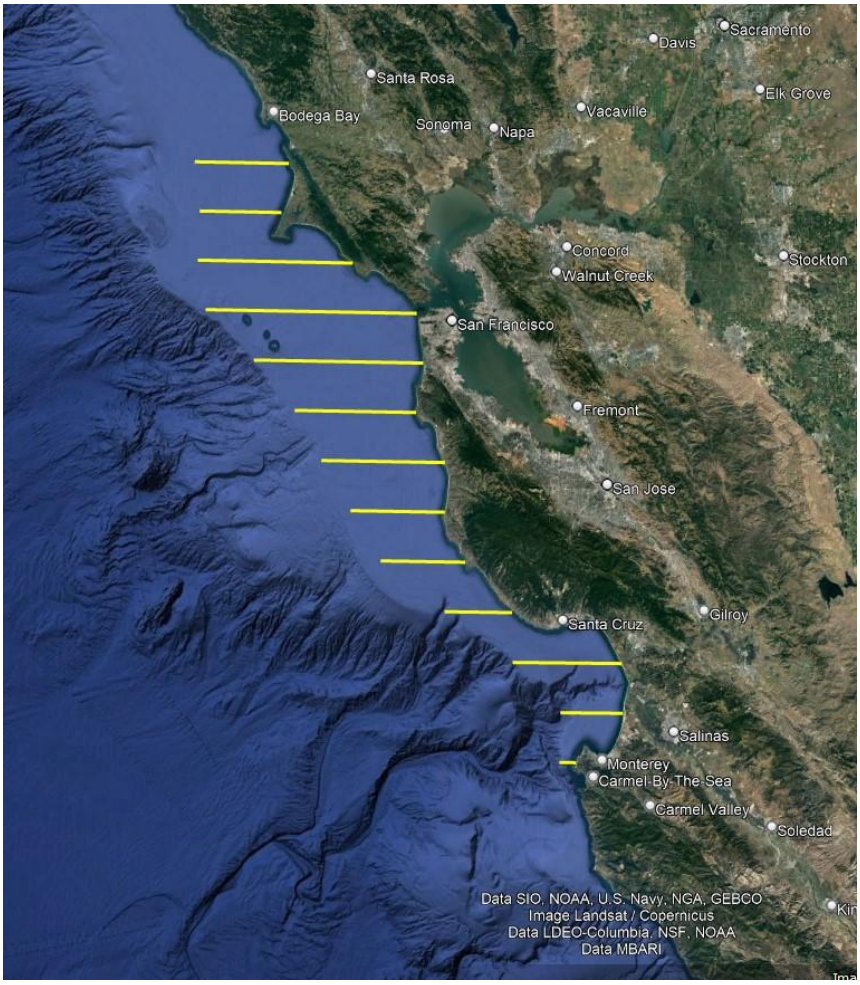

Figure E-2. Yellow lines depict typical aerial survey east-west transect lines.

The zig zag transect pattern can be conducted in Fishing Zones 1-5, which moves in a zig zag pattern between the coast and ~100m depth contour lines (Figure E-3).

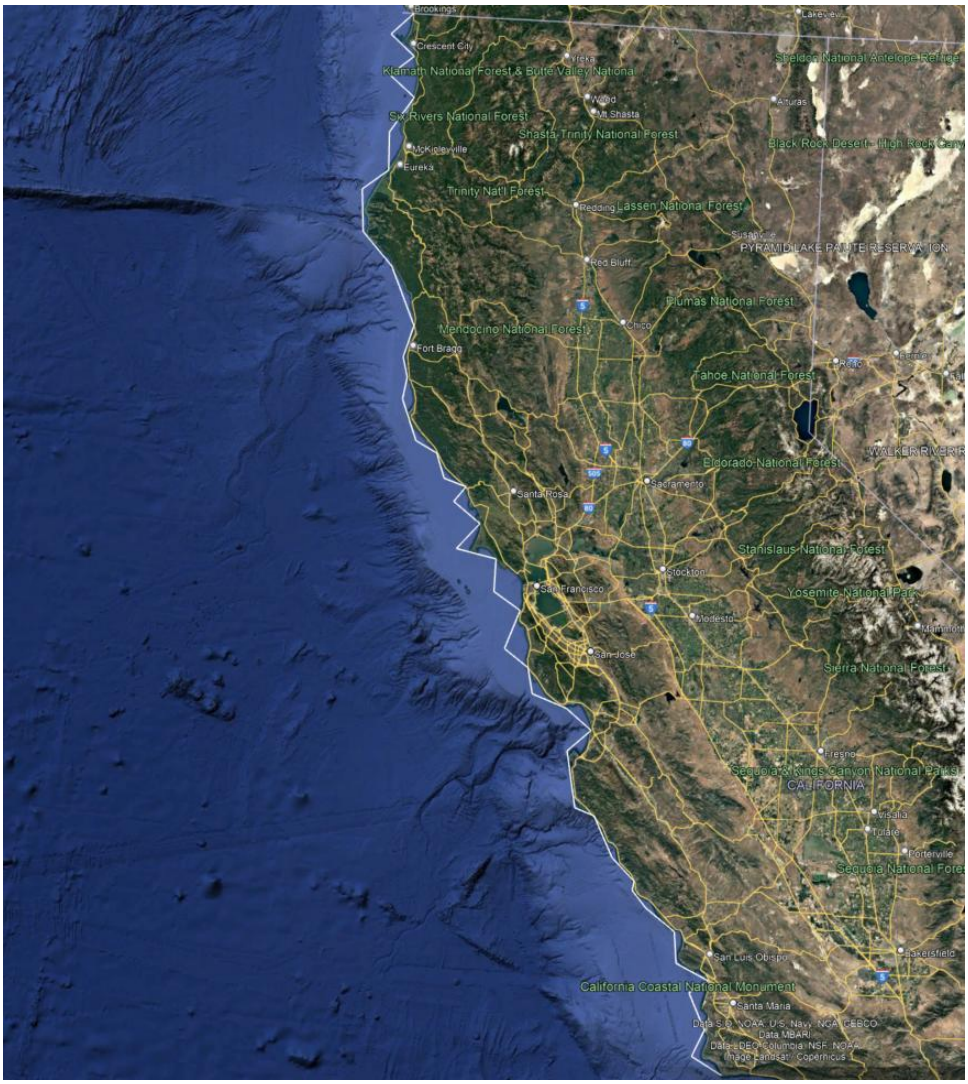

Figure E-3. White line shows zig zag aerial survey transect lines.

5.1.2 In Flight Survey Protocol

Observer staff utilize the Quick Capture App to record observations in flight. The Quick Capture App has been built by Whale Safe Fisheries staff for aerial surveys and is part of the ESRI ArcGIS software.

To record observations an observer will need an iPad to access the app, and a Bad Elf GPS booster to record position while in flight. When recording transects instruct the pilot to alert when at the transect starting point, and when the plane goes off transect. Only record when on transect.

Record sightings by selecting the species and entering the number seen. Record any additional observations about visibility issues, etc. via your field notebook. Survey observation options include:

Cetaceans (humpback whale, blue whale, gray whale, fin whale, dolphins, unidentified whale), Turtles (leatherback sea turtle), Gear (single trap, trap cluster, trap string), Forage and Ocean Conditions (bait ball, mola mola, jellies), and Additional Observations (note time and details in field notebook).

5.2 Vessel Surveys

California Coast Crab Association (CCCA)and The Nature Conservancy (TNC)

The CCCA and TNC have collaborated to develop an industry-led vessel survey that utilizes commercial fishing vessels and crews to document the presence of Covered Species. Input from the Working Group members and advisors was collected to design a survey protocol, with support from the Advisory Committee which included members from CDFW, NOAA NMFS, and Cascadia Research Collective. Since the pilot survey was tested in fall 2020, the waypoints have undergone periodic minor revisions, with input from the Advisory Committee, to increase efficiency and avoid shallow areas or other obstructions. The developed protocols prioritize surveys in Fishing Zones 1 and 5, areas where survey data can be limited due to weather constraints. During the 2023-24 season, TNC and CCCA began collaborating with the Marine Mammal Education and Research Program at Cal Poly Humboldt to provide observers onboard the survey vessels. Surveys have been conducted opportunistically to inform fall and spring risk assessments from 2020 to 2024.

The protocol uses independent observers as data recorders when available and industry vessel operators and crew in other circumstances. Surveys are typically conducted by eight boats, with two operating out of each of the ports of Eureka, Crescent City, Morro Bay, and Port San Luis. Each port has two survey lines, one north and one south, that alternate between the 30- and 200-fathom depth contours to provide comprehensive Fishing Zone coverage and inshore/offshore distribution. Whether all eight survey lines are conducted depends on vessel and observer availability, as well as the Fishing Zone's priority for RAMP Marine Life Concentration estimates. The protocol prioritizes counts by species and vessel location, with the option to estimate animal location and specify other information like animal behavior or forage. Data collectors are also instructed to track environmental conditions at every way point and in the case of significant shifts in conditions (e.g., swell, visibility).