

Risk Assessment and Mitigation Program Data Sources

Last Updated: September 2021

This document provides an overview of key data sources frequently considered by the California Department of Fish and Wildlife (CDFW) and California Dungeness Crab Fishing Gear Working Group (Working Group) when assessing marine life entanglement risk and appropriate management actions under the Risk Assessment and Mitigation Program ([§132.8, Title 14, California Code of Regulations](#)). Sources used to evaluate whether risk is elevated (i.e. triggers under §132.8(c)) are discussed first, followed by other available data which may inform assessment of management considerations under §132.8(d). This is not a comprehensive list of all data under consideration for a given risk assessment, and not all data are available for a given risk assessment. This document will be periodically updated as new information becomes available or data collection methods are altered.

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Confirmed Entanglements: §132.8(c)(1)

National Marine Fisheries Service (NMFS) Reports

In close coordination with members of the West Coast Large Whale Entanglement Response Network, NMFS staff provide summaries of large whale and Pacific leatherback sea turtle entanglements that are reported to NMFS, along with any specific details or documentation from individual entanglement cases needed to support RAMP discussions. Summaries are typically provided for the current fishing season and calendar year, however data from previous years may also be shared to provide historical context (see Appendix 1 of the [April 7, 2020 Data Compilation](#) for an example).

Information provided may relate to both confirmed and unconfirmed reports. Confirmed reports are those reports which meet one or more of the following criteria (from Saez et al. 2020):

- Photo or video of gear on the entangled animal
- Direct visual observation by NOAA staff
- Reported by a trusted source (trained or professional reporting party)
- Reporting source was interviewed by an experienced member of the large whale entanglement response network or NMFS expert, and the information provided is detailed and specific enough to confirm the entanglement
- Multiple sources provided reports with detailed descriptions of the animal and entanglement

Confirmed reports often, but not always, include sufficient information for NMFS to positively identify the species entangled; if not, these are categorized as “unidentified whale.” Depending on the type of information available about the entangling material, NMFS may attribute the entanglement to a specific fishery (e.g. California commercial Dungeness crab), a general category (e.g. gillnet), or categorize it as “unidentified” (e.g. dark colored rope). Pursuant to Section 132.8(a)(4) and Section 132.8(c)(1)(A), Confirmed Entanglements will be evaluated separately depending on whether NOAA confirms them in California commercial Dungeness crab gear or in Unknown Fishing Gear. For the purposes of evaluating elevated risk and need for management action under the RAMP, CDFW will not consider Confirmed Entanglements which NMFS attributes to other fisheries or non-fishery origins.

Marine Life Concentrations: §132.8(c)(2)

Marine Life Concentrations will be evaluated at the Fishing Zone level (see Figure 1). The following are sources which will be considered by CDFW to assess attainment of triggers specified in the RAMP regulations. Other sources of Marine Life Concentrations information are described under 132.8(d)(6) and 132.8(d)(11).

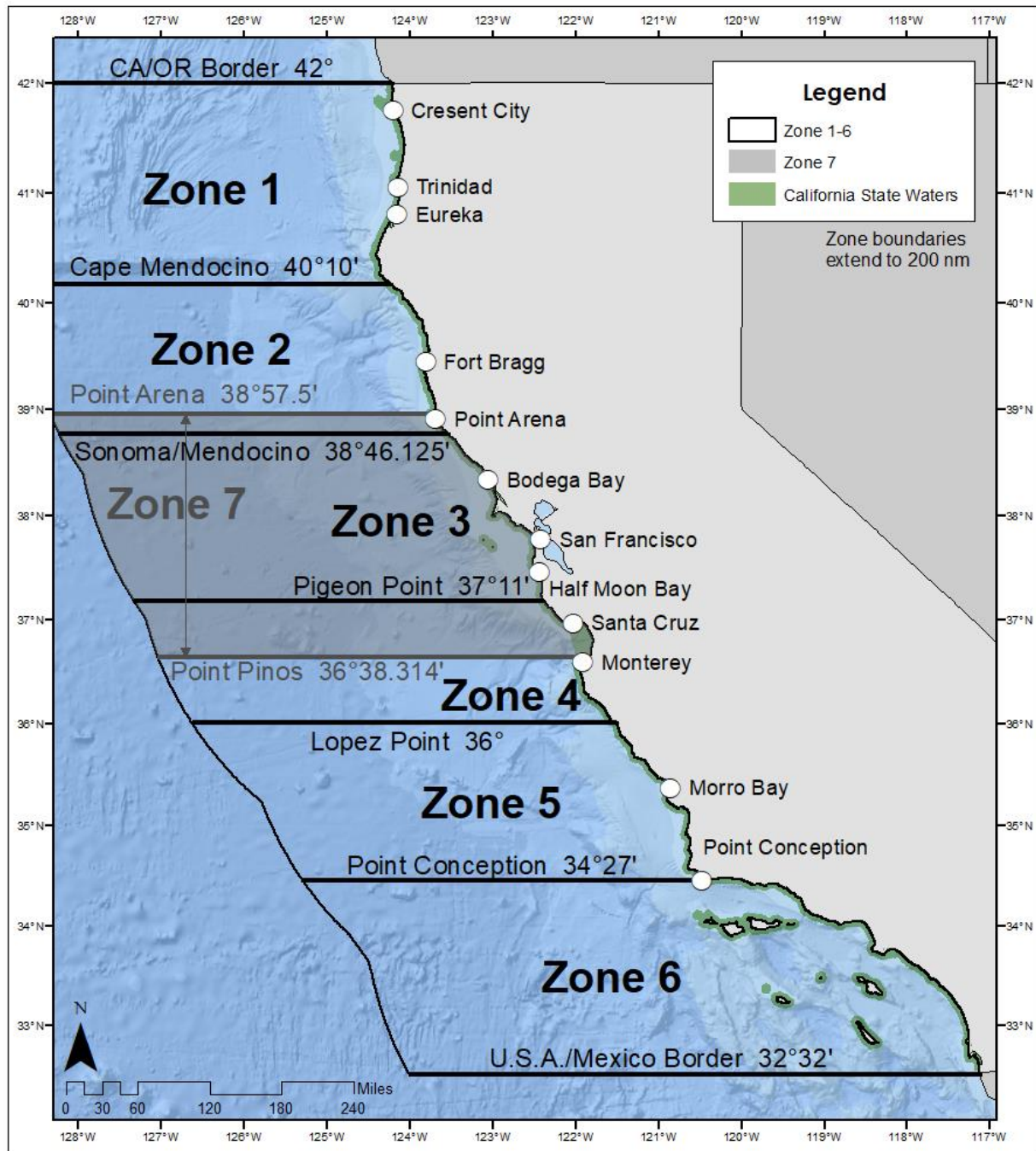


Figure 1. RAMP Fishing Zones. Map showing latitudinal boundaries of each Fishing Zone, as defined in Section 132.8(a)(7). All Fishing Zones extend to 200 nautical miles offshore.

Aerial Surveys: Line Transect, Reconnaissance

Multiple aerial survey methods are used to inform assessment of marine life entanglement risk. Each method has distinct caveats, and is therefore summarized separately.

Distance Sampling: Line Transects

To date, line transects have been used by Working Group Advisors from the National Marine Fisheries Service Southwest Fisheries Science Center. The methodology is based on a well-established sampling technique known as distance sampling. All objects of interest (e.g. large whales, leatherback sea turtles, trap buoys) which can be viewed from the plane are counted, as is the location from which the observation is made (e.g. side window, belly window). The angle of each observation is recorded, which is paired with the height of the plane to calculate the distance between the plane and the object. Based on the frequency of sighting a particular object (e.g. Humpback whale) at a given distance, after correcting for group size and sea conditions, the effective strip width is calculated. By summing the effective strip widths, compared to the total area surveyed, the number of observed objects can be used to estimate the total number of objects within the surveyed area. Observations and transect lines are also plotted to assess spatial distribution of the observations and assess overlap (Figures 2-4).

One key assumption of distance sampling is that transect lines proportionally sample available habitat. Surveys are flown along lines perpendicular to the coast or in a zig-zag pattern between two depth contours, to ensure even sampling across all depth ranges.

Due to the importance of being able to detect and accurately measure distances to objects, surveys are only flown during calm sea states and low wind conditions.

The primary targets of these surveys are whales, Pacific leatherback sea turtles, and available forage (bait balls, jelly blooms, etc). If sufficient observers are present, trap gear is also recorded. Due to the speed and altitude at which the plane is flying, buoy configurations or markings which might identify the gear as belonging to a particular fishery cannot always be documented. Therefore, neither the observed nor estimated total number of traps should be interpreted as reflecting the total amount of commercial Dungeness crab gear.

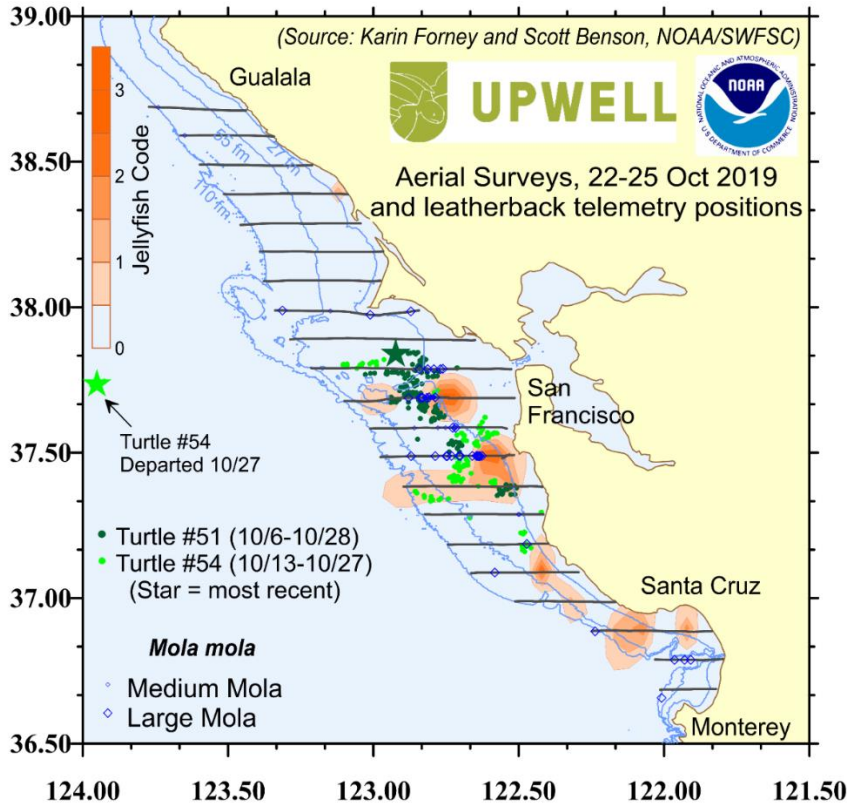


Figure 2. Example aerial survey using line transects, focused on leatherback sea turtles.

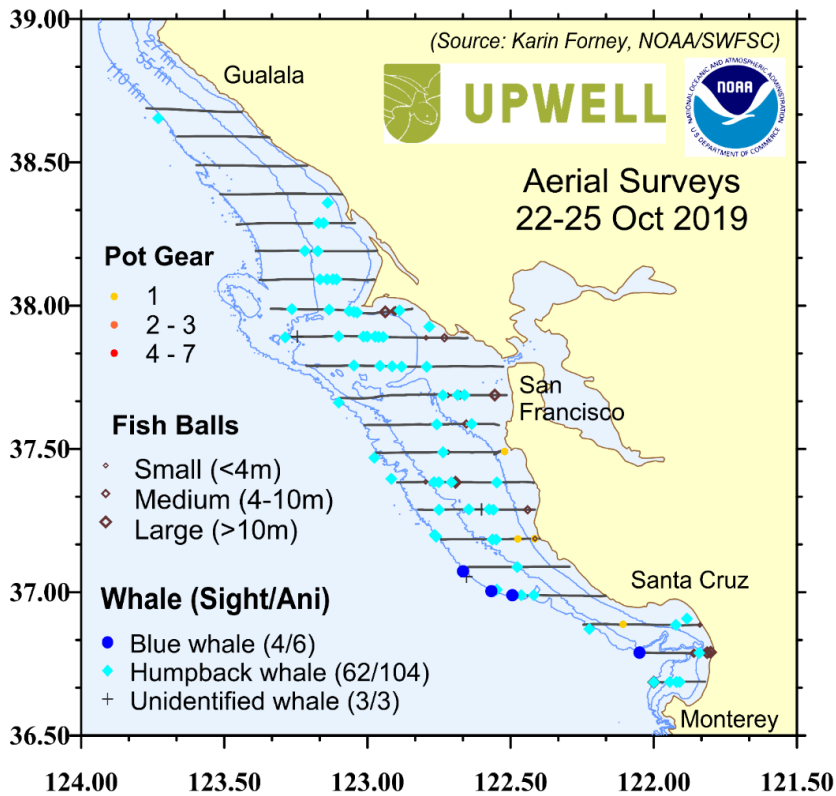


Figure 3. Example aerial survey plot showing line transects focused on whales, trap gear, and bait balls.

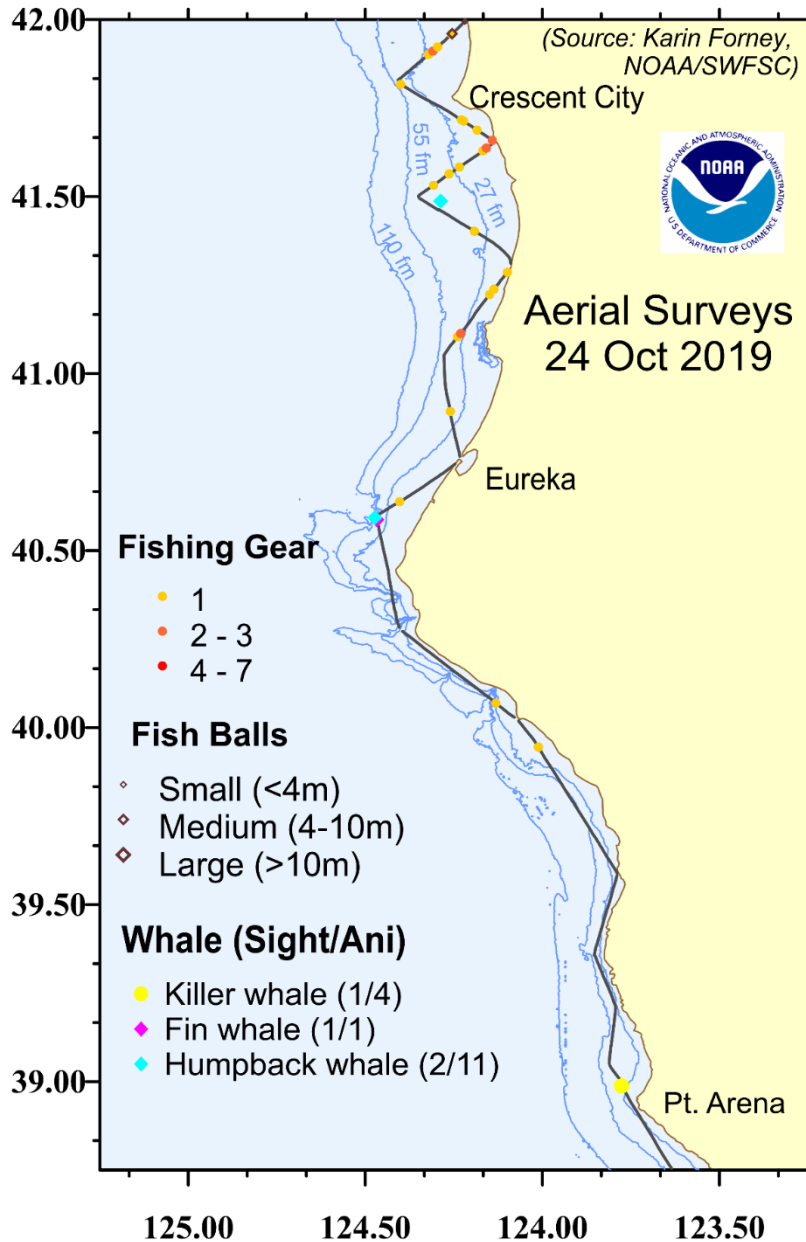


Figure 4. Example aerial survey plot showing zig-zag transect method.

Reconnaissance

Reconnaissance flights have been used by CDFW, Lighthawk, and the US Coast Guard. Flights may utilize perpendicular line transects, zig-zag transects, or follow specified depth contours (e.g. flying the 30 fathom contour north to south and the 50 fathom contour south to north). Regardless of the transect design, observations are used to estimate relative abundance and identify hotspots with a high concentration of Actionable Species. However, effective strip widths are not calculated, and the surveys are not used to estimate total presence of a given species within the surveyed area. Additionally, trap gear abundance and distribution are assessed qualitatively, rather than the census approach during line transect surveys.

Small Vessel Surveys

Small vessel surveys are periodically conducted by Cascadia Research Group and other partners (Figure 5). Transects typically follow both a shallower (e.g. 70m) and deeper (e.g. 200m) depth contour to assess the spatial distribution of large whales across multiple depths. All sightings of Humpback whales and Blue whales are recorded, as well as unidentified whales and other species of interest. In addition to sightings information, researchers document prey species when animals are observed foraging at the surface. Photographs are taken to allow for identification of individual humpback whales and assignment to a specific Distinct Population Segment. Satellite telemetry tags are opportunistically deployed, allowing tracking of individual animal movements and inference of foraging behavior. These additional sources of information are considered under Section 132.8(d)(6) and 132.8(d)(8).

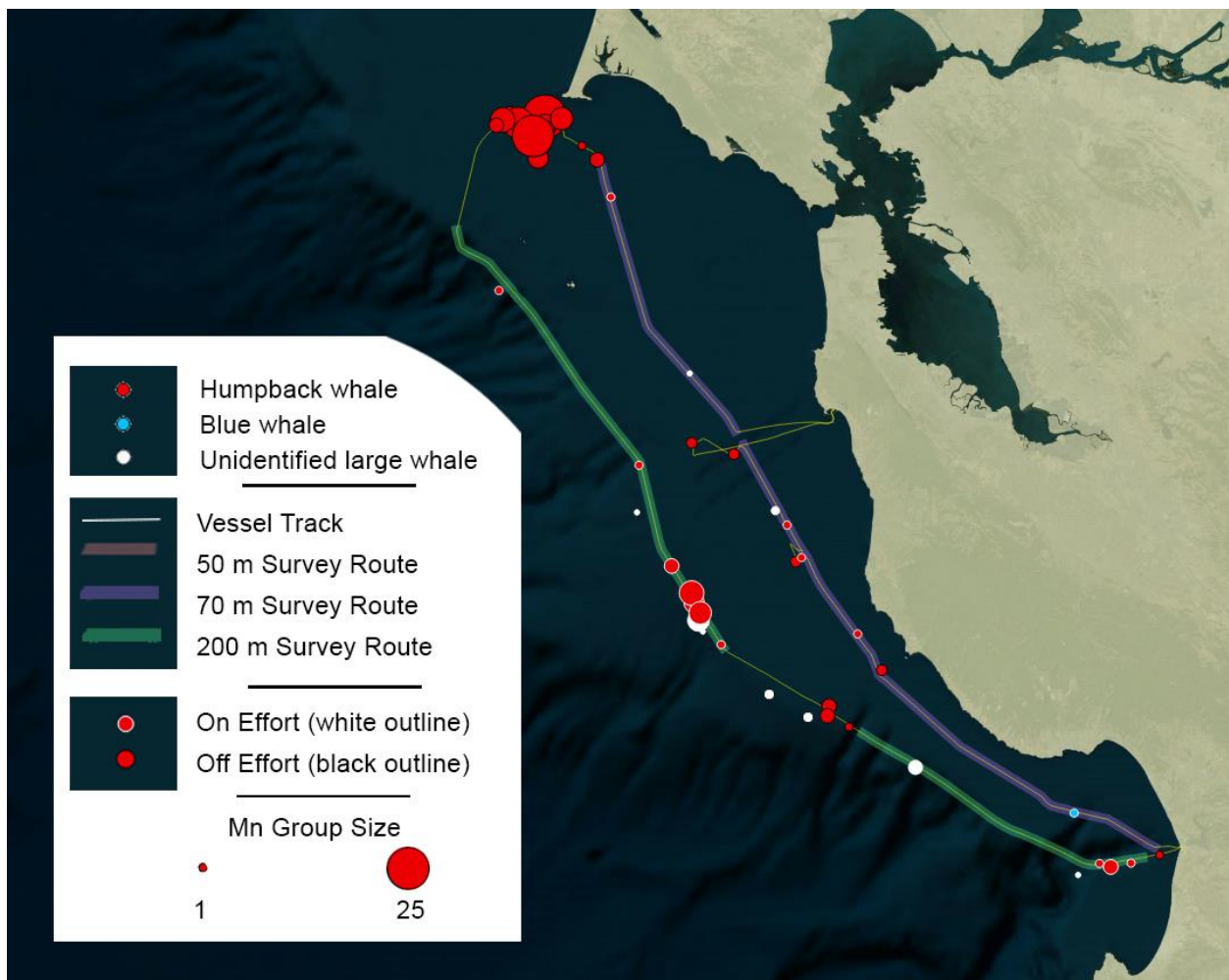


Figure 5. Example small vessel survey plot showing transect lines and sightings information.

During the 2020-21 fishing season, industry members are piloting a similar small-vessel survey on commercial fishing vessels focused on assessing abundance and distribution of Humpback and Blue whales along both inshore and offshore transects. Findings are considered under Section 132.8(d)(11).

Satellite Telemetry

In contrast to large whales, Pacific leatherback sea turtles are rare and cryptic. Due to their low profile, Pacific leatherback sea turtles are very difficult to encounter from a ship unless the sea state is unusually calm. Aerial platforms provide a better means for finding Pacific leatherback sea turtles but even this method has its limitations because the effective strip half-width is only about 260 meters on each side of the aircraft, therefore, satellite telemetry is a superior means for obtaining information about the presence of leatherback turtles. Furthermore, unlike vessel or aerial survey observations, which provide a snapshot of animal distributions at a given time, satellite telemetry also allows for long-term tracking of individual animals. Within the context of RAMP, satellite telemetry has focused on tracking Pacific leatherback sea turtles. Aerial surveys are used to locate Pacific leatherback sea turtles foraging off central California during the summer and early fall, and small vessels are used to approach and capture the animal to directly attach a transmitter to the carapace (or shell). The transmitter reports the animal's location at specified intervals until the attachment or batteries fail. Movement patterns and current position can be viewed from a web interface (see Figure 6), allowing continuous near real-time assessment of the animal's position and any directional movement patterns (e.g. migration in or out of the foraging grounds).

As the number of concurrently tagged animals increases, there is increased confidence observations are representative of the overall patterns for the population foraging off California during the summer and fall months. Pacific leatherback sea turtles return to their western Pacific nesting beaches every 3-5 years. Those that do not engage in trans-Pacific movements return to California foraging grounds during the spring and early summer months. Tags that persist until the spring and early summer can provide an indication of when Pacific leatherback sea turtles are likely to return to Dungeness crab fishing grounds.



Figure 6. Fastlock GPS positions for tagged leatherback sea turtle from October 6 to December 2, 2019.

Monterey Bay Whale Watch

Sightings on commercial whale watching trips and research surveys by Nancy Black are reported on [a publicly available website](#). Karin Forney (National Marine Fisheries Service Southwest Fisheries Science Center) compiles new postings into a database which contains reported sightings from 2003 to present.

Data is summarized as a time series of daily sightings (blue bars), standardized to half-day trips (see Figure 7). The figure includes the 7-day running average (red line) to make it easier to discern patterns. Green lines are added on November 15th of each year (the typical start date of the commercial Dungeness crab season), and x-axis tick marks are at one-month intervals. Plots are prepared for each large whale species (humpback, blue, and gray). Plots may be re-scaled to include only more recent data to make it easier to identify trends (see Figure 8).

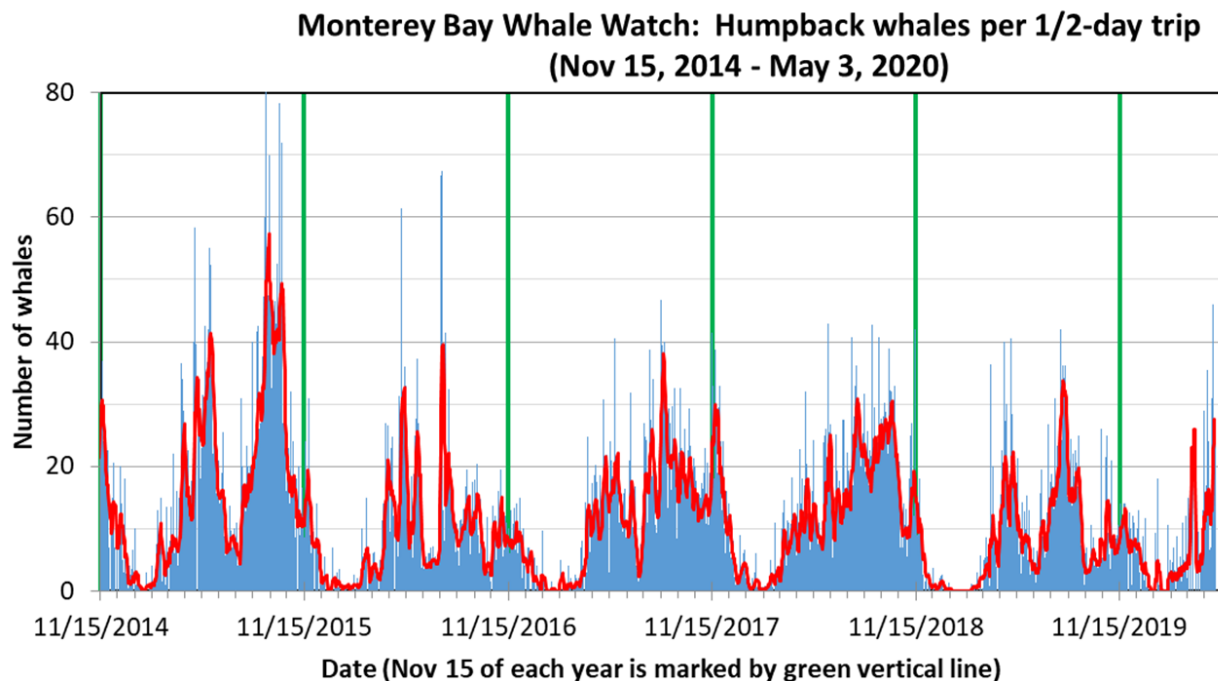


Figure 7. Example plot of Monterey Bay Whale Watch data for humpback whales, expanded time series.

Monterey Bay Whale Watch: Humpback whales per 1/2-day trip (Jan 15, 2019 - May 3, 2020)

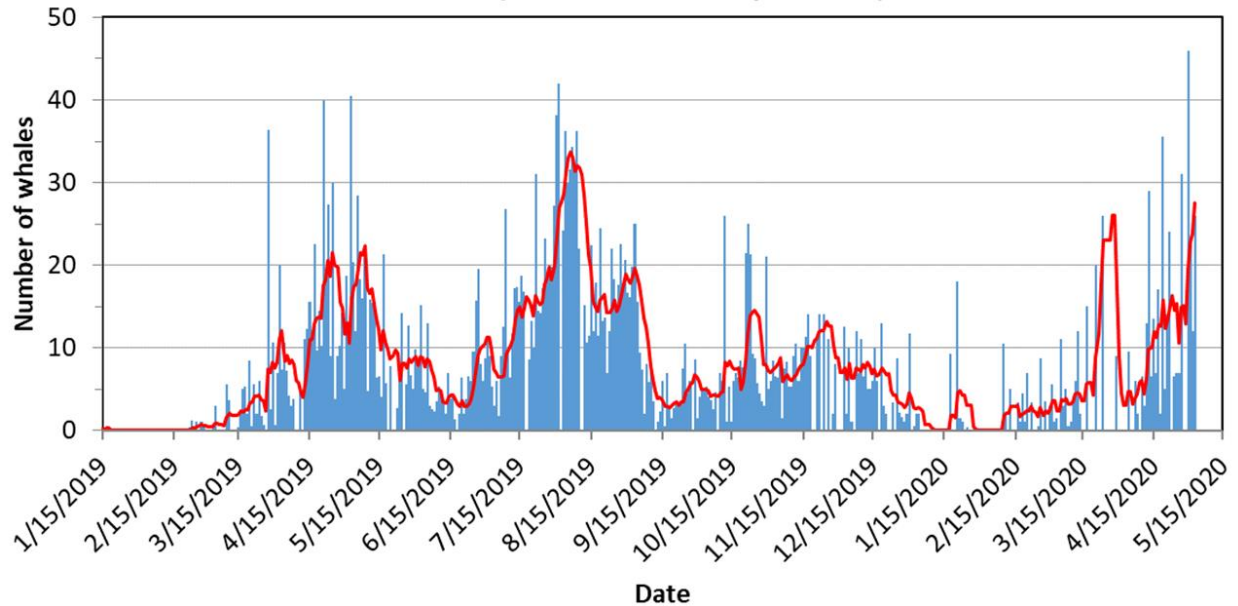


Figure 8. Example plot of Monterey Bay Whale Watch data for humpback whales, shorter time series.

Another type of plot (Figure 9) presents bi-monthly (1st – 15th, 15th- end of the month) averages of sightings from 2003 to present. The boxplots are formatted according to standard statistical practice; the horizontal black line is the average number of whales, the blue box shows the 24th – 75th percentiles (i.e. half of all past averages fall within the box), and outliers are shown as black dots. Average values for more recent years may be overlaid on top of the boxplots to show them in historical context. Plots are prepared separately for each large whale species. These are generally considered under Section 132.8(d)(6).

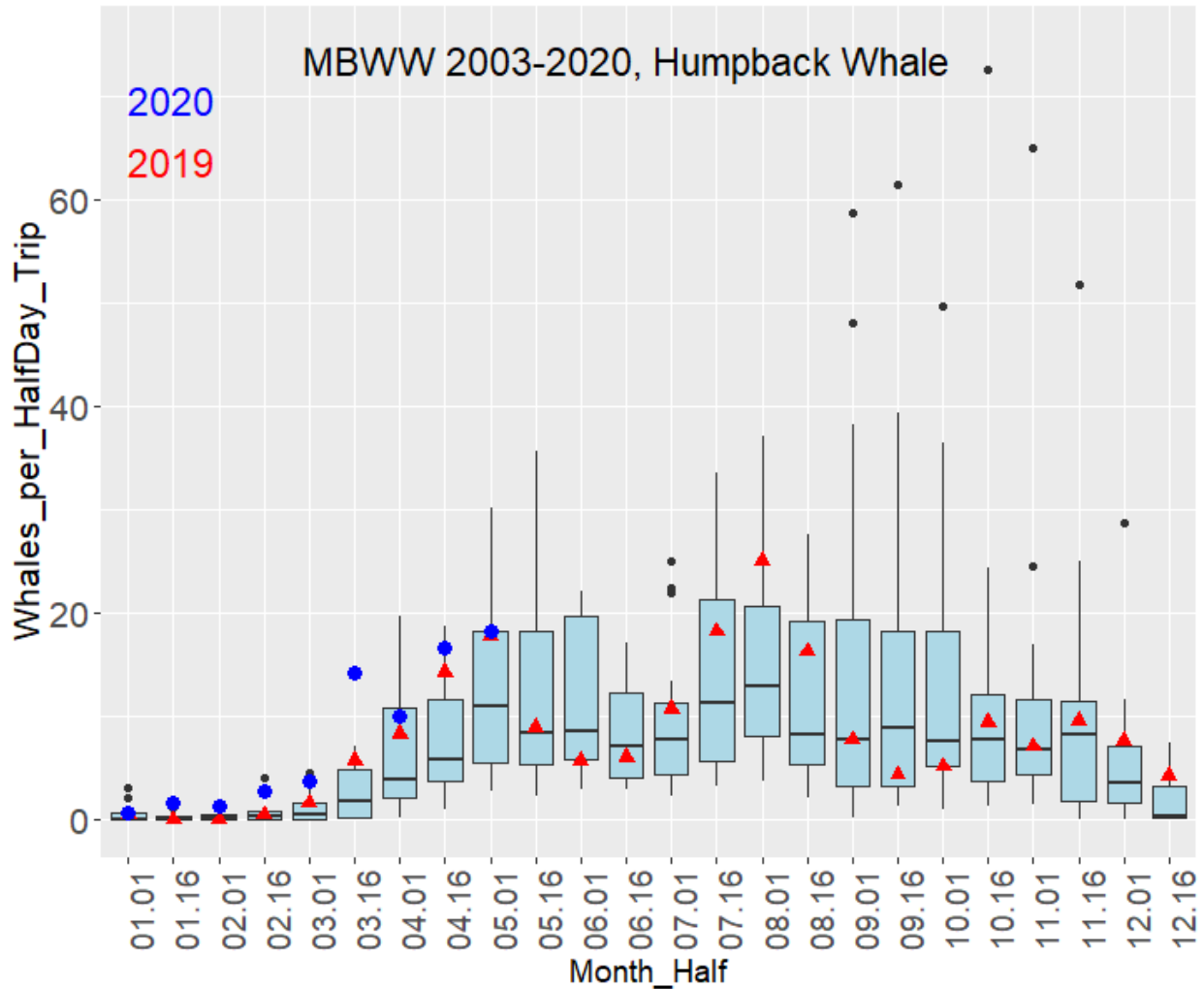


Figure 9. Historical boxplots and recent bi-monthly averages for MBWW data.

Fishing Season dynamics: §132.8(d)(7)

Domoic Acid Testing

Annual domoic acid testing of Dungeness crab begins at the end of September and results are posted as PDF files on the California Department of Public Health (CDPH) website under [Analytical Data - Crabs](#). Currently, 17 locations are sampled between Crescent City and Avila/Port San Luis. A sample contains a minimum of 6 Dungeness crab. If all crab viscera are found to be at or below 30 ppm for domoic acid, that location will not be re-tested. If a sample contains at least one crab that exceeds 30ppm in the viscera, then the site is retested. To clear a site a minimum of two consecutive sets of crab samples must be collected at least a week apart and all crab from both sets must be at or below 30 ppm domoic acid. Any location(s) that does not clear in time for the season start date would result in a delay of the corresponding Biotoxin Management Area(s) from the Director via a recommendation from the health agencies of the Office of Environmental Health Hazard Assessment and CDPH (Fish and Game Code Section 5523). When a commercial closure is lifted, the Director is required to give the

fleet a minimum of 72-hours notice before the fishery opens. If that opening day would land on a state or federal holiday, the opener may be further postponed to avoid a holiday opener. Each Biotxin Management Area has at least one boundary line that aligns with a RAMP Fishing Zone boundary. More information can be found on [CDFW's Update on Biotxin Management](#).

Quality Testing

Pre-season testing for crab quality (i.e. the amount of crab meat) could result in a delay of RAMP Fishing Zones 1 and 2. Since crab that are harvested for the purposes of the quality test can be sold, these locations must be cleared of domoic acid prior to scheduling the first round of the quality test. Within each port area (Crescent City, Trinidad and Eureka), samples are collected from the same locations as those used for domoic acid testing. The test is overseen by CDFW in coordination with the fishery managers of Oregon and Washington under the Tri-State agreement. Quality testing procedures are outlined in the latest [PSMFC protocol](#) (see the "Crab tests" section). Results of the coastal crab quality tests are also posted at this PSMFC website.

For a port to pass the quality test and open without delay, the average meat recovery percentage must be at or above 24% (no rounding). If a given port does not meet this minimum value, then the Director will delay the opener for that area (Fish and Game Code Section 8276.2) after consulting with the other Tri-State managers.

Quality delays occur in 15-day increments, and the season cannot be delayed due to low quality after January 15. Initial quality tests for California typically occur at the end of October, in order to inform whether the scheduled December 1 opener should be delayed to December 16. In some instances, an additional round of testing may occur in mid-November, with a target completion date of November 15, to further inform decisions regarding the December 1 opener. If an area is delayed due to low quality, additional rounds of testing are scheduled for completion by December 7 (to inform a December 31 opener) and December 22 (to inform a final delay until January 15).

CDFW Databases: Landing Receipts and Permitting Information

All commercial fishing activity must be documented on a landing receipt, which must be submitted electronically through Pacific States Marine Fisheries Commission's E-Tix platform within 3 business days. Data is transferred twice per day to CDFW's Marine Landings Data System (MLDS), where it is available to CDFW staff for extraction and analysis.

Error-checking procedures are implemented throughout the fishing season, however there may be delays between identification and correction of errors. All landings data is preliminary until official publication of the [annual CDFW commercial landing report](#) the following year.

CDFW typically summarizes data at the weekly level (starting with the first day the season was open). In light of the delays between the landing date and data availability, and to avoid presenting incomplete data, summaries do not include information from partial weeks. This means data from up to two weeks prior to data extraction will be withheld.

For the purpose of spatial analyses regarding deployed gear and harvest, CDFW staff have identified the CDFW fishing blocks comprising each Fishing Zone shown (see Figure 10). [View fishing block maps.](#)

Assessing the amount of deployed trap gear (i.e. vertical lines), and changes over time, is a key component of determining entanglement risk. Prior to the 2020-21 fishing season, there were no mandatory reporting requirements allowing CDFW to directly determine this value. As an interim approach, permitting information from CDFW's Automatic License Data System (ALDS; which provides the trap allotment for each permitted Dungeness crab vessel) was paired with MLDS data (which provides the activity for a given vessel). By summing the trap allotments for all vessels making a landing during the specified time period, the number of deployed traps can be estimated.

There are several limitations of this approach. Overestimation may occur if a vessel does not utilize their full trap allocation. Underestimation may occur if a vessel has traps deployed but does not make a landing during that time period or if a vessel number was incorrectly reported on a landing receipt (preventing assignment of the vessel's trap allocation). Incorrectly reported catch locations (blocks) will also generate discrepancies. However, this type of analysis will continue to be generated for comparison with information gathered from new mandatory reporting requirements.

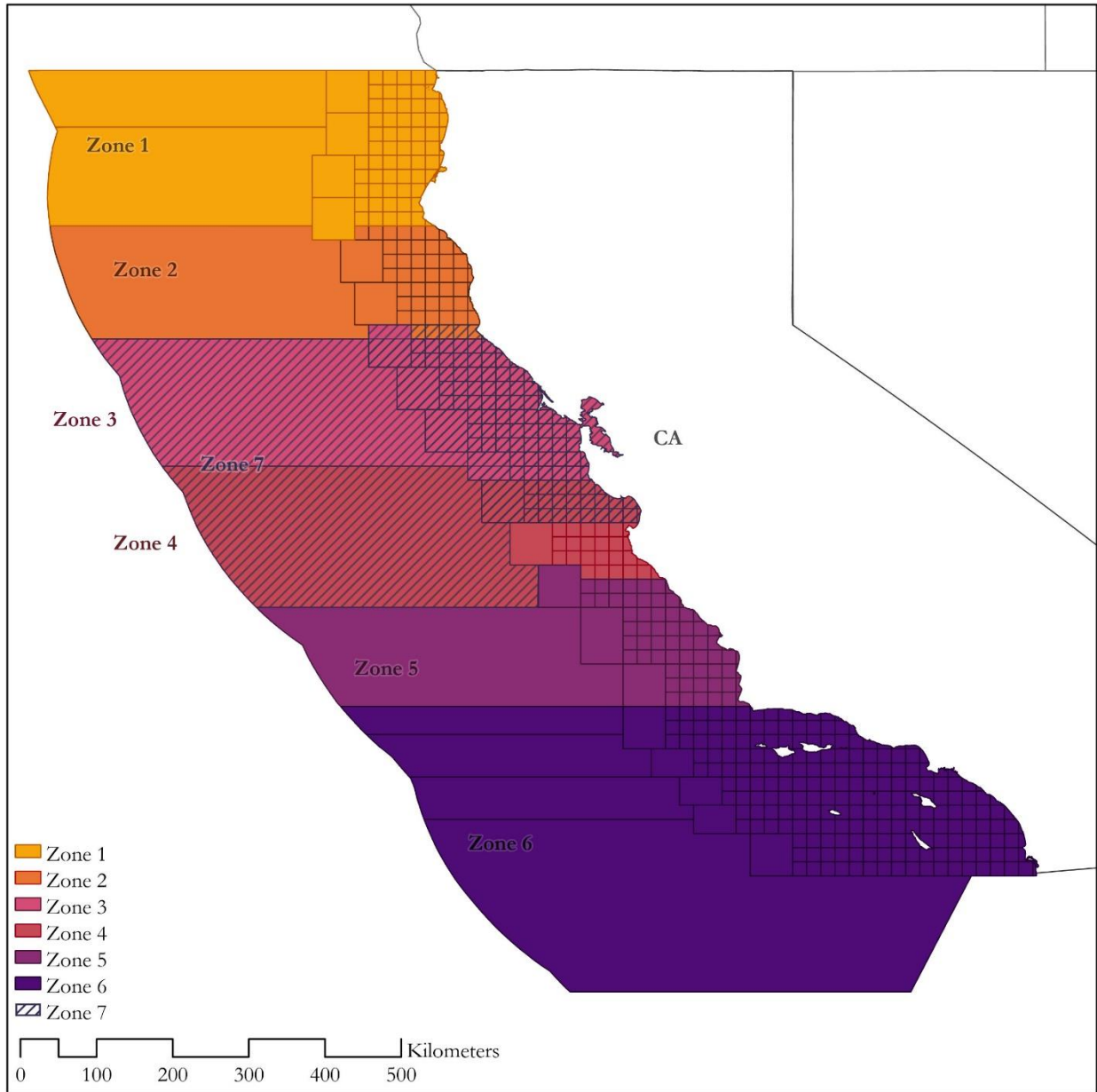


Figure 10. Map showing assignment of CDFW Fishing Blocks to RAMP Fishing Zones.

Mandatory Bi-Weekly Reporting

Section 132.8(g)(1) requires all vessels participating in the California commercial Dungeness crab fishery to submit electronic reports on or before the first and 16th day of each month. The reports include the Dungeness crab vessel permit number, current Fishing Zone, depth range, and number of traps deployed at the time of reporting. CDFW staff review and compile these reports to produce summary tables, charts, and figures.

Electronic Monitoring

Section 132.8(g)(2)(A) requires all vessels operating under a depth constraint or using Alternative Gear must have an operational electronic monitoring system. Section 132.8(g)(2)(B)

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expands the electronic monitoring requirement to all vessels participating in the commercial Dungeness crab fishery beginning with the 2023-24 season. While specific devices or manufacturers are not identified, the system must meet requirements for ping rate, data collection, and data retention.

Solar Loggers

Through a grant from the Ocean Protection Council, electronic monitoring devices have been installed on multiple commercial fishing and whale watch vessels. These solar-powered instruments, known as “solar loggers”, automatically collect positional information every few seconds. Data is then uploaded via cellphone networks to Pelagic Data Systems, which aggregates data to produce a variety of map-based summaries.

Review of solar logger data by fishery participants has informed development of filters which enable specific portions of each vessel track to be classified as either transiting or fishing activity (see Figure 11), and to distinguish between fishing for Dungeness crab or other species.



Figure 11. Example map showing transiting and fishing activity for vessels based in Half Moon Bay.

Vessel position information is presented in two main forms: track lines or cumulative time within specified cells. The cumulative time analyses allow assessment of overlap between fishing effort (i.e. time spent fishing for Dungeness crab; see Figure 12) and large whale presence (inferred by the total time spent in the area by whale watch vessels).

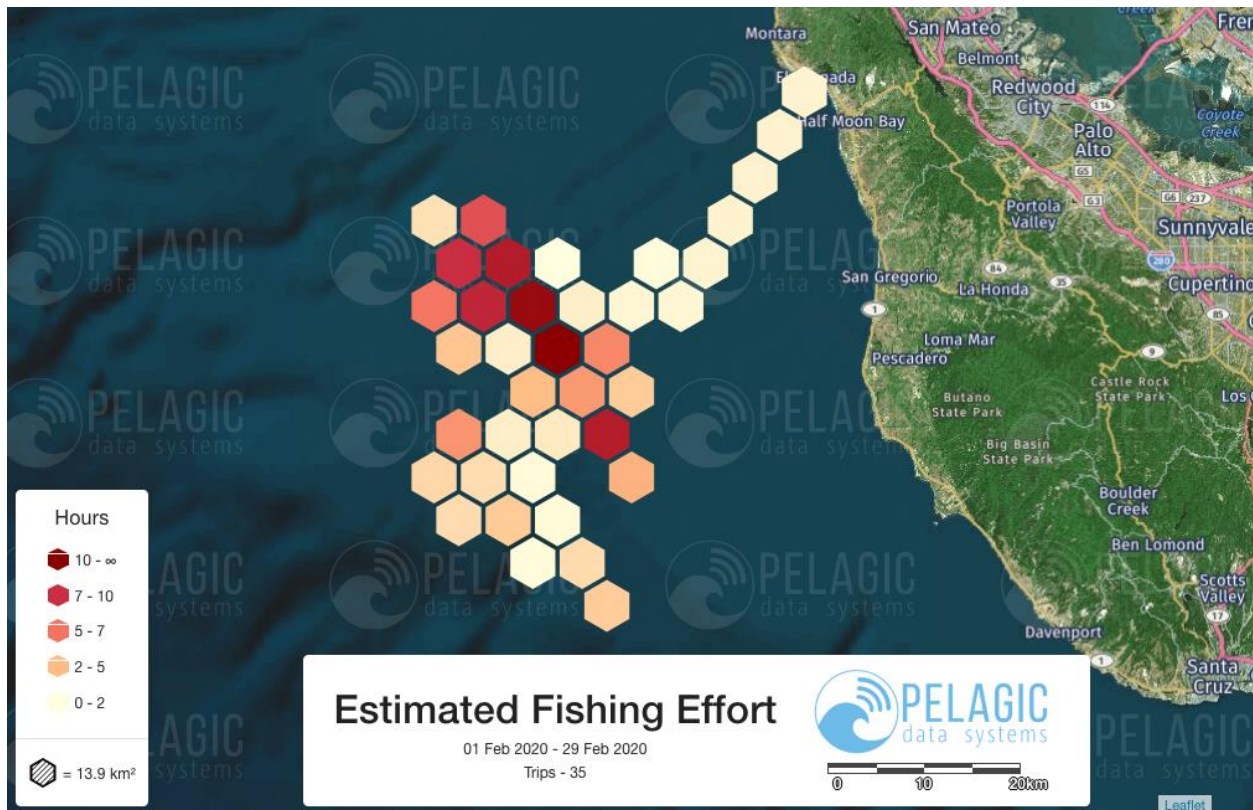


Figure 12. Example map showing estimated fishing effort (in hours) for vessels based in Half Moon Bay.

Forage distribution and abundance: §132.8(d)(8)

California Current Integrated Ecosystem Assessment Indices

Relative abundance of krill and anchovy is assessed during the annual NOAA Southwest Fisheries Science Center 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 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.

Ocean conditions: §132.8(d)(9)

Habitat Compression Index

The Habitat Compression Index (HCI) uses sea surface temperature output from the [Regional Ocean Modeling System](#) to calculate the area of cool surface water (< 12 °C) and track available coastal upwelling habitat on a monthly basis. Cool expansion periods are defined as months where area exceeds +1 standard deviation (SD) of the full time series (1980 – present) and limited cool habitat as months where area is less than -1 SD. Habitat compression (months

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when area falls between the long-term monthly mean and -1 SD) indicates increased whale entanglement risk.

HCI information can be viewed as a time series (Figure 13) or overlaid on a map of monthly average sea surface temperature values (Figure 14).

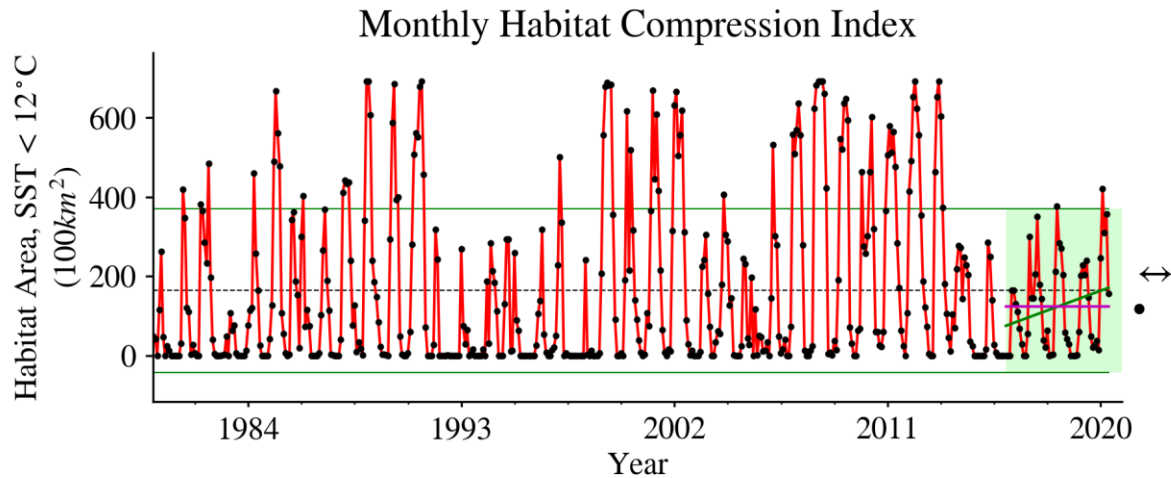


Figure 13. Monthly Habitat Compression Index values.

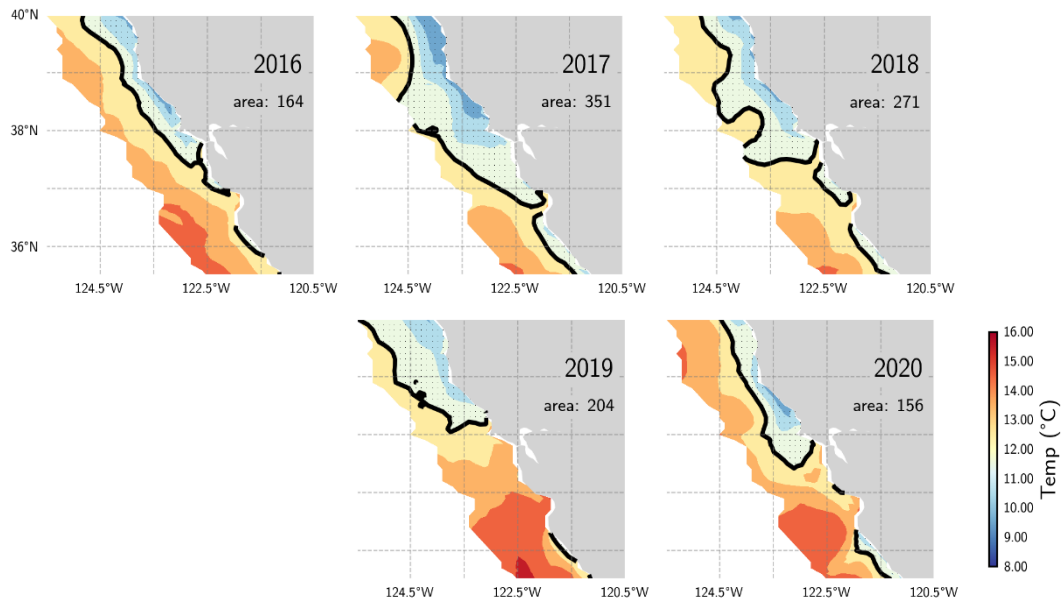


Figure 14. Maps of March Sea Surface Temperature and location of HCI boundary.

Coastal Upwelling Transport Index (CUTI)

CUTI is an upwelling index which uses ocean models, satellite data, and real-time sampling information to estimate the amount of vertical water transport near the coast (i.e. upwelling or downwelling) for a specific line of latitude. Data can be viewed on an annual or seasonal

timescale. Higher values indicate greater upwelling, which is associated with more productive foraging conditions for large whales and sea turtles.

North Pacific High (NPH)

Variations in large-scale atmospheric forcing influence upwelling dynamics and ecosystem productivity off California. The NPH is a semi-permanent area of high pressure (> 1020 Pascals) in the North Pacific Ocean. Variation in both the size and location of the NPH affects the timing and strength of coastal upwelling off California. Winter NPH values (January – February mean) provide an early indication of likely upwelling conditions during the spring and summer.

Oceanic Niño Index (ONI)

The ONI is a 3-month running mean of Sea Surface Temperature (SST) anomalies in the Niño 3.4 region (120°-150°W and 5°N-5°S). Positive values indicate higher-than-average SST (aka El Niño conditions). Negative values indicate lower-than-average SST (aka La Niña conditions).

California Current Marine Heatwave Tracker

Marine heatwaves occur when ocean temperatures are warmer than usual (based on location and time of year) for an extended period of time. A large marine heatwave event which began in 2014 and persisted until mid-2016, colloquially known as “the blob” resulted in a large number of ecosystem impacts and helped drive the increased numbers of large whale entanglements seen during those years. The NOAA Integrated Ecosystem Assessment program’s [Blob Tracker webpage](#) provides maps (Figure 15) and analysis describing SST anomalies in the Northeastern Pacific and any large marine heatwave events.

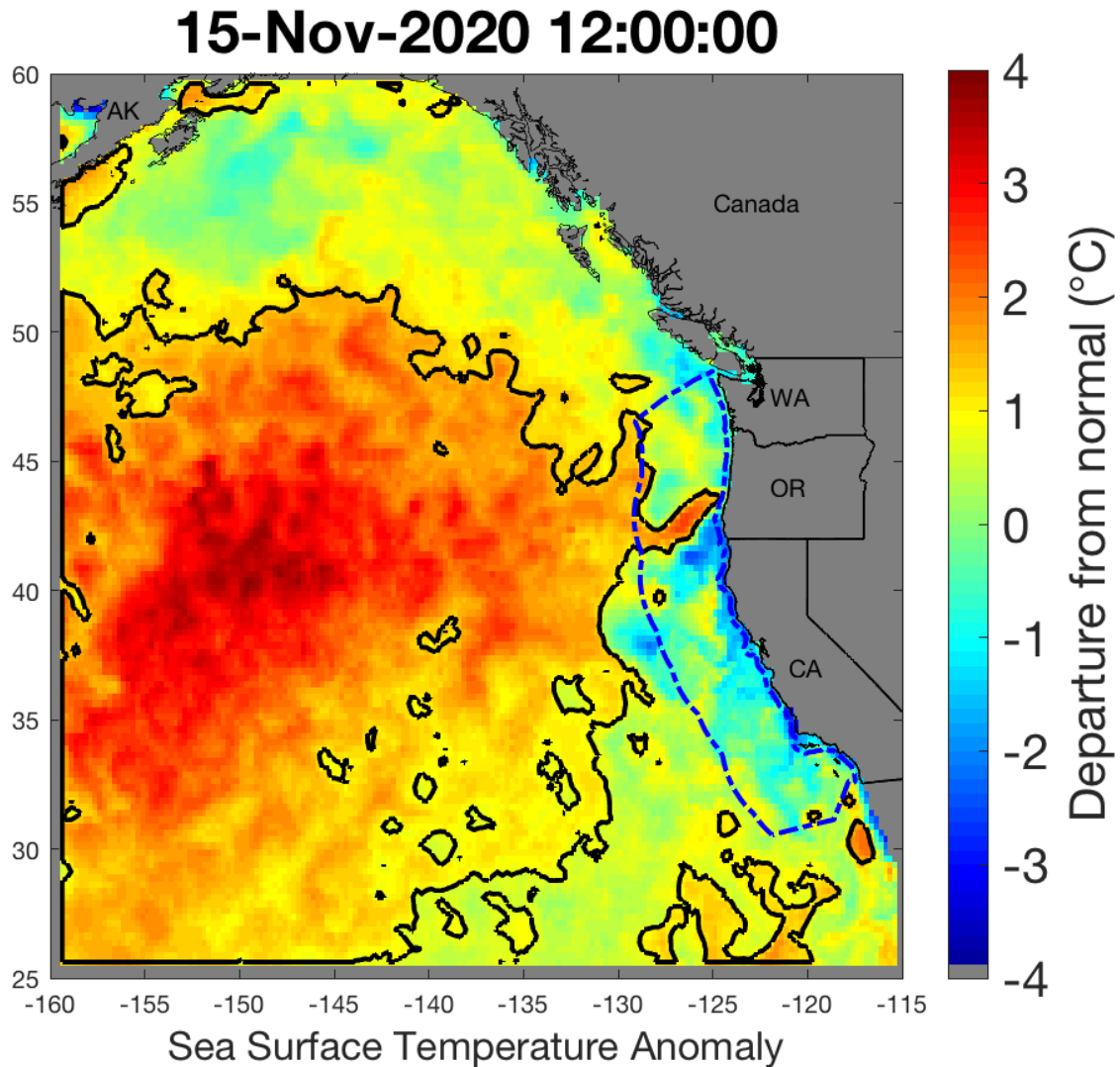


Figure 15. Example map showing Sea Surface Temperature anomalies and large marine heatwave extent.

Actionable Species migration into or out of Fishing Grounds and across Fishing Zones: §132.8(d)(11)

Point Blue Conservation Science Whale Observations and Mapping Tool

In the Gulf of the Farallones (north-central CA), whale observations are made by trained biologists from [Point Blue Conservation Science](#) stationed on the Farallon Islands. In Monterey Bay (central CA), whale observations are made by trained naturalists and researchers from [Monterey Bay Whale Watch](#) and [Marine Life Studies](#). In the Channel Islands (southern CA), whale observations are made by the [Channel Islands Naturalist Corp](#), a joint program between Channel Islands National Park and Channel Islands National Marine Sanctuary that represents the sanctuary and park on board local whale watch vessels.

In all cases, whale sightings are entered using a mobile application that records the whale species and count, time and GPS location of the observation. The record is stored in the mobile device until there is access to a phone network. Once the observation is transmitted, it takes about two hours for Point Blue Conservation Science to harvest the data and update the [map](#). Once on the mapping tool, observations can be filtered and summarized by location, species and time period.

Data is typically visualized with a map displaying recent sightings for key whale species (humpback whales and blue whales), over either the last 7 day or 30 day period (Figure 16). Each white dot represents a single report, which may include sightings of multiple individuals. In the online data portal, clicking on one of these dots will display additional information (e.g. observation date and number of individuals by species).

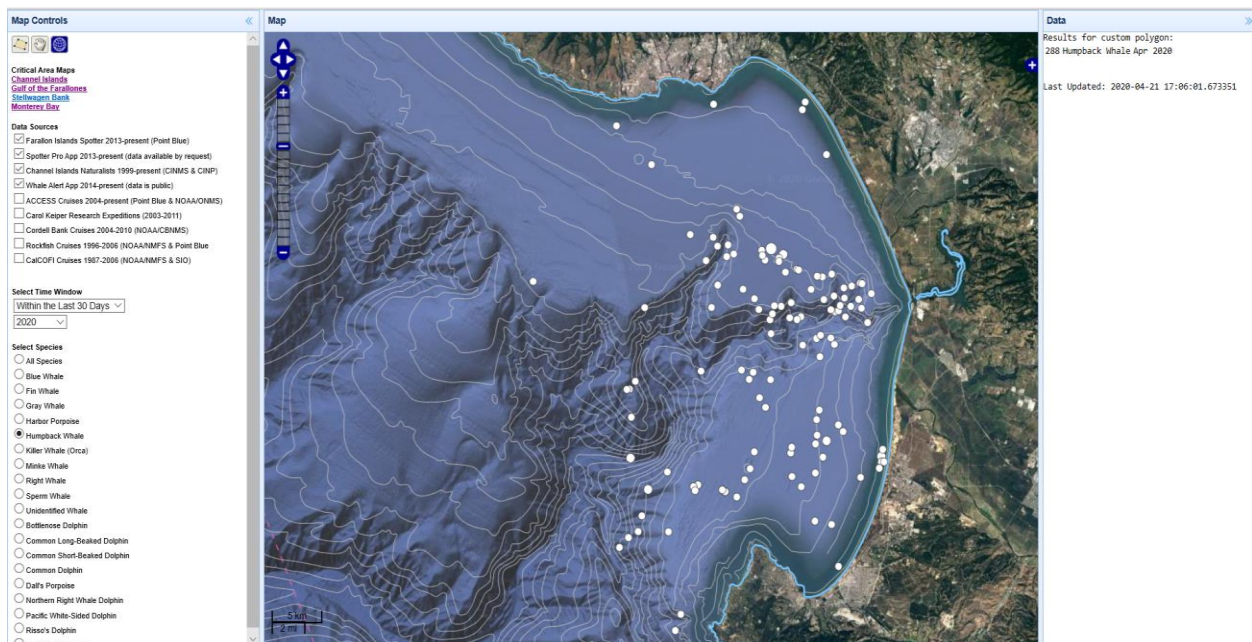


Figure 16. Screenshot of the Point Blue Conservation Science Data Portal, showing Humpback Whale observations for Monterey Bay.

Sightings from all three areas can be used as a proxy for humpback whale migration trends and distribution patterns (e.g. onshore/offshore). The systematic nature of the counts for the Farallon and Channel Islands means observations can also be used to assess trends in abundance and distribution. In Monterey Bay, the same individual may be counted multiple times by different whale watch companies, or the same company on multiple days.

WhaleWatch 2.0

WhaleWatch 2.0 is a web-hosted map which generates daily predictions of the spatial distribution of blue whales along the entire California coast (Figure 17). These predictions are based on a collection of models which predict suitable blue whale habitat based on current ocean conditions. Better habitat (aka higher likelihood of blue whale presence) is indicated by

red colors and poorer habitat (aka lower likelihood of blue whale presence) is indicated by blue colors.

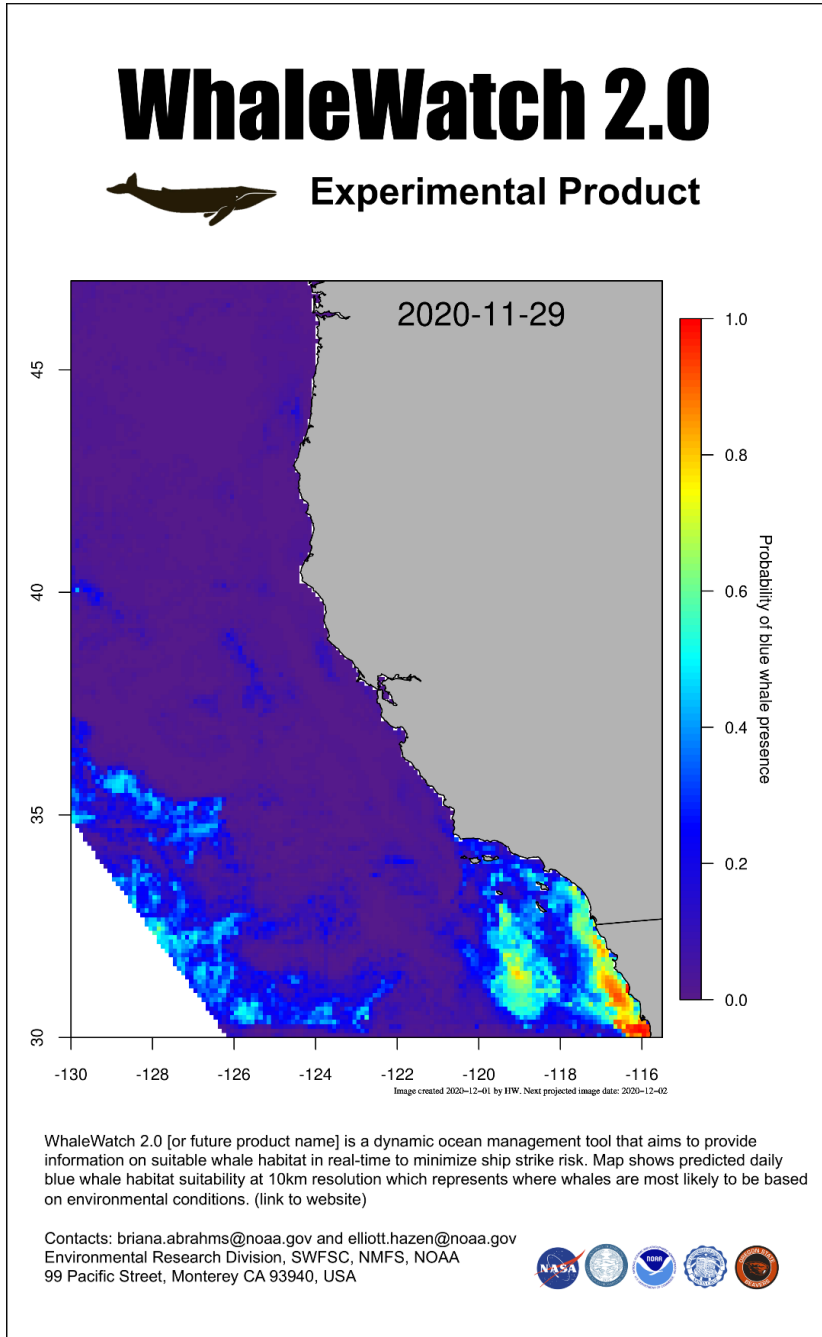


Figure 17. Example WhaleWatch 2.0 map.