State of California
Department of Fish and Wildlife

Memorandum

Date: November 1, 2019

To: Charlton H. Bonham
Director
Department of Fish and Wildlife

From: Craig Shuman, D. Env.
Marine Regional Manager

Subject: Commercial Dungeness Crab Entanglement Pre-season Risk Assessment

On October 15 and 31, 2019 the California Dungeness Crab Fishing Gear Working Group (Working Group) met to review available data and provide a recommendation to the Director based on the Risk Assessment and Mitigation Program (RAMP) framework. Based on this review and with additional support from RAMP factor experts, the four RAMP factors were evaluated by the Working Group as follows:

- Entanglement: not applicable
- Marine life concentrations: risk is moderate and decreasing
- Ocean conditions and forage: risk is moderate/low and decreasing
- Fishing dynamics: risk is low

The Working Group's majority recommendation, minority recommendation, and data relied upon are enclosed.

Based on the above risk assessment, at its October 31 meeting the Working Group majority recommended the Director not impose any mandatory management measures on the fleet. The Working Group majority recommended that the Central and Northern Management Area open as scheduled (November 15 and December 1, respectively), presuming that delays are not warranted due to human health risks or low crab quality.

The Working Group also provided a minority recommendation. In consideration of the number of whales still present, a minority of Working Group members recommended a delay in the season opener from November 15 to December 1.

Marine Region staff have independently reviewed all available data, the risk assessment factors, the factors outlined in Fish and Game Code section 8276.1(c) regarding a significant entanglement risk, and the potential impacts to the fishery. Recent aerial survey data indicate high levels of marine life, specifically species protected under the Endangered Species Act, including Humpback and Blue whales. Based on this independent analysis of the RAMP factors, and informed by the

majority and minority opinions expressed by the Working Group and its advisors, the Marine Region recommends a season delay in the Central Management Area (south of the Mendocino/Sonoma County line) of eight days due to a significant risk of entanglement. A season delay of eight days will provide additional opportunity for whales and turtles to begin their southern migration prior to the start of the commercial fishery. An eight-day delay will also preserve the ability for the fleet to provide crab for the Thanksgiving Holiday, an important cultural and economic opportunity for the state of California.

Attachments:

- Commercial Dungeness Crab Fishery Closure CEQA Overview Memo
- Notice of Exemption- Appendix E
- Attachment to Notice of Exemption
- RAMP 2019-20 Management Recommendations Form – Recommendation 10/15/19
- RAMP 2019-20 Pre-Season Risk Assessment – 10/15/19
- RAMP 2019-20 Management Recommendations Form – Recommendation 10/31/19
- RAMP 2019-20 Pre-Season Risk Assessment – 10/31/19
- Preliminary Determination of Significant Entanglement Risk Notice

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

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

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

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

California Dungeness Crab Fishing Gear Working Group (Working Group)
Risk Assessment and Mitigation Program (RAMP) 2019-20 Management Recommendations Form
Discussion Date: October 31, 2019; Recommendation Finalized: November 1, 2019
Note: this recommendation form is intended to supplement the Working Group's October 18, 2019 recommendation with a minority opinion expressed by Working Group membership as an alternative management recommendation (D).

The Working Group's discussion was informed by the pre-season data compilation provided by CDFW[1], in partnership with Working Group advisors and partner agencies, on October 30, 2019 as well as information provided and discussed during the October 15, 2019 meeting. Working Group advisors also provided additional input during the meeting. A majority (15 members) of the Working Group supported the recommendation put forward on October 18, 2019. A minority opinion was developed as an alternative and is summarized below to supplement the prior recommendation.

D. Alternatives
A minority (7 members) of the Working Group generally concurred with the risk levels as specified in the October 18, 2019, recommendation but suggested a more precautionary approach would be to delay the opening of the Central Management Area until December 1, 2019. This was recommended out of concern that opening the season on November 15 when a significant numbers of whales are present, could result in an entanglement, jeopardizing the rest of the fishing season. The Working Group requested that CDFW provide for an orderly opening, including a pre-soak period which would be broadly communicated to the fleet. Communications should also specify that this delay does not trigger fair start provisions for the Northern Management Zone. CDFW, in partnership with other agencies and advisors, should continue to monitor key data streams and reconvene the Working Group if updated information suggests risk due to marine life concentrations has abated. At that time, the Working Group could recommend an opening prior to December 1, 2019.

Discussion around of the minority recommendation included the fact that a delayed opener would pose significant economic hardship to the fleet if it lost access to the Thanksgiving Holiday market. However, this delay is expected to benefit the annual whale migration, (Humpback and Blue whales) who typically begin their southbound migration in mid-November. A delayed commercial opener would help to reduce risk of entanglement due to co-occurrence with commercial fishing gear. Recent aerial surveys conducted by NOAA on October 22, 24, and 25, 2019 indicated a significant number of Humpback and Blue whales in the Central Management Zone.

The Working Group also discussed opening the Central Management Area on time but with a specified reduction in the number of traps which can be fished between November 15 and December 1. Due to concerns about implementation and equity among the 7 trap tiers, the minority in favor of management action decided to recommend season delay.

[1] https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=174925&inline

Available Data: 2019-20 Pre-Season Risk Assessment
Compiled for October 31, 2019 Working Group Discussion

Last updated: October 31, 2019[1]

FACTOR: ENTANGLEMENTS

Data provided by: Dan Lawson and Lauren Saez

Entanglements, known CA commercial Dungeness crab

- 2018-19 season: 1 humpback whale, 0 blue whales, 0 leatherbacks
- After close of 2018-19 season: 3 humpback whales, 0 blue whales, 0 leatherbacks
- During 2019-20 season: n/a for pre-season risk assessment

Entanglements, confirmed, unknown gear

- 2018-19 season: 1 humpback whale (likely other fishery), 0 blue whales, 0 leatherbacks
- After close of 2018-19 season: 3 humpback whales (1 likely other fishery), 0 blue whales, 1 leatherback (likely other fishery, not Dungeness crab)
- During 2019-20 season: n/a for pre-season risk assessment

FACTOR: OCEAN AND FORAGE

Data provided by: Karin Forney and Scott Benson; see Appendix

- Bait balls of schooling fish (likely anchovies) observed in many areas with humpback whales.
- No surface krill observed.
- Abundant sea nettles (main leatherback prey species) and many medium and large molas (feed on sea nettles, often co-occur with leatherback turtles) observed between Farallon Islands and Año Nuevo.

FACTOR: MARINE LIFE CONCENTRATIONS

Data provided by: Karin Forney and Scott Benson; see Appendix

Species: Humpback Whales

Aerial Surveys, National Marine Fisheries Service (October 22-24, 2019)

- Most whales were observed in the central coast (104 individuals), although some were also spotted between Cape Mendocino and Crescent City (11 individuals) and between Port Sal and Port San Luis (7 individuals)

Species: Blue Whales

Aerial Surveys, National Marine Fisheries Service

- 6 blue whales were observed in waters 100-110 fathoms between Monterey Canyon and Año Nuevo

Species: Leatherback Sea Turtles

Aerial Surveys, National Marine Fisheries Service (October 22-24, 2019)

- No leatherback turtles observed, despite good habitat between the Farallon Islands and Año Nuevo

[1] Most recent domoic acid testing results included

Tagging Data, National Marine Fisheries Service

- Of the two leatherbacks which were still foraging in the Gulf of the Farallones in mid-October, one departed coastal waters on 10/27 and appears to have initiated it's winter migration. One was still foraging in the Gulf of the Farallones as of 10/28.
- A third turtle, which initially swam to Southern California after tagging, swam up the coast to Piedras Blancas before turning south and offshore on 10/27; currently 50 miles WNW of Point Arguello.

FACTOR: FISHING DYNAMICS

Data provided by: California Department of Fish and Wildlife and California Department of Public Health

Domoic Acid

CDPH SUMMARY OF DOMOIC ACID LEVELS IN CRABS **JULY 1, 2019 - OCTOBER 28, 2019**

PORT	AREA	SAMPLE COLLECTION DATE	CRAB TYPE VISCERA	INDIVIDUAL SAMPLE RESULTS (FDA ACTION LEVEL >30 PPM)	AVERAGE LEVEL (Information Only)	PERCENT OF SAMPLES EXCEEDING ACTION LEVEL
Crescent City	George Reef	10/2/2019	Dungeness	<2.5, 3.6, 7.1, 5.6, 8.5, 4.3	4.9 ppm	0%
	Klamath River	10/3/2019	Dungeness	4.8, 2.7, <2.5, <2.5, <2.5, 6.0	2.3 ppm	0%
Trinidad	Trinidad North	10/2/2019	Dungeness	3.7, <2.5, <2.5, <2.5, 2.6, <2.5	1.1 ppm	0%
	Trinidad South	10/2/2019	Dungeness	2.7, <2.5, <2.5, 2.5, <2.5, <2.5	0.9 ppm	0%
Eureka	LP Eureka	10/2/2019	Dungeness	<2.5, <2.5, 3.0, <2.5, 3.0, 5.2	1.9 ppm	0%
	Eel River	10/2/2019	Dungeness	<2.5, <2.5, <2.5, <2.5, <2.5, 3.5	0.9 ppm	0%
Fort Bragg	**Usal**	10/12/2019	Dungeness	6.1, **32**, 4.1, 8.1, 13, 5.1	11.4 ppm	17%
	Point Arena	10/11/2019	Dungeness	3.8, 2.6, <2.5, 3.3, 4.4, 4.2	3.1 ppm	0%
Bodega Bay	Point Reyes	9/25/2019	Dungeness	4.9, 4.7, 6.1, 2.5, 4.3, <2.5	3.8 ppm	0%
	Bodega Head	9/25/2019	Dungeness	11, 9.5, 4.5, 19, **43**, **58**	24 ppm	33%
	Russian River	9/21/2019	Dungeness	24, <2.5, <2.5, <2.5, <2.5, <2.5	4 ppm	0%
	Salt Point	9/21/2019	Dungeness	<2.5, <2.5, <2.5, <2.5, 12, <2.5	2 ppm	0%
	Bodega Head	10/8/2019	Dungeness	27, 10, 6.9, 5.9, <2.5, 20	12 ppm	0%
	Bodega Head	10/19/2019	Dungeness	8.4, 7.8, 8.1, <2.5, 3.3, 7.2	5.8 ppm	0%
Half Moon Bay/ San Francisco	Pillar Point	9/27/2019	Dungeness	<2.5, <2.5, <2.5, <2.5, <2.5, <2.5	Non-Detectable	0%
	Pigeon Point	9/27/2019	Dungeness	2.6, <2.5, <2.5, <2.5, <2.5, <2.5	0.4 ppm	0%
	Farallones/ Golden Gate		Dungeness			
	Duxbury	10/15/2019	Dungeness	**39**, <2.5, <2.5, <2.5, 4.9, <2.5	7.3 ppm	17%
Monterey	Monterey Bay	9/29/2019	Dungeness	5.8, 3.4, 2.9, 14, 5.9, 13	7.5 ppm	0%
	Monterey Bay		Rock			
Morro Bay	Avila Beach	9/25/2019	Dungeness	<2.5, <2.5, <2.5, <2.5, <2.5, 3.5	0.6 ppm	0%
	Avila Beach	9/25/2019	Rock	<2.5, <2.5, <2.5, <2.5, <2.5, <2.5	Non-Detectable	0%

1 SET = 6 SAMPLES

Figure 1. Domoic Acid Testing Results for Dungeness and Rock Crabs as of October 28, 2019.

APPENDIX

CALIFORNIA DUNGENESS CRAB FISHING GEAR WORKING GROUP (WG)
2019-20 RISK ASSESSMENT AND MITIGATION PROGRAM (RAMP)
Summary of 22-25 Oct 2019 pre-season aerial survey and leatherback telemetry

(Prepared by Karin Forney and Scott Benson, NOAA/SWFSC; scientific advisors to the WG)

Survey Logistics:

The survey was conducted over three days (10/22. 10/24 and 10/25), completing all of the target transects for this pre-season survey (Southern Option B and Northern Option A). The transect lines included a zig-zag pattern between the coast and the 50-fm (92-m) isobath from Pt Conception to Monterey, and from about Gualala to the CA/OR border. Along the central coast, a more detailed survey was conducted along parallel east-west lines spaced every 6 nautical miles between Monterey and Gualala and extending from the coast offshore to the 110-fm (200-m) isobath. Surveys were led by Karin Forney, with a team that included one fisherman and one experienced aerial observer each day (see Table 1).

Table 1. Aerial survey teams for the three survey days.

DATE	REGION	COORDINATOR	AERIAL OBSERVER	FISHERMAN
10/22/19	Pt Conception to Año Nuevo	Karin Forney, NOAA/SWFSC	Lauren Saez, NOAA/WCR	Calder Deyerle, Moss Landing
10/24/19	Tamales Bay to CA/OR border	Karin Forney, NOAA/SWFSC	Melinda Nakagawa Upwell	Dick Ogg, Bodega Bay
10/25/19	Salt Pt. to just south of Pigeon Pt	Karin Forney, NOAA/SWFSC	Scott Benson, NOAA/SWFSC	Dick Ogg, Bodega Bay

The surveys were flown at 700 ft altitude and 100kts in a twin-engine, high-wing aircraft (Partenavia P-68), chartered from Aspen Helicopters, Inc. in Oxnard, CA. Karin Forney recorded all data into a laptop connected to a GPS, while the observers and fisherman searched through 1) a downward facing belly window and 2) through bubble windows on the non-glare side of the plane. We systematically recorded all whales, dolphins, porpoises, surface-visible 'bait balls' of anchovies or other fish, ocean sunfish (*Mola mola*), turtles, and any fishing gear, covering a strip that extended from directly below the plane (90 degrees declination angle) out to an angle of 35 degrees (about 300 m or 0.16 nautical miles to the side). Dolphins and porpoises were also recorded when on transect lines. To provide additional spatial information on whales, we also recorded any whales outside of that strip as 'opportunistic' sightings. These opportunistic sightings are coded differently in our data file, allowing them to be excluded from any analyses that relies on the systematic strip-survey data. To provide the most complete information for the Working Group, all systematic and opportunistic sightings are included in the plots below; however, they could be plotted separately or with different symbols if desired.

Figure 1. One of the two Partenavia P-68 aircraft used during the surveys, with the October 22, 2019 aerial survey team: Calder Deyerle, Karin Forney, and Lauren Saez.

Survey Results:

Weather was mostly good to excellent, with light winds and mostly sunny skies. The only exceptions were two windy sections near Pt. Sur and around Cape Mendocino (Beaufort sea state 5), and portions of the lines between Bodega Bay and Pt. Arena, where smoke from the Kincade Fire reduced visibility somewhat. Overall, however, conditions were very good for observing whales and other marine life. The combined surveys required just over 24 hrs of flight time (including transits to/from aircraft base in Oxnard, CA).

Key observations:

1. **Humpback whales:** During the combined surveys, there were 68 sightings of an estimated 122 humpback whales. Most of these whales (104 individuals) were observed in the central coast region, but 11 humpback whales were documented from Cape Mendocino to Crescent City, and 7 humpback whales were observed between Pt. Sal and Pt San Luis in the southern area.
2. **Other whales:** Four groups of six total blue whales were documented in waters of about 100-110 fm depth between Monterey Canyon and Año Nuevo. One fin whale was observed just north of Cape Mendocino, and a group of four killer whales was documented near Pt. Arena.
3. **Whale prey:** Bait balls of schooling fish (most likely anchovies) were observed in many of the areas with humpback whales, suggesting that these whales were feeding on anchovies. No surface krill was documented.
4. **Leatherback turtles:** No leatherback turtles were observed during the Oct 22-25 surveys, but the flights documented good leatherback habitat from about the Farallon Islands to Año Nuevo, with abundant sea nettles (the leatherback's main prey species) and many medium/large molas (ocean sunfish, which also feed on sea nettles and are often found in the same areas as leatherback turtles). Two of the previously tagged leatherback turtles continued to forage within the Gulf of the Farallones, although one of the two turtles left coastal waters on 10/27/2019 and appears to have initiated the winter migration to subtropical waters of the eastern North

Pacific. The other foraging leatherback turtle remains in the Gulf of the Farallones as of 10/28/2019 (see Figure 5 below). A third turtle, which initially swam southward into waters of Southern California after tagging, spent the last week swimming back up the coast to about Pt. Piedras Blancas and then turned south and offshore on 10/27/2019. The most recent position is about 50 miles WNW of Pt. Arguello, and it is unknown whether this animal will return to coastal waters or start the southward migration.

5. **Fishing activity:** There were several areas with active or apparent derelict fishing gear. Fishermen Calder Deyerle and Dick Ogg on our flights noted likely rock crab, slime eel, spot prawn, and coonstrip shrimp gear, along with individual pots that were consistent with Dungeness crab gear.
6. **Other species:** We also observed numerous sightings of smaller marine mammal species, including harbor porpoises, Dall's porpoises, Risso's dolphins, common dolphins, bottlenose dolphins, sea otters, and pinnipeds (seals and sea lions).

FIGURES 2-4: WHALE AND FISHING GEAR PLOTS:

Completed survey transects (gray lines), locations of whales, fishing gear and anchovy balls. Light blue lines show the 27 fm, 55 fm and 110 fm (= 50m, 100m and 200m) isobaths. Whale numbers indicated in the plots represent a minimum number of animals present, because whales that are diving when the plane passes overhead cannot be detected. A few whales could not be identified because they dove or were too distant when seen.

SOUTH-CENTRAL REGION (Pt. Conception to Monterey)

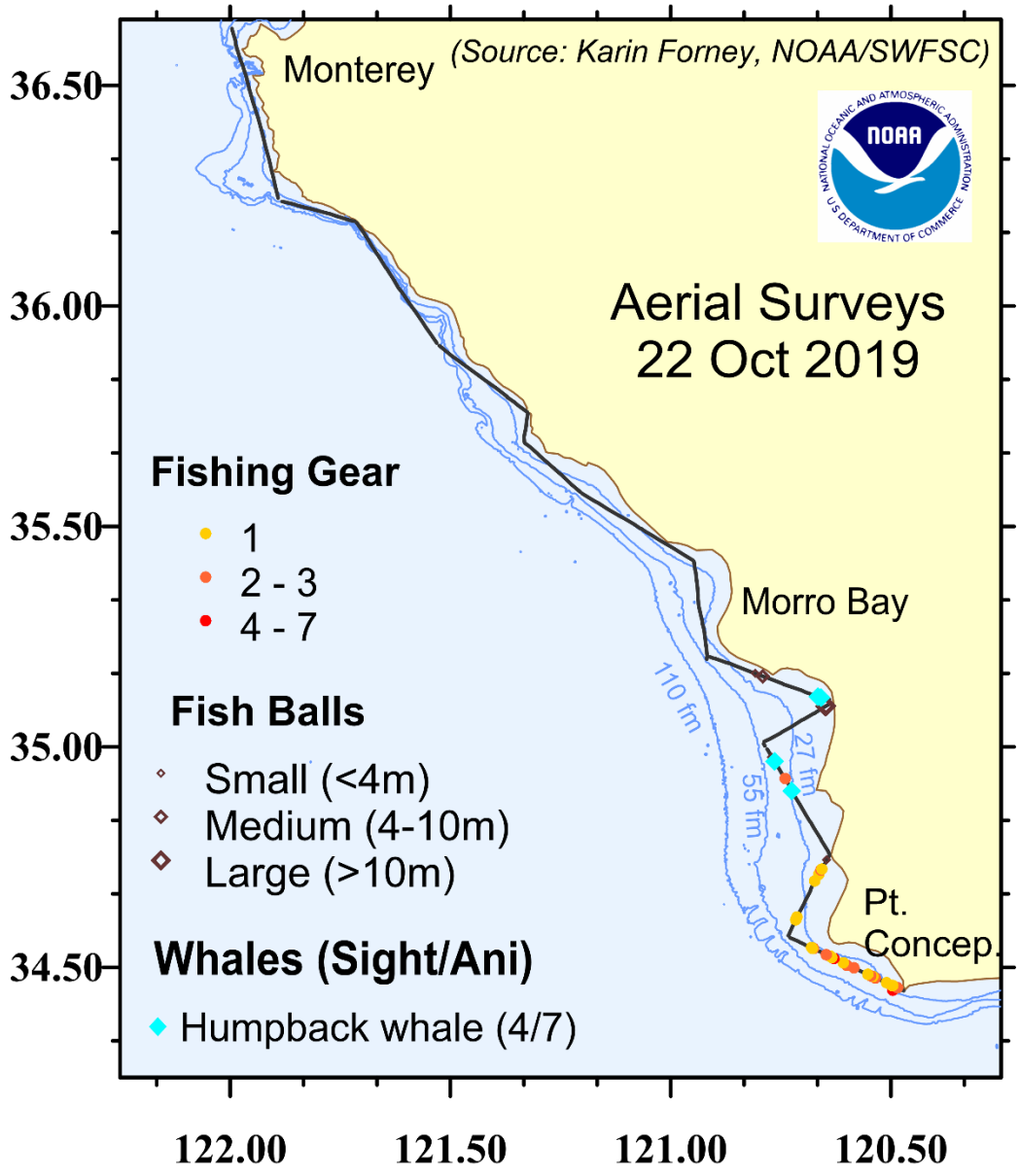


Figure 2. South-central coast aerial surveys, 22 Oct 2019

CENTRAL COAST REGION (Monterey to Gualala):

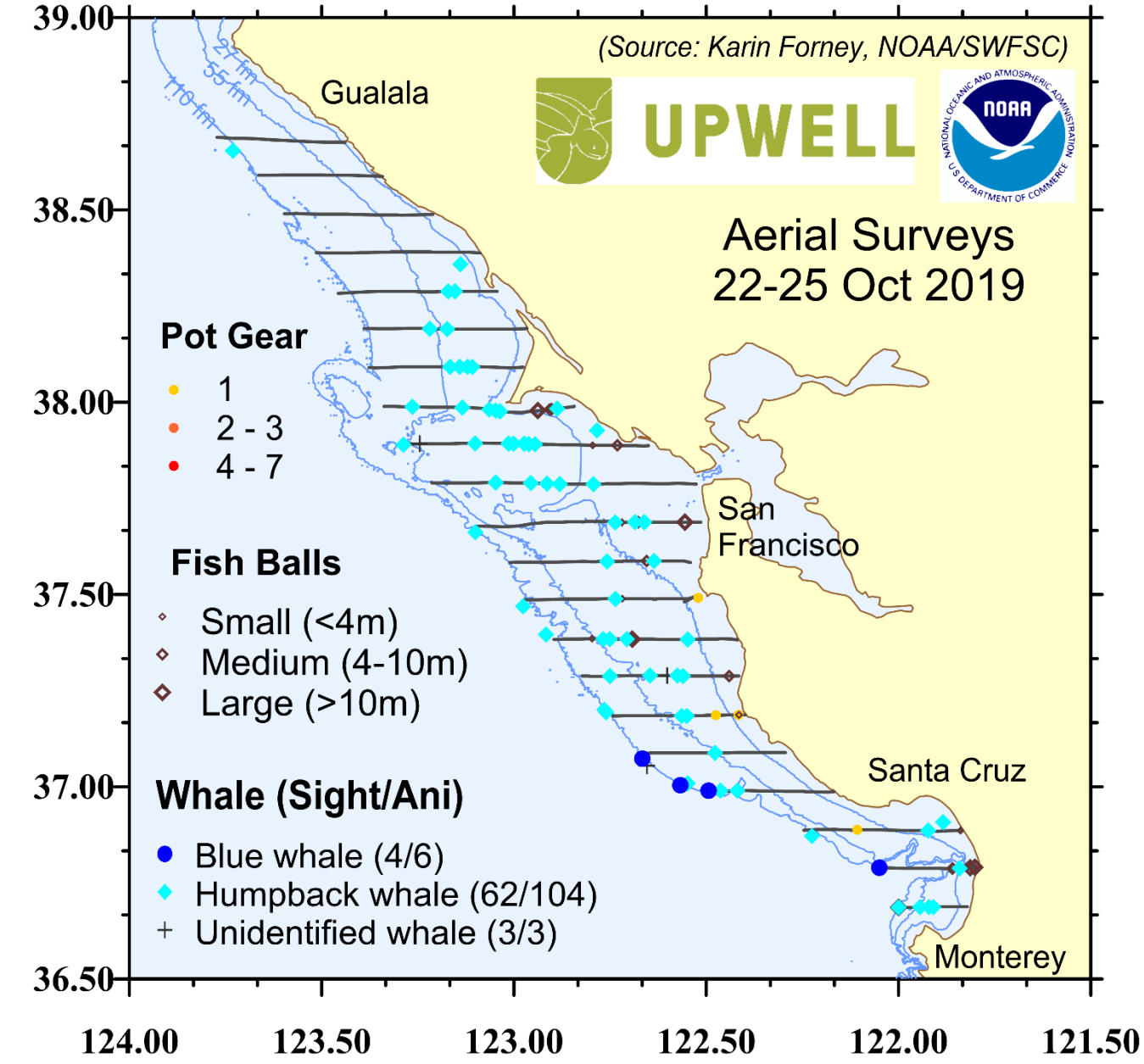


Figure 3. Central coast aerial surveys, 24-25 Oct 2019.

NORTHERN COAST REGION (Gualala to California/Oregon border):

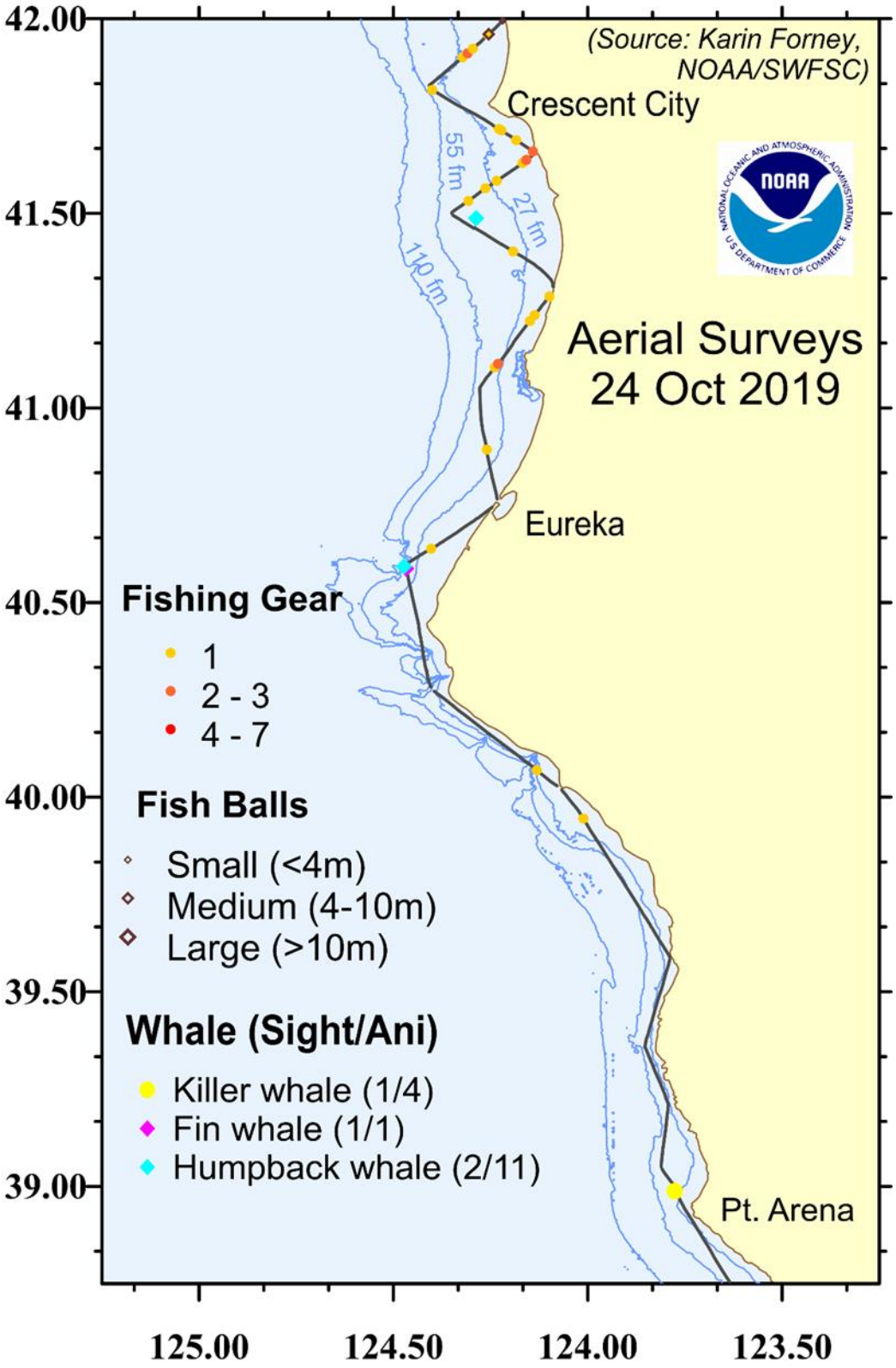


Figure 4. North coast aerial surveys, 24 Oct 2019.

FIGURE 5. LEATHERBACK PLOT

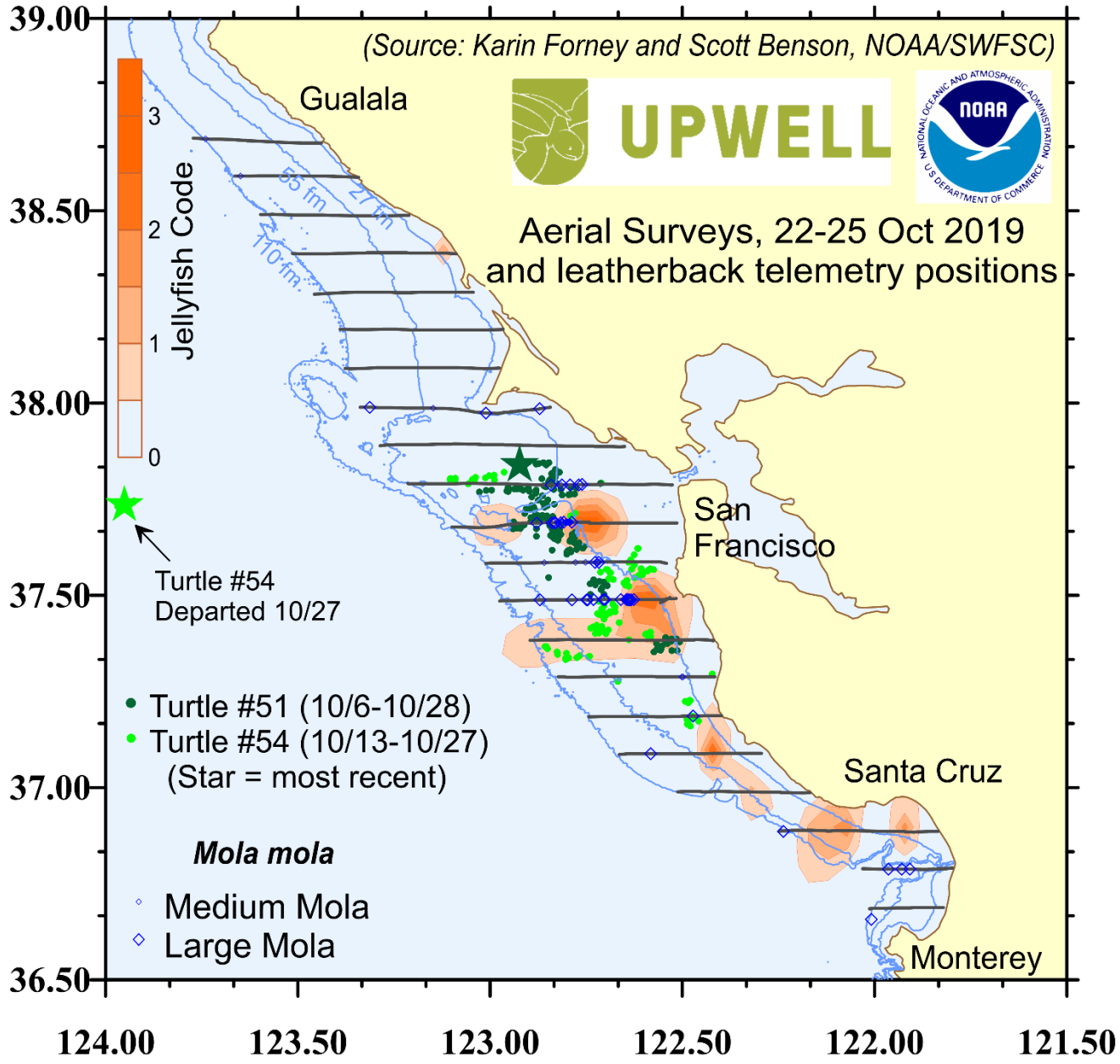


Figure 5. Leatherback habitat (jellyfish and molas) documented during the 24-25 October 2019 central coast aerial surveys, and telemetry positions for two tagged leatherbacks showing foraging movements during October 2019. Most recent leatherback positions are indicated with the star symbol. There was little evidence of leatherback habitat in the south-central and northern regions.

California Dungeness Crab Fishing Gear Working Group (Working Group)
Risk Assessment and Mitigation Program (RAMP) 2019-20 Management Recommendations Form
Discussion Date: October 15, 2019; Recommendation Finalized: October 18, 2019

The Working Group requests this recommendation, and information relied upon, be considered by the California Department of Fish and Wildlife (CDFW) Director prior to the November 1, 2019, risk determination. The Working Group plans to review additional updated information, if available, prior to the November 1 determination and may submit an updated Recommendation Form to the Director.

A. Identified risk(s) and severity
Based on the information available during the October 15, 2019, discussion, the Working Group's risk assessment associated with the four RAMP factors is as follows:

- **Entanglement: not applicable**
- **Marine life concentrations: risk is moderate and decreasing**
- **Ocean conditions and forage: risk is moderate/low and decreasing**
- **Fishing dynamics: risk is low**

Rationale supporting this risk assessment is provided in Section B. The Working Group's discussion primarily focused on risk assessment for Humpback whales and included risk assessment for Blue whales and Leatherback sea turtles based on the best available information.

B. Available information
The Working Group's discussion was informed by the pre-season data compilation (Data Compilation[1]) provided by CDFW, in partnership with Working Group advisors and partner agencies, on October 14, 2019. Working Group advisors provided additional input during the meeting. Rationale and key information which informed the above risk assessment are summarized below for each factor.

Entanglement - Rationale

- The season has not yet opened; therefore, this risk factor is not applicable.

Marine Life Concentrations - Rationale

- Humpback whales have been observed between the Gulf of the Farallones and Monterey Bay, and foraging on fish in both nearshore and offshore waters. Presence is decreasing in Monterey Bay, and was the highest it had been in the last couple of months in the Gulf of the Farallones.
- Humpback whale concentrations are typical for this time of year; their distributions normally shift prior to commencing their southbound migration in mid-November.
- Blue whales have been observed in very low numbers during spring and early fall surveys.
- Six Leatherback sea turtles were tagged during fall surveys; 4 have since left the California coast (possibly in response to capture/handling). Departure of the two remaining Leatherbacks will indicate when the foraging season begins to wind down, likely within the next 2-4 weeks.
- Please see pages 2-3 of the Data Compilation for additional available information.

Ocean Conditions and Forage - Rationale

- A large marine heatwave has emerged and is developing off the U.S. West Coast. This large marine heatwave is causing compression of upwelling habitat and restriction of cold water closer to the coast, which will likely persist over the next month. Monitoring the heatwave (area, extent) over the next few months is recommended.

[1] http://www.opc.ca.gov/webmaster/_media_library/2019/10/RAMP-Data_Pre-Season_2019-20_10142019.pdf

- In 2019, spring/summer ecosystem surveys indicated krill abundance was at the lowest level seen since 1998 and lower compared to the 2014-2016 heatwave. Aerial surveys conducted in early October 2019 documented surface swarms of krill which may indicate spawning.
- Anchovy abundance is at unprecedentedly high levels, over 2.5 orders of magnitude higher than previous years (see Figures 3a and 3b in the Data Compilation). Because young-of-the-year anchovy abundance is also increasing, the anchovy population will likely continue to expand and anchovies are expected to be both nearshore and offshore. This provides broadly dispersed anchovy foraging opportunities for Humpback whales (rather than concentrating Humpback whale feeding on anchovy bait balls nearshore).
- Generally, better anchovy feeding conditions are likely to result in Humpback whales meeting their nutritional needs and then beginning their southward migration.
- Brown sea nettle biomass has been very high and broadly distributed, although vessel surveys documented a few individuals displaying signs of seasonal senescence. Foraging is expected to continue off central California for a few more weeks.

Fishing dynamics - Rationale

- Risk was considered in terms of potential delay in season openers due to domoic acid.
- Widespread delays are not currently expected due to domoic acid levels; thus far, only one area (Bodega Bay) had samples which exceeded the domoic acid action level (see page 3 of the Data Compilation). Additional results from other areas, and re-testing for Bodega Bay, are anticipated within the next week.
- Results from quality testing in Northern Management Area ports will not be available until after the November 1 risk determination date.

C. Management recommendation(s)

The Working Group reviews and considers the RAMP Guiding Principles in the development of any management recommendation(s).

Based on the above risk assessment, the Working Group does not recommend the Director impose any mandatory management measures on the fleet at this time. The Working Group recommends that the Central and Northern Management Area open as scheduled (November 15 and December 1, respectively), presuming that delays are not warranted due to human health risks or low quality.

The Working Group recommends voluntary actions, including implementation of the Best Fishing Practices Guide, which includes best practices for surface-gear set-up, as well as slackline reduction, and using neutral buoyancy line. The Best Practices Guide is available on the Working Group's website.

The Working Group requests that CDFW, in coordination with the RAMP factor leads, continue to collect and review available information regarding entanglement risk, particularly with respect to marine life concentrations. If additional information from aerial surveys or other data streams suggest that the southbound migration of Humpback and Blue whales does not occur as expected in mid-November, the Working Group may submit a supplemental recommendation to the CDFW Director.

D. Alternatives

The Working Group arrived at the above recommendations by consensus. No minority recommendations were expressed.

Available Data: 2019-20 Pre-Season Risk Assessment
Compiled for October 15, 2019 Working Group Discussion

Last updated: October 14, 2019

Factor: Entanglements

Data provided by: Dan Lawson

Entanglements, known CA commercial Dungeness crab

- 2018-19 season: 1 humpback whale, 0 blue whales, 0 leatherbacks
- After close of 2018-19 season: 2 humpback whales, 0 blue whales, 0 leatherbacks
- During 2019-20 season: n/a for pre-season risk assessment

Entanglements, potentially CA commercial Dungeness crab

- 2018-19 season: 3 or 4 humpback whales, 0 blue whales, 0 leatherbacks
    - Also: 1 grey whale, 1 minke whale
- After close of 2018-19 season: 0 humpback whales, 0 blue whales, 0 leatherbacks
- During 2019-20 season: n/a for pre-season risk assessment

Factor: Ocean/Forage Conditions

Data provided by: Dan Lawson

Other Contributors: Scott Benson, John Calambokidis, Karin Forney, Jaime Jahncke, Jarrod Santora

Oceanographic indices (as of mid-September 2019)

- ENSO-neutral likely during fall 2019 (75% chance) and spring 2020 (55-60% chance); see Figure 1
- Large marine heatwave developing off US West Coast; previous large marine heatwave ("the Blob") coincided with unusual foraging conditions and record high entanglement reports; see Figure 2

IEA Forage indices (standardized survey data through 2018), with updates for 2019 by Jarrod Santora

- Anchovy biomass at relatively high levels in recent years; see Figure 3a and 3b
- Krill biomass at relatively low levels in recent years. Although 2017 and 2018 were good krill years, krill biomass in 2019 was at the lowest level since 1990; see Figure 3a and 3b
- Chrysaora biomass higher in recent years and trending upward; see Figure 3a

Aerial Surveys, National Marine Fisheries Service (Summer and Fall 2019)

- High levels of anchovy and other forage fish in nearshore waters; see Figures 4-8, Appendices 1 and 2
- Concentrated aggregations of Chrysaora and ocean sunfish near Pillar Point; see Figures 4-8, Appendices 1 and 2

ACCESS Vessel Surveys (September 2019)

- Typical late season ocean productivity, with scattered bait balls of krill and fish, copepods, and gelatinous invertebrates

Additional Reports (2019)

- High levels of anchovy and other forage fish in nearshore waters off California (Calambokidis, Santora)

- Low krill biomass in nearshore waters off California (Santora)

Factor: Marine Life Concentrations
Data provided by: Dan Lawson
Other Contributors: Scott Benson, Karin Forney, Jaime Jahncke

Species: Humpback Whales

Monterey Bay Whale Watch
- Humpbacks presence in Monterey Bay is declining (compared to summer and early fall); consistent with large numbers being seen in the Gulf of the Farallones and in deeper waters outside of Monterey Bay; see Figure 9

Cascadia Research Collective, tagging and surveys (Summer 2019)
- Relatively low presence of humpback whales in Monterey Bay
- Surveys between Half Moon Bay and Cordell Bank showed some humpback whales feeding on fish in nearshore waters but also concentrations along the edge of the continental shelf, farther offshore than typical

Aerial Surveys, National Marine Fisheries Service (September and October 2019)
- September 12-13, San Mateo to Bodega Bay: humpback whales seen throughout surveyed area, including a concentration inshore near Half Moon Bay; see Figure 4 and Appendix 1
- September 20, San Mateo to Half Moon Bay: humpback whales seen off Half Moon Bay, inshore of 40 fathom contour; see Figure 5 and Appendix 1
- October 2-8, Santa Cruz to Point Reyes: humpback whales abundant throughout the Gulf of the Farallones, with their distribution following movement of anchovy and krill patches; seen actively feeding on abundant fish balls (likely anchovies) and krill swarms; see Figure 6 and Appendix 2

ACCESS Vessel Surveys (September 2019)
- Humpbacks primarily distributed along the 200 meter isobaths
- Nearshore humpbacks feeding on small schooling fish across the continental shelf

Daily Shoreside Counts, Farallon Islands (Summer and Fall 2019)
- When conditions suitable, counts were low (< 5 humpback whales per day) in July (n = 10), more variable in August (n = 12), high in September (n = 1); see Figure 10

Species: Blue Whales

Monterey Bay Whale Watch
- Blue whales remain scarce within Monterey Bay; see Figure 9

Cascadia Research Collective, tagging and surveys (Summer 2019)
- Blue whale distribution father north than usual, with only one whale seen in the Southern California Bight and no whales seen in Monterey Bay
- Two blue whales tagged near Cordell Bank, both shifted north after tagging and were foraging off Fort Bragg although one later came down to Monterey

Aerial Surveys, National Marine Fisheries Service

- No blue whales seen

ACCESS Vessel Surveys (September 2019)

- Blue whales primarily distributed along the 200 meter isobaths

Daily Shoreside Counts, Farallon Islands (Summer and Fall 2019)

- When conditions suitable, counts were almost always low (< 5 humpback whales per day) in July (n = 10), August (n = 12), and September (n = 1); see Figure 10

Species: Leatherback Sea Turtles

Aerial Surveys, National Marine Fisheries Service (September and October 2019)

- September 12-13, San Mateo to Bodega Bay: 2 leatherback turtles seen; see Figure 7 and Appendix 1
- September 20, San Mateo to Half Moon Bay: 3 leatherbacks seen; see Figure 8 and Appendix 1
- October 2-13, Santa Cruz to Point Reyes: at least 6 unique leatherbacks observed foraging in waters 20-35 fathoms, 5 were captured and tagged; see Figure 6 and Appendix 2

Tagging Data, National Marine Fisheries Service

- Leatherback tagged on September 20 (see Figure 11) showed an abrupt change in behavior and movement after 30 September; Benson suspects that the strong winds we experienced on 28-29 September altered the environment and may have triggered the tagged turtle to leave the area and begin moving toward tropical latitudes. Has seen this happen in previous years. Sea surface temperature had dropped on 2 Oct to 13-14 degrees C from 16+ degrees C previously.
- Of the 6 leatherbacks tagged this season, 3 are in offshore areas or waters off of Southern California, and three are still foraging near Pillar Point and or east of the Farallon Islands (see Figure 12).

Factor: Fishing Dynamics

Data provided by: California Department of Fish and Wildlife and California Department of Public Health

Domoic Acid; see Figure 13

- Bodega Bay results: 33% of 9/25 samples exceed action level for Bodega Head area, second set sent to CDPH on 10/9; all other areas below action level
- Half Moon Bay: two of 4 areas have data available, all samples below action level
- Monterey samples: all samples below action level
- Morro Bay: all samples below action level
- Crescent City, Trinidad, Eureka: CDPH received samples October 8
- Fort Bragg: sample collection planned for next week (~ 10/14)

Supporting Figures

Figure 1. Oceanic Nino Index, 2013-2019. Updated October 7, 2019 by NOAA Climate Prediction Center. https://www.cpc.ncep.noaa.gov/products/analysis_monitoring/lanina/enso_evolution-status-fcsts-web.pdf.

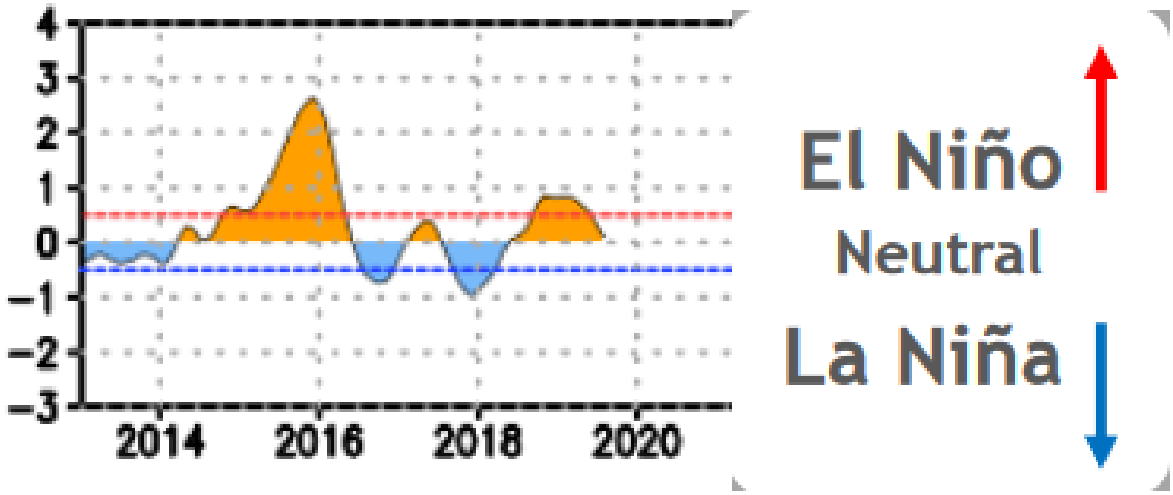


Figure 2. Sea Surface Temperature Anomaly, California Current ecosystem. Accessed October 9 2019 from https://www.integratedecosystemassessment.noaa.gov/regions/california-current/cc-projects-blobtracker.

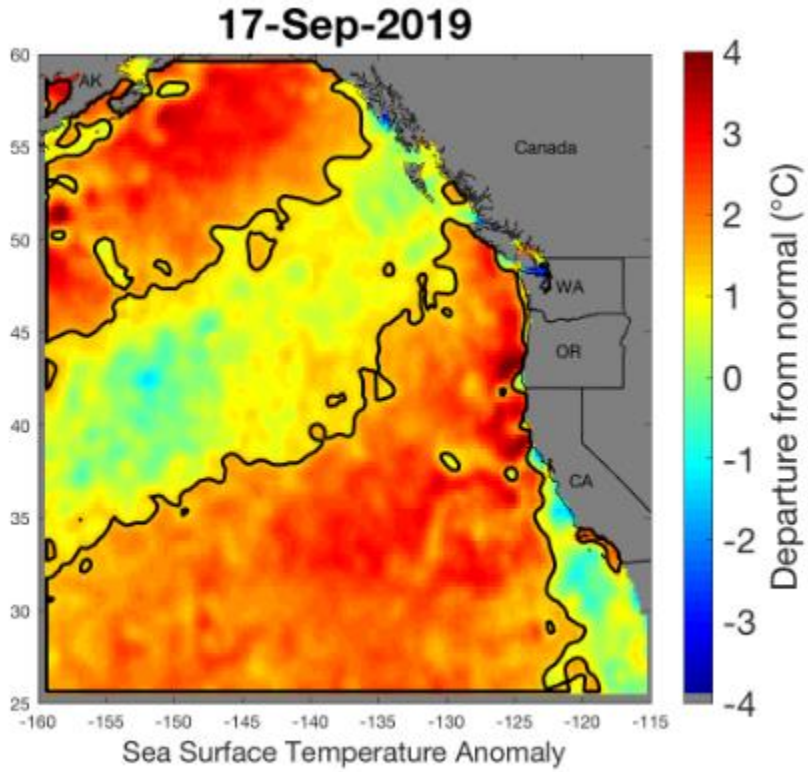


Figure 3a. Abundance of adult anchovy, young-of-the-year anchovy, krill, and Chrysaora (brown sea nettles) during Rockfish Recruitment and Ecosystem Assessment Surveys conducted by NMFS SWFSC. Data through 2018.

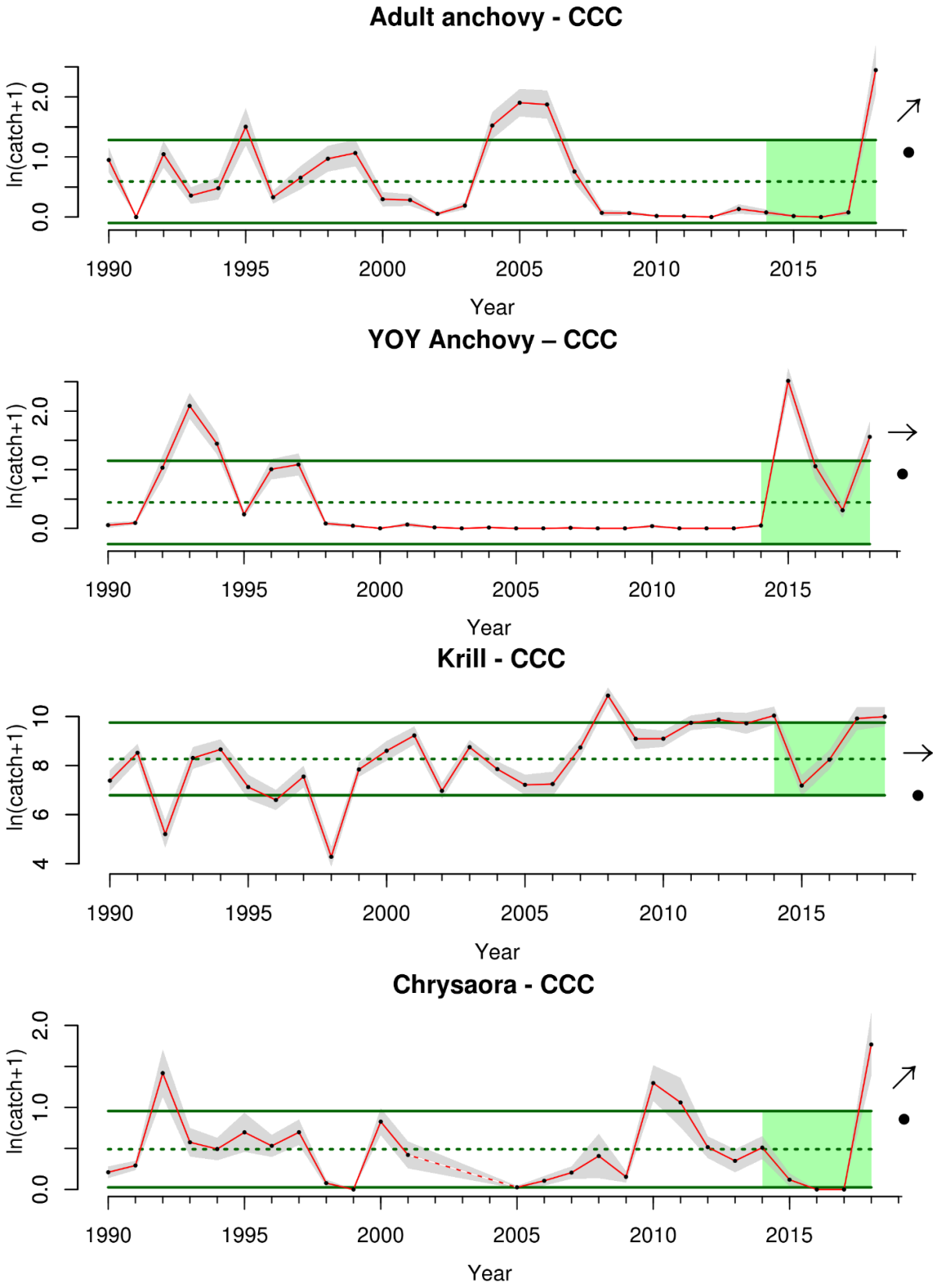


Figure 3b. Abundance of adult anchovy, young-of-the-year anchovy and krill during Rockfish Recruitment and Ecosystem Assessment Surveys conducted by NMFS SWFSC, updated from 2019 by Jarrod Santora.

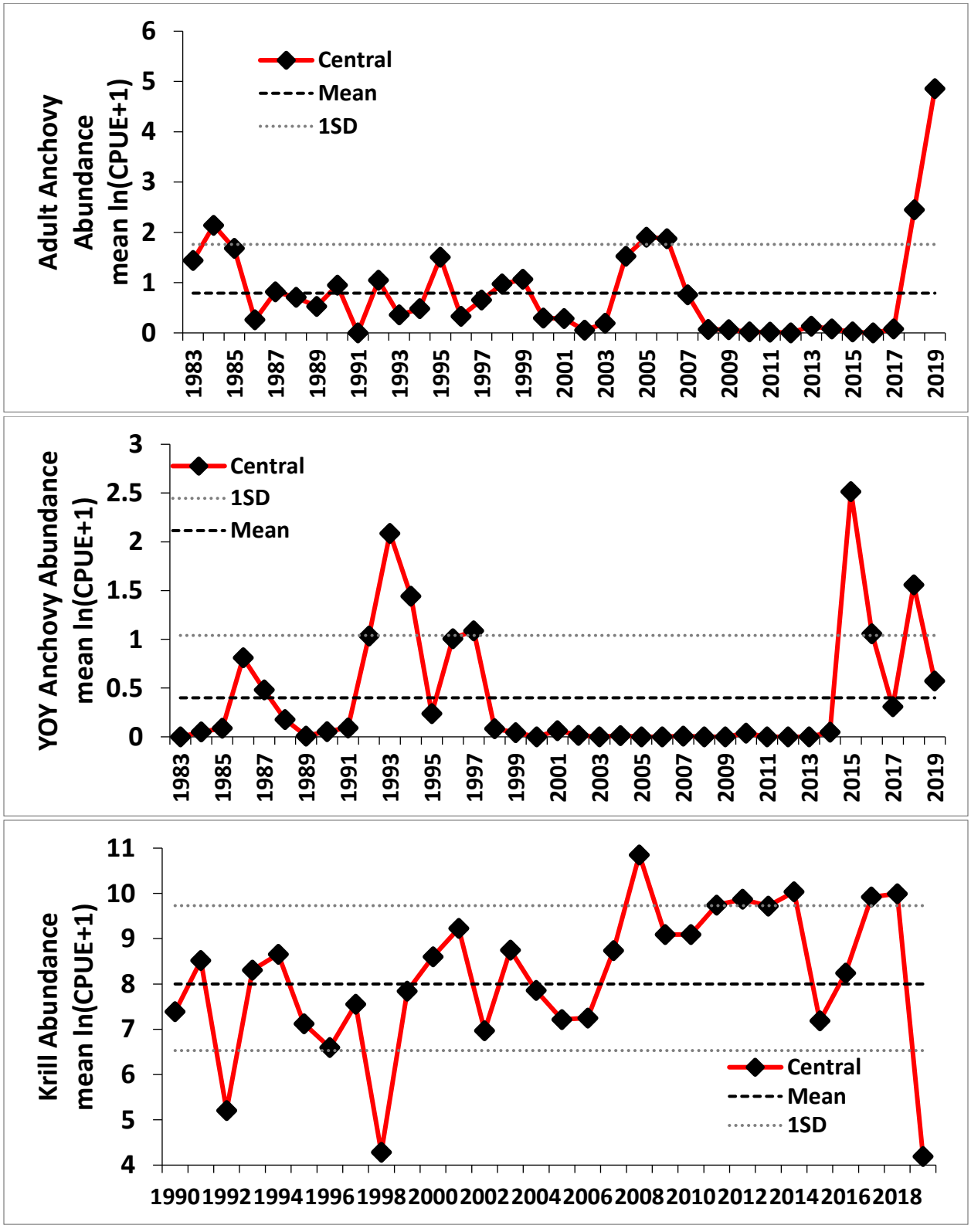


Figure 4. Aerial Survey showing distribution of Humpback Whales, pot gear, and bait balls; September 12-13, 2019.

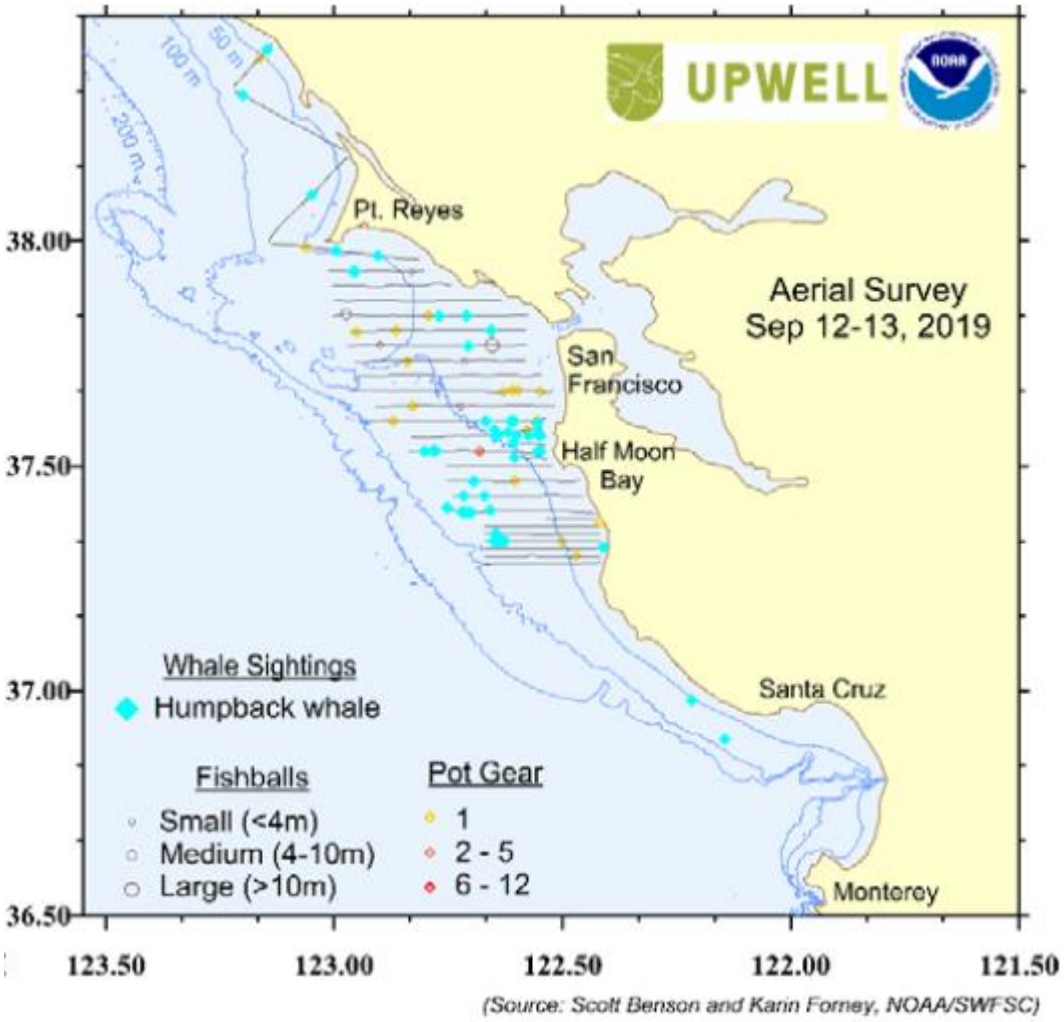


Figure 5. Aerial Survey showing distribution of Humpback Whales, pot gear, and bait balls; September 20, 2019.

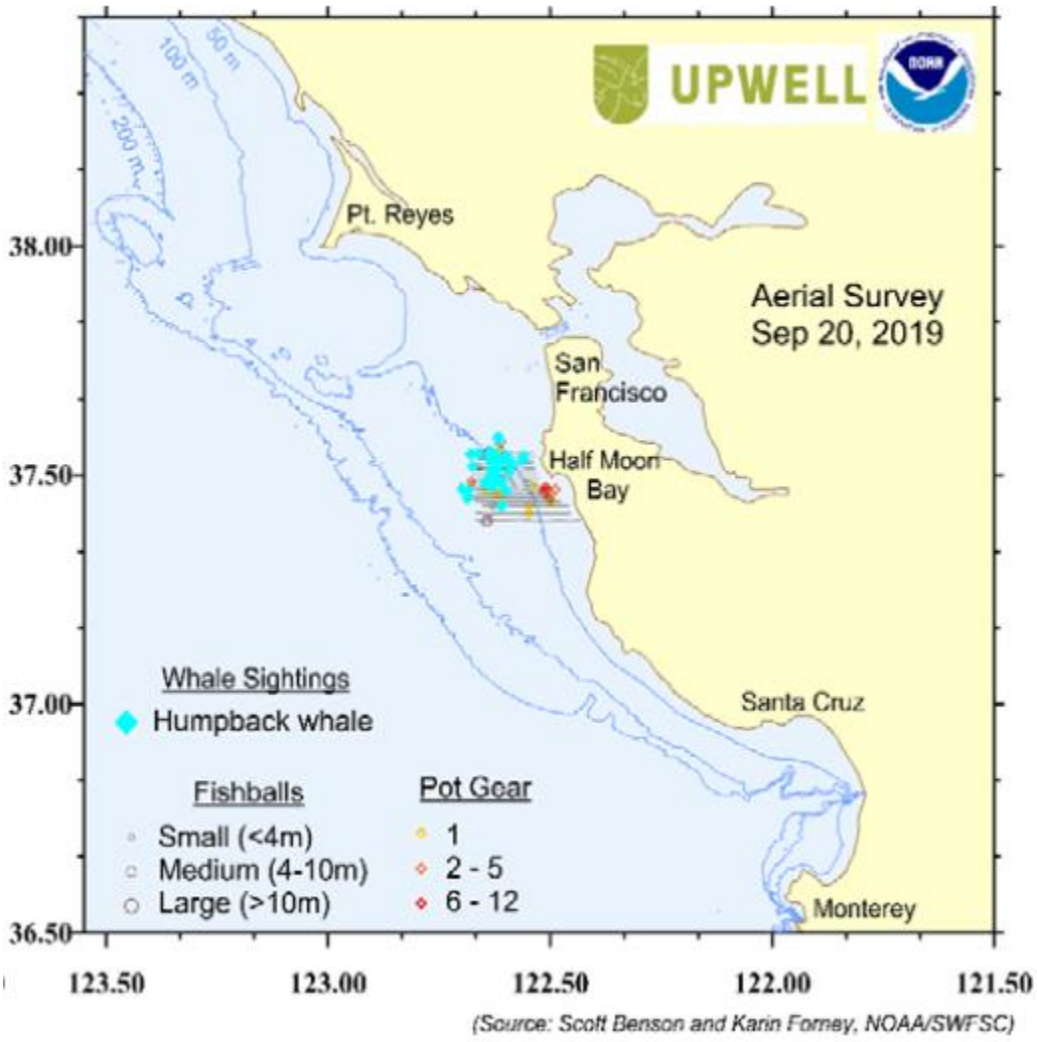
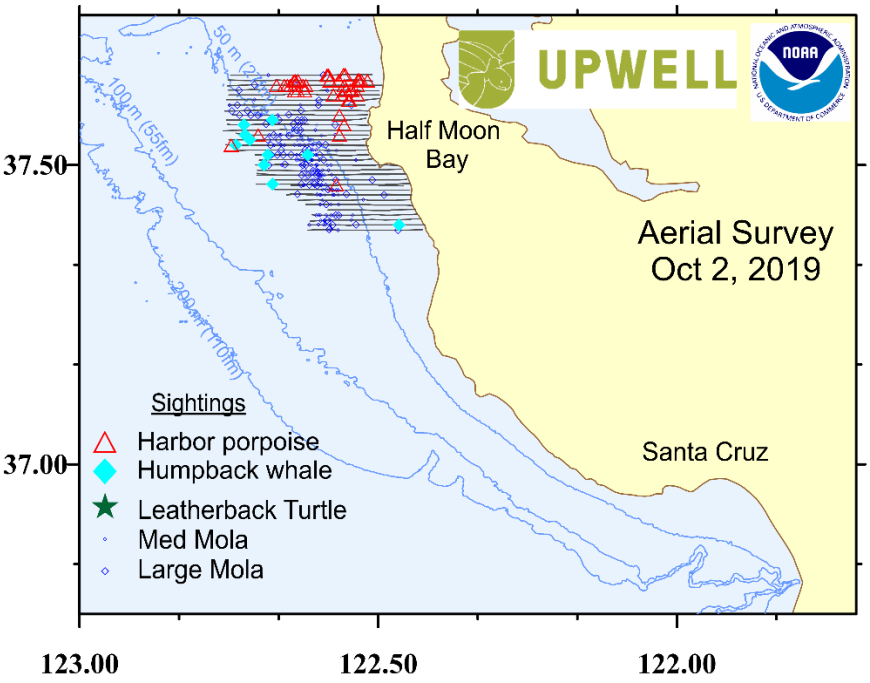
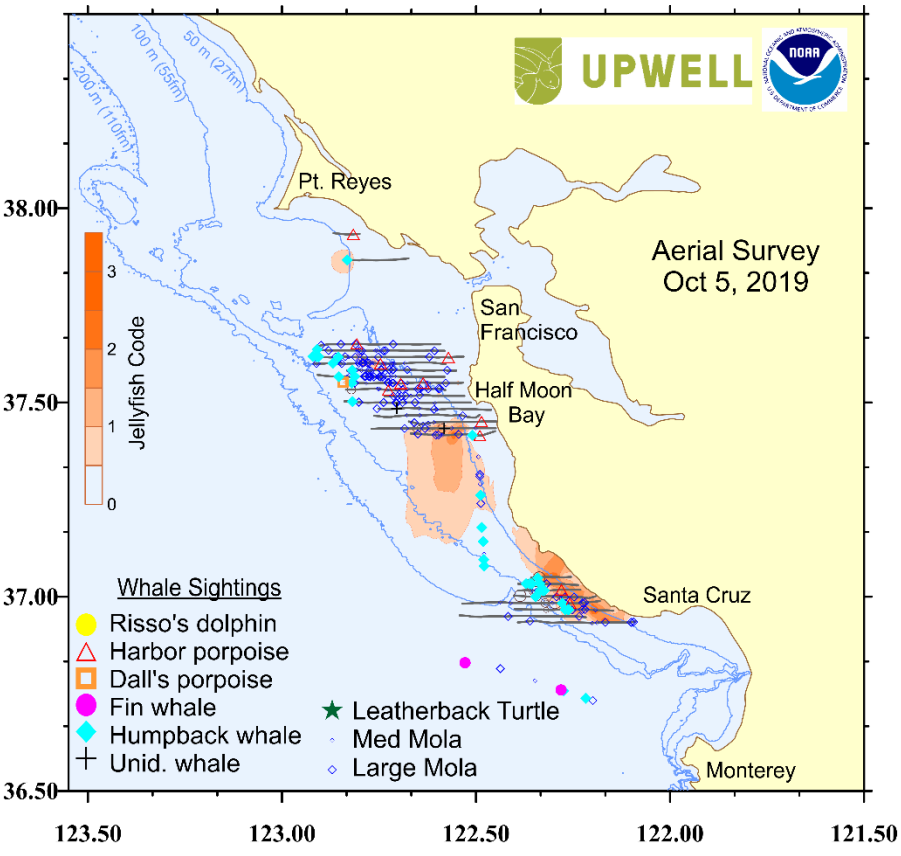


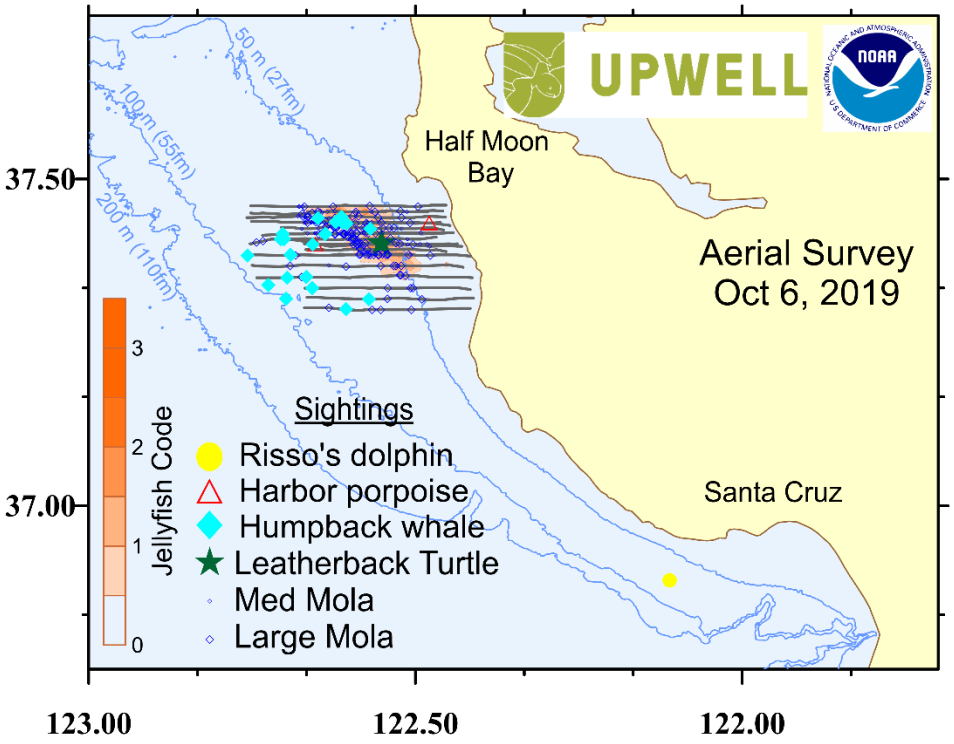
Figure 6. Aerial Survey showing distribution of marine mammals, Leatherback Turtles, Ocean Sunfish, pot gear, Chrysaora patches, and bait balls; October 2-13, 2019.



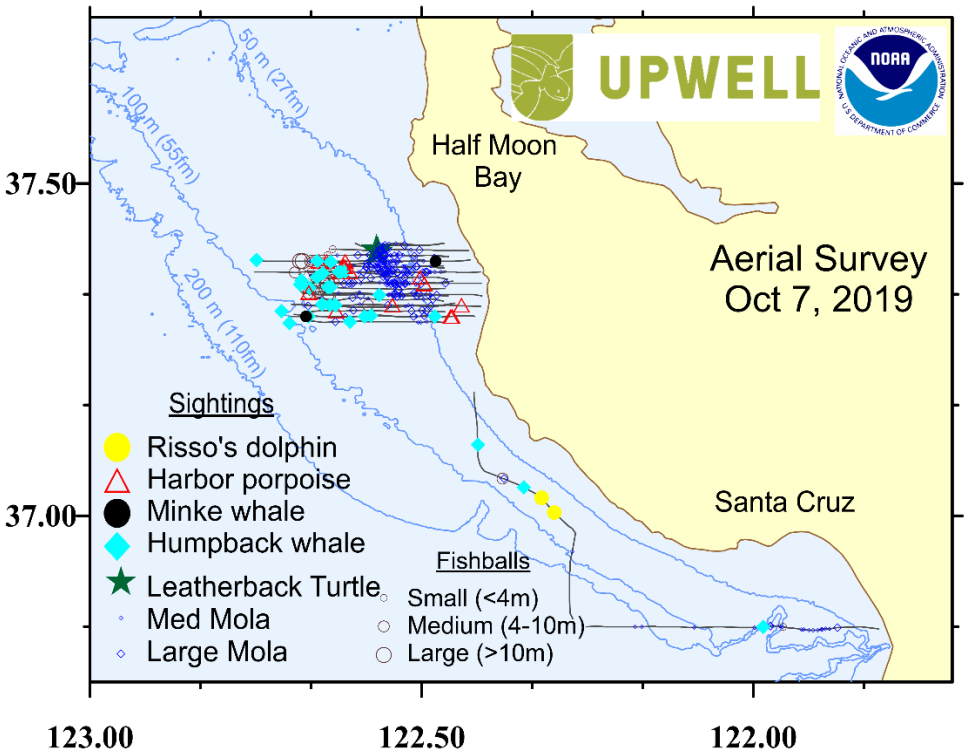
(Source: Scott Benson and Karin Forney, NOAA/SWFSC)



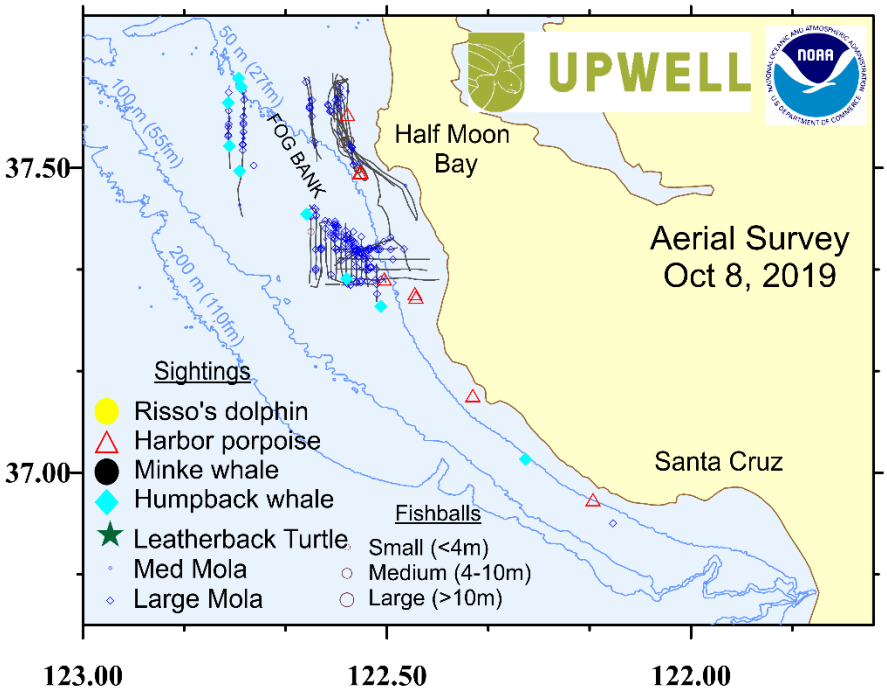
(Source: Scott Benson and Karin Forney, NOAA/SWFSC)



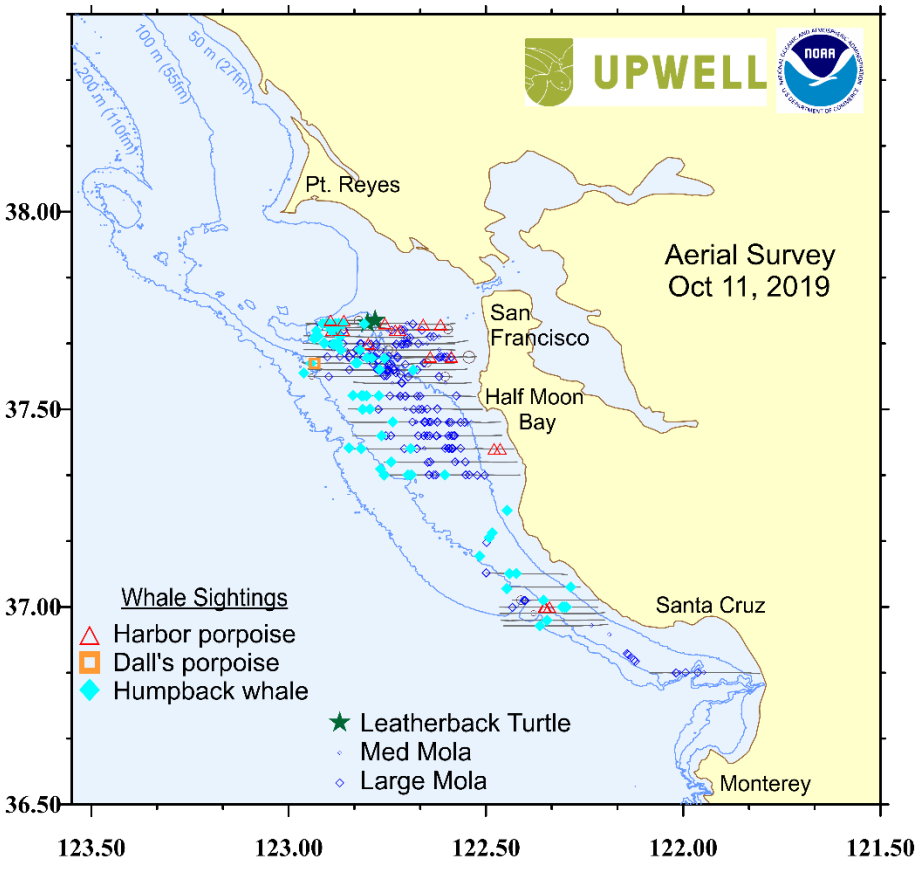
(Source: Scott Benson and Karin Forney, NOAA/SWFSC)



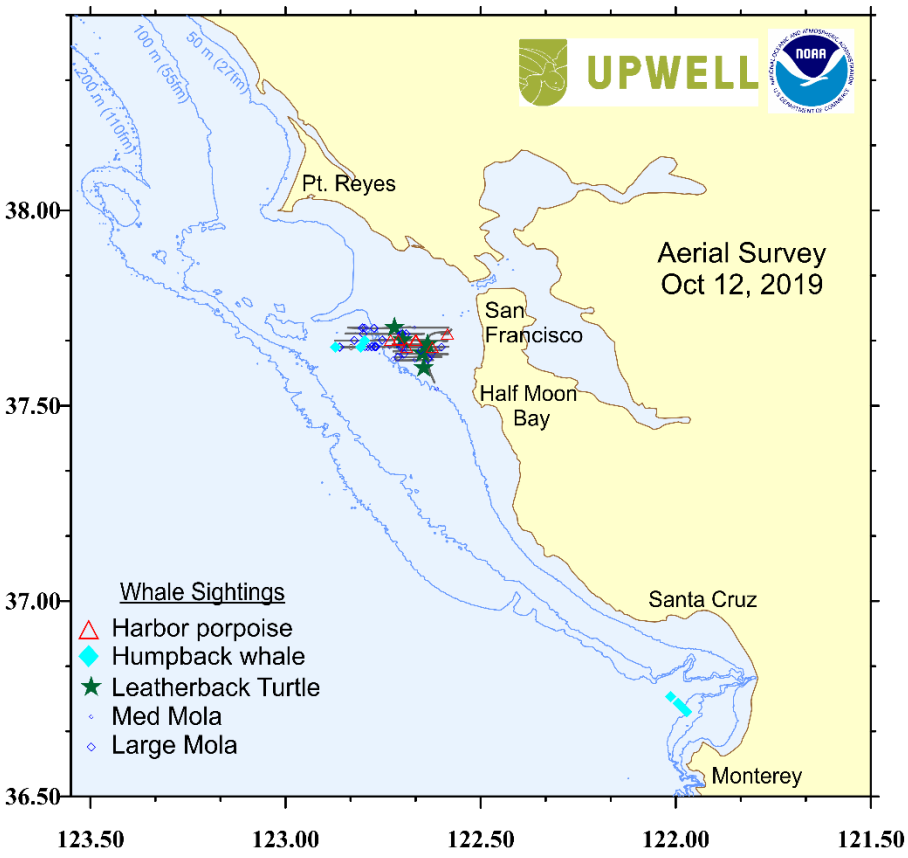
(Source: Scott Benson and Karin Forney, NOAA/SWFSC)



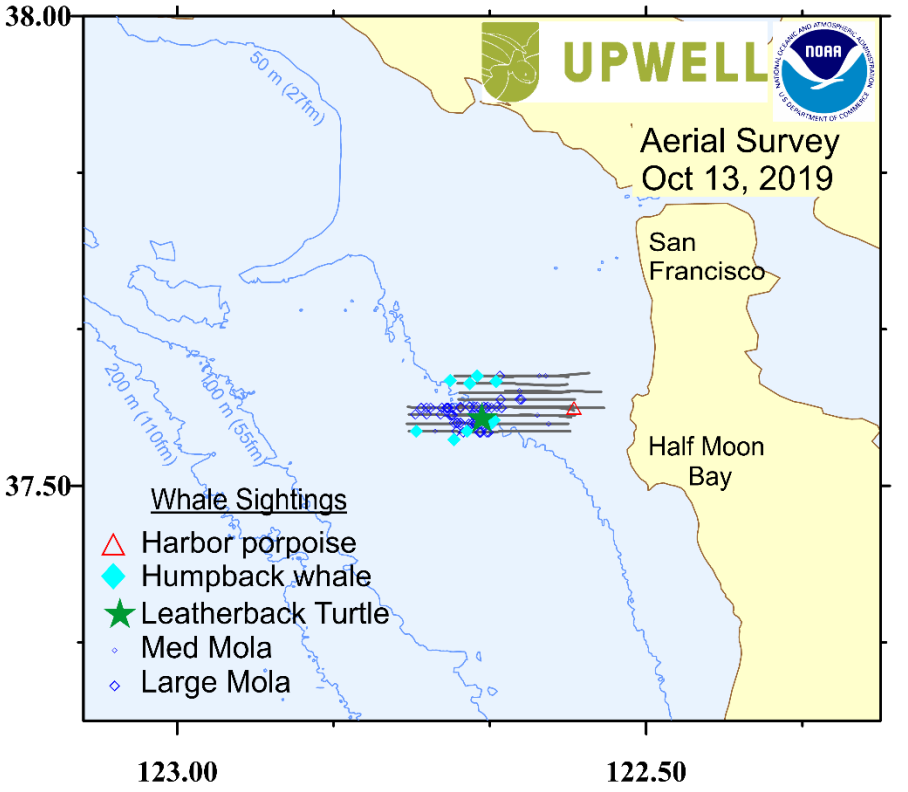
(Source: Scott Benson and Karin Forney, NOAA/SWFSC)



(Source: Scott Benson and Karin Forney, NOAA/SWFSC)



(Source: Scott Benson and Karin Forney, NOAA/SWFSC)



(Source: Scott Benson and Karin Forney, NOAA/SWFSC)

Figure 7. Aerial survey showing distribution of leatherback turtles, pot gear, mola molas, and brown sea nettles; September 12-13, 2019.

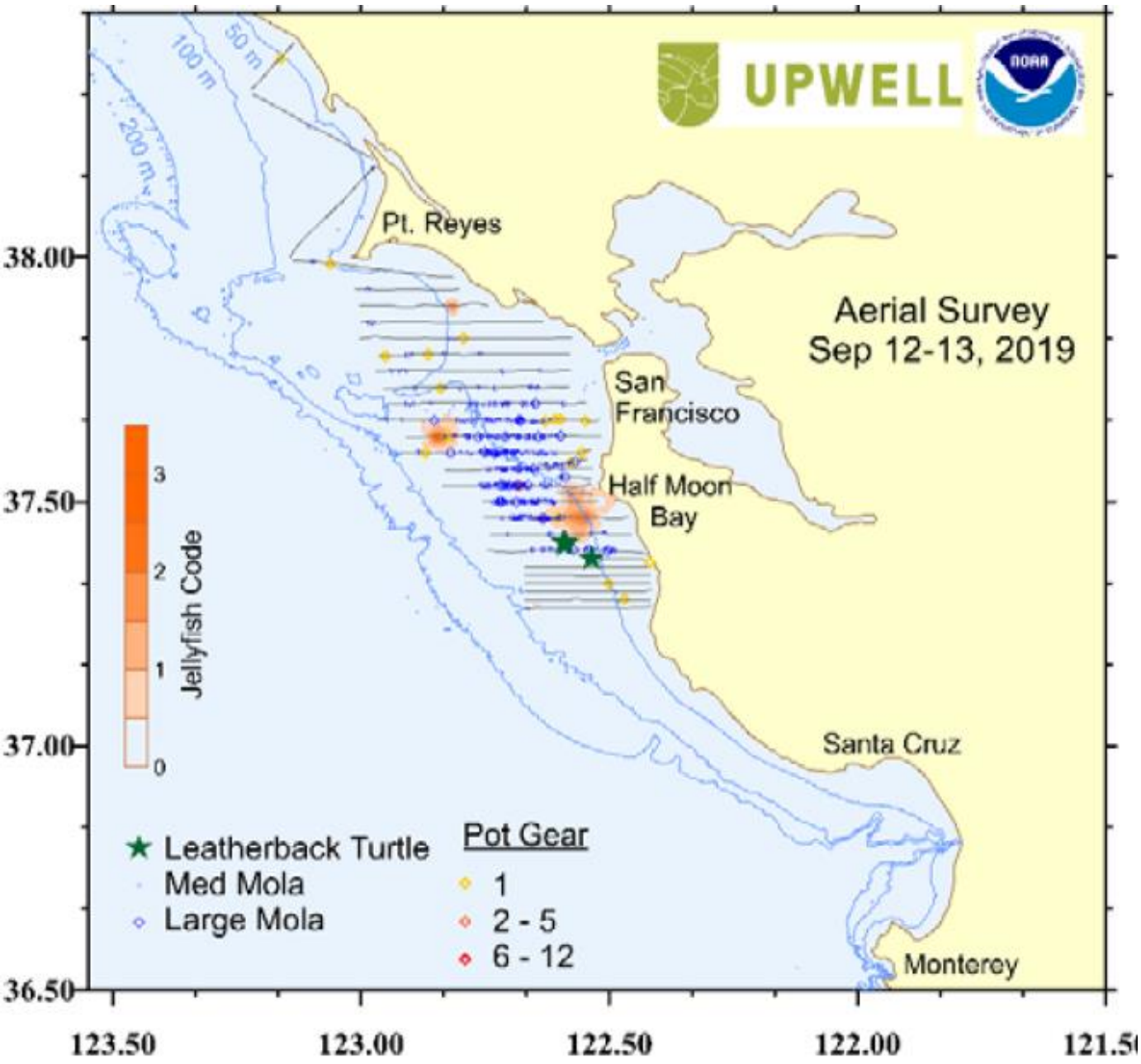


Figure 8. Aerial survey showing distribution of leatherback turtles, pot gear, mola molas, and brown sea nettles; September 20, 2019.

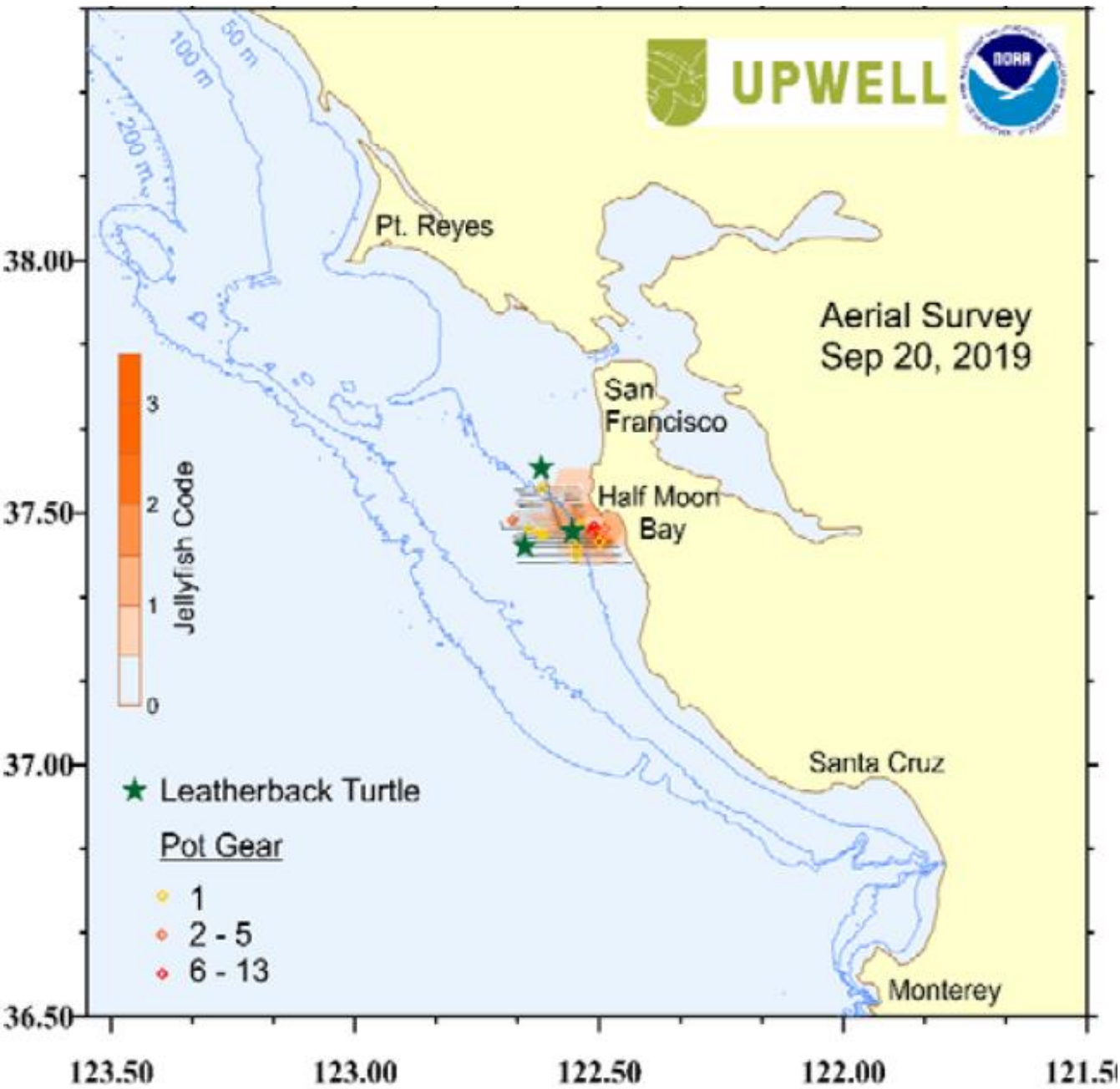
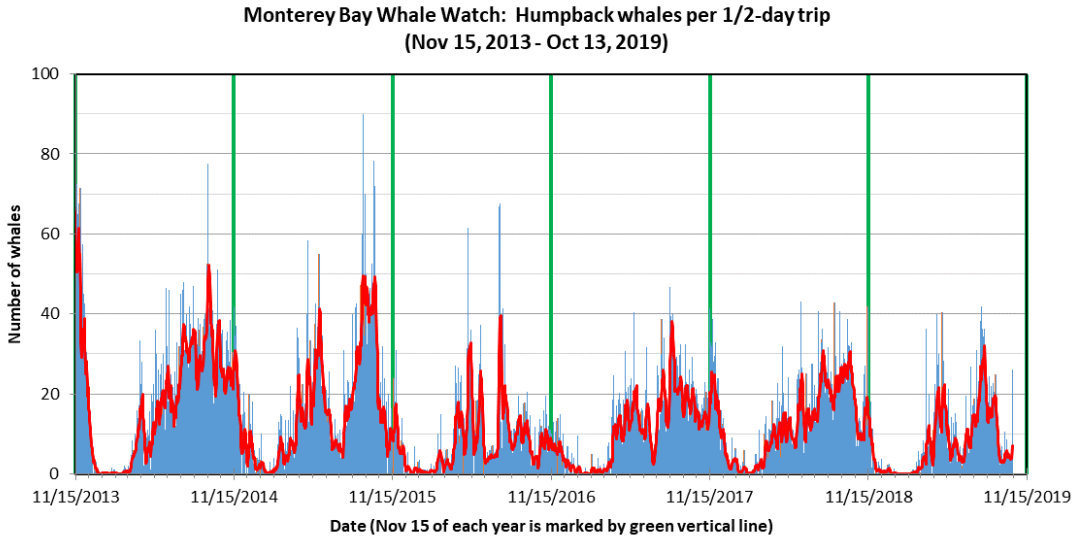
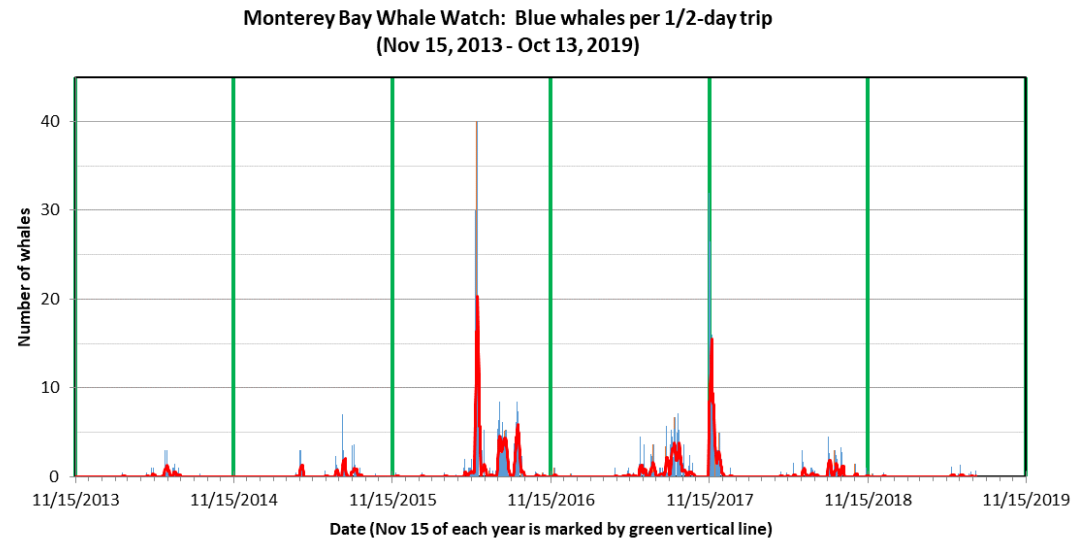


Figure 9.

Number of whale sightings from 15 November 2013 - 13 Oct 2019 for Monterey Bay Whale Watch. The y-axis is the number of whales; the thin blue bars are the average daily whale numbers, and the red line is a 7-day running average to make the patterns a bit easier to see. A vertical green line has been added at November 15 of each year for reference. Each tick mark is one month.





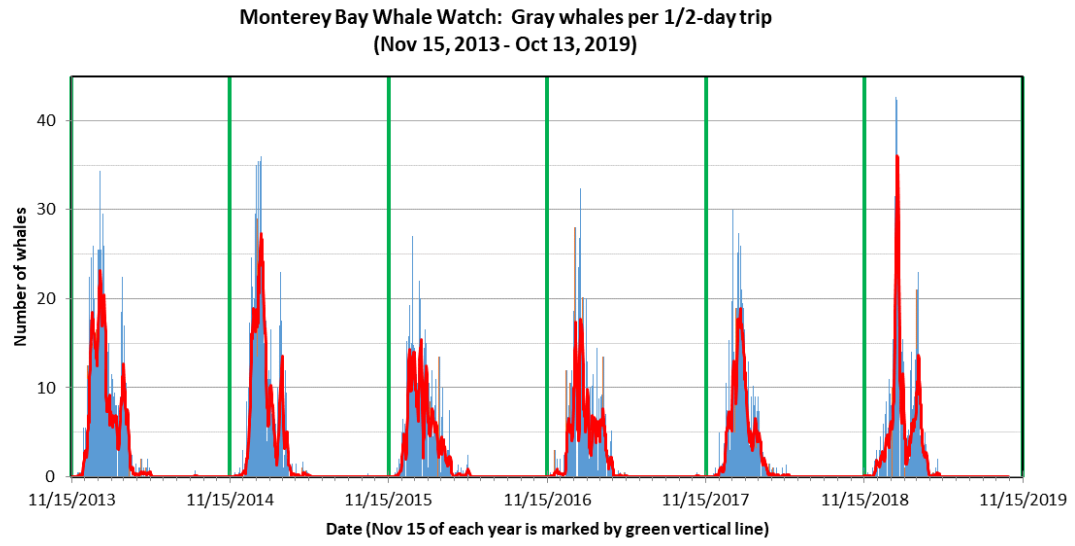


Figure 10. Daily whale counts at the Farallon Islands. For Humpback Whales, low is < 5 whales, medium is 5-9 whales, high is > 9 whales. For Blue Whales, low is < 2 whales and high is > 2 whales.

Figure 11. Leatherback turtle satellite track from September 20, 2019 (date tagged) to October 2, 2019.

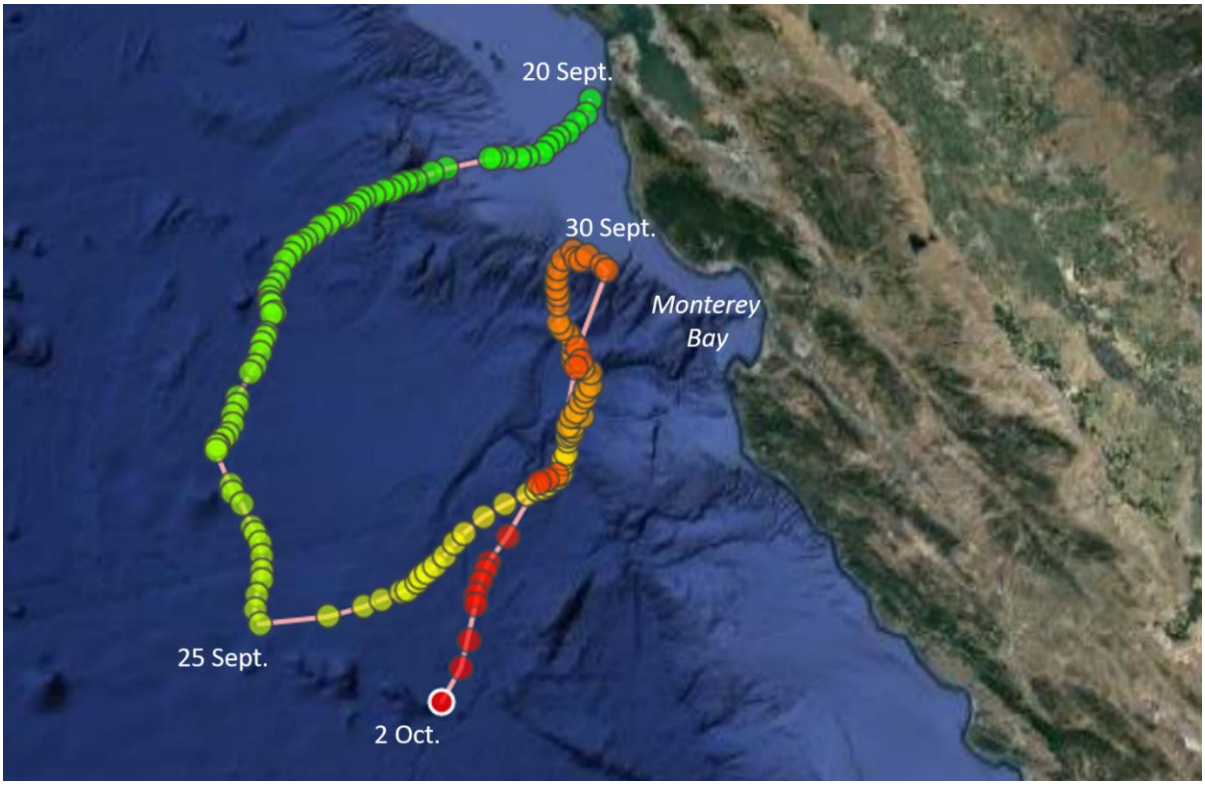


Figure 12. Positions from leatherback turtles tagged on October 6, 12, and 13.

Daily satellite-derived positions, 6-14 October 2019, for three leatherback turtles that were tagged on Oct 6th (red dots), 12th (yellow dots) and 13th (green/black dots), and continued to forage within the greater Gulf of the Farallones.

Figure 13. Domoic acid sample results. Accessed October 14, 2019 https://www.cdph.ca.gov/Programs/CEH/DFDCS/pages/fdbprograms/foodsafetyprogram/domoicacid.aspx

CDPH SUMMARY OF DOMOIC ACID LEVELS IN CRABS **JULY 1, 2019 - OCTOBER 11, 2019**

PORT	AREA	SAMPLE COLLECTION DATE	CRAB TYPE VISCERA	INDIVIDUAL SAMPLE RESULTS (FDA ACTION LEVEL >30 PPM)	AVERAGE LEVEL (Information Only)	PERCENT OF SAMPLES EXCEEDING ACTION LEVEL
Crescent City	George Reef		Dungeness			
	Klamath River		Dungeness			
Trinidad	Trinidad North		Dungeness			
	Trinidad South		Dungeness			
Eureka	LP Eureka		Dungeness			
	Eel River		Dungeness			
Fort Bragg	Usal		Dungeness			
	Point Arena		Dungeness			
Bodega Bay	Point Reyes	9/25/2019	Dungeness	4.9, 4.7, 6.1, 2.5, 4.3, <2.5	3.8 ppm	0%
	Bodega Head	9/25/2019	Dungeness	11, 9.5, 4.5, 19, **43, 58**	24 ppm	33%
	Russian River	9/21/2019	Dungeness	24, <2.5, <2.5, <2.5, <2.5, <2.5	4.0 ppm	0%
	Salt Point	9/21/2019	Dungeness	<2.5, <2.5, <2.5, <2.5, 12, <2.5	2.0 ppm	0%
Half Moon Bay/ San Francisco	Pillar Point	9/27/2019	Dungeness	<2.5, <2.5, <2.5, <2.5, <2.5, <2.5	Non-Detectable	0%
	Pigeon Point	9/27/2019	Dungeness	2.6, <2.5, <2.5, <2.5, <2.5, <2.5	0.4ppm	0%
	Farallones/ Golden Gate		Dungeness			
	Duxbury		Dungeness			
Monterey	Monterey Bay	9/29/2019	Dungeness	5.8, 3.4, 2.9, 14, 5.9, 13	7.5ppm	0%
	Monterey Bay		Rock			
Morro Bay	Avila Beach	9/25/2019	Dungeness	<2.5, <2.5, <2.5, <2.5, <2.5, 3.5	0.6 ppm	0%
	Avila Beach	9/25/2019	Rock	<2.5, <2.5, <2.5, <2.5, <2.5, <2.5	Non-Detectable	0%

1 SET = 6 SAMPLES

Appendix 1

Leatherback Aerial Survey and Tagging Summary
September 12-13 and September 20, 2019

(Prepared by Karin Forney and Scott Benson, NOAA/SWFSC;
Scientific Advisors to the Dungeness Crab Fishing Gear Working Group)

Survey Details:
Aerial surveys were conducted 12-13 September and 20 September 2019 in support of leatherback capture and tagging operations. The surveys were led by Karin Forney and Scott Benson, with a team of trained aerial observers from NOAA and a local research partner, Upwell (based in Monterey). Weather conditions were very good, with light winds and mostly clear skies. Observations in support of the Working Group are plotted and summarized below (Figures 1-2). One turtle was captured and tagged with a satellite-linked transmitter (Figure 3).

Humpback whales: Similar to the June and August 2019 surveys, humpback whales were numerous in shallow waters of the Gulf of the Farallones, and the most dense aggregation was encountered between Pillar Point and Devil's Slide in relatively shallow waters (approx.15-30 fm; 30-50m) (See right panels in Figs 1-2). The whales appeared to be feeding on anchovies.

Leatherback Turtles: Consistent with recent years, leatherback turtles were observed foraging on dense aggregations of brown sea nettles within shallow waters (approx. 25-40fm; 45-70m), in an area extending from just south of Pillar Point north to at least Pacifica. Ocean sunfish (*Mola mola*), another jelly predator, was abundant within that region. Six unique leatherback turtles were documented during the three days of capture & sampling effort, including five observed during aerial surveys and one observed from the capture vessel on 9/21, when there were no aerial surveys.

Pot Gear: Some pot gear was recorded throughout the survey areas, including what appeared to be derelict gear (visibly fouled) as well as actively fished gear (clean and in strings) near Pillar Pt.

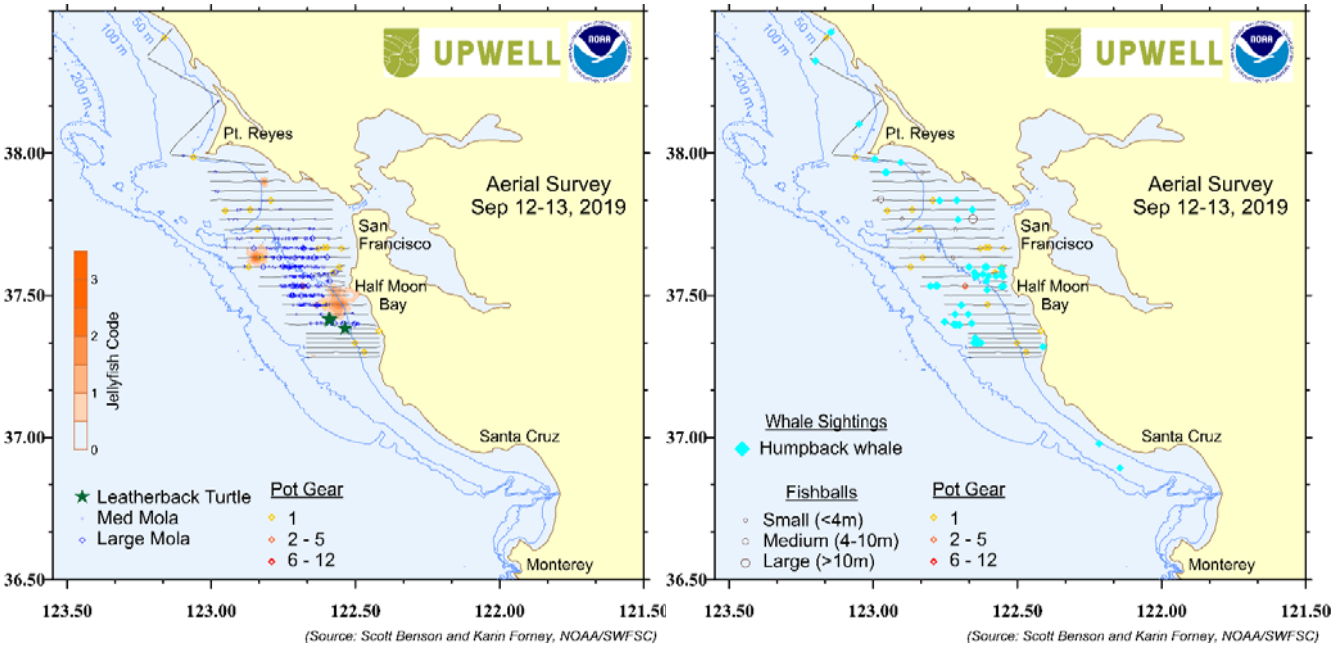


Figure 1. Leatherback Aerial Surveys on Sep 12-13, 2019. **LEFT**: Observations of leatherback turtles, their jellyfish prey (coded 0-3, with 3 being the densest aggregations), medium and large ocean sunfish (*Mola mola*) that also feed on jellies, and pot gear (both fouled and clean). **RIGHT**: Observations of humpback whales, fish balls (anchovies), and pot gear.

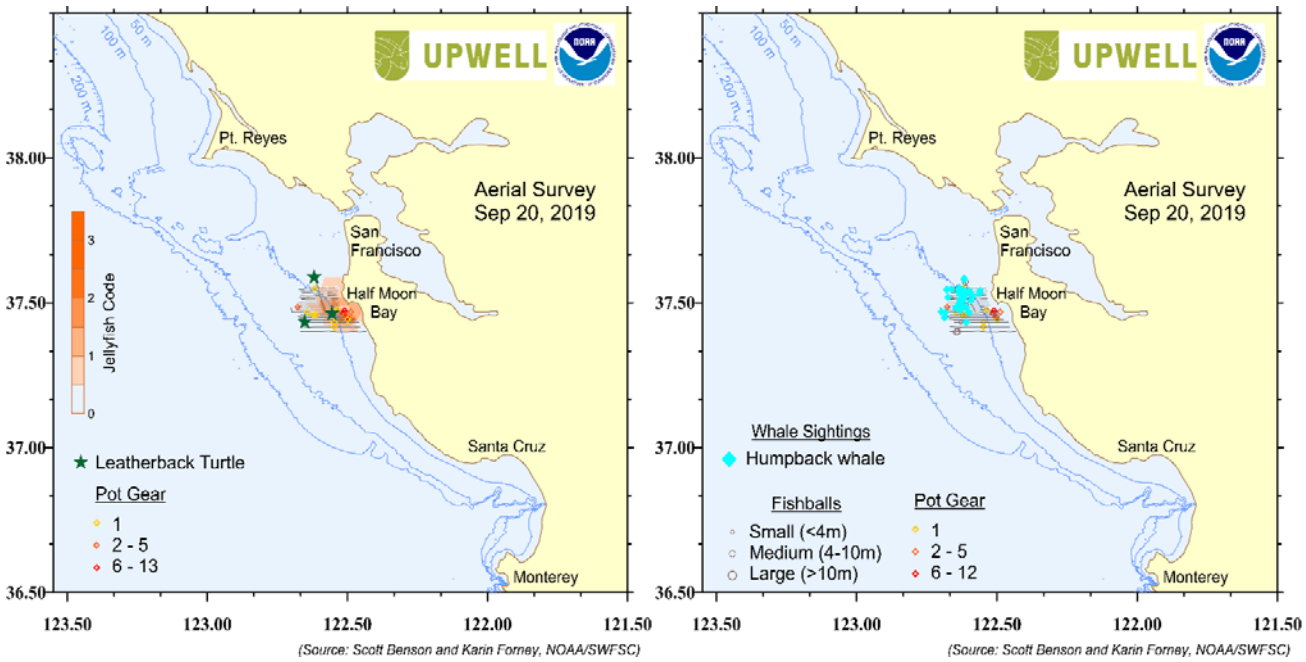


Figure 2. Leatherback Aerial Surveys on Sep 12-13, 2019. **LEFT**: Observations of leatherback turtles, their jellyfish prey (coded 0-3, with 3 being the densest aggregations), medium and large ocean sunfish (*Mola mola*) that also feed on jellies, and pot gear (both fouled and clean). **RIGHT**: Observations of humpback whales, fish balls (anchovies), and pot gear.

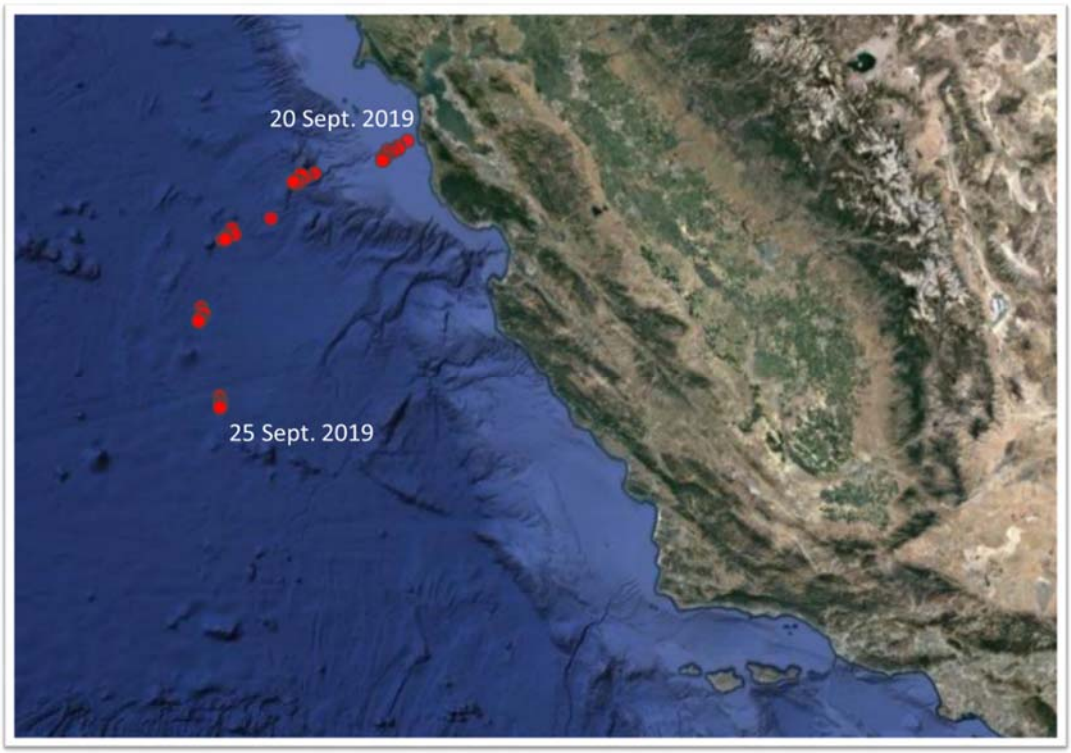


Figure 3. Track of leatherback turtle tagged on 9/20/2019 off Half Moon Bay. The animal was in good body condition, suggesting a successful foraging season, and departed coastal waters after tagging.

Leatherback Aerial Survey and Tagging Summary
2-13 October 2019

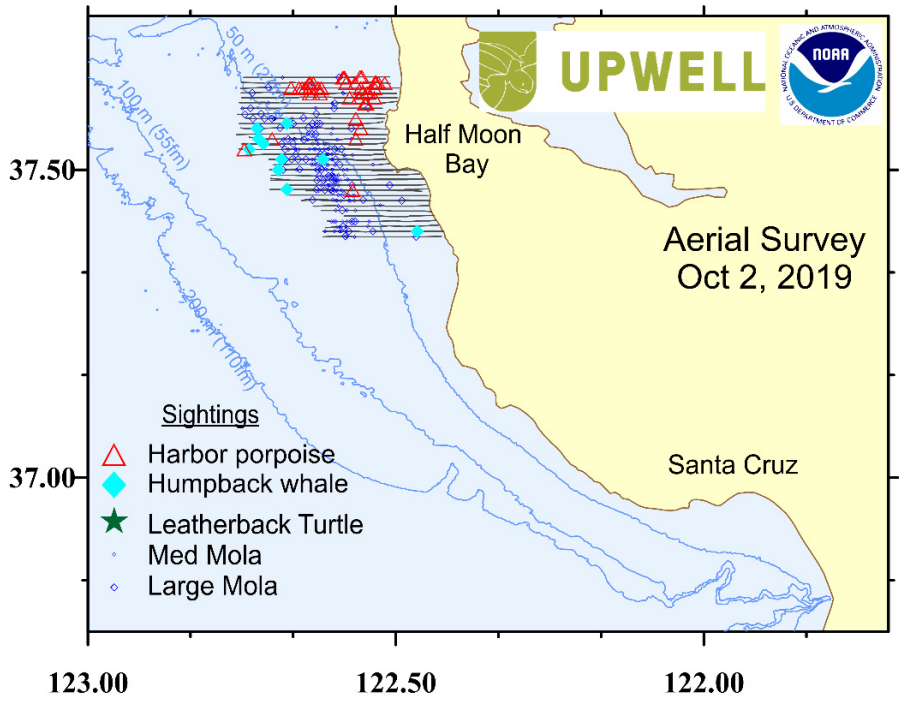
(Prepared 14 Oct 2019 by Karin Forney and Scott Benson, NOAA/SWFSC;
Scientific Advisors to the Dungeness Crab Fishing Gear Working Group)

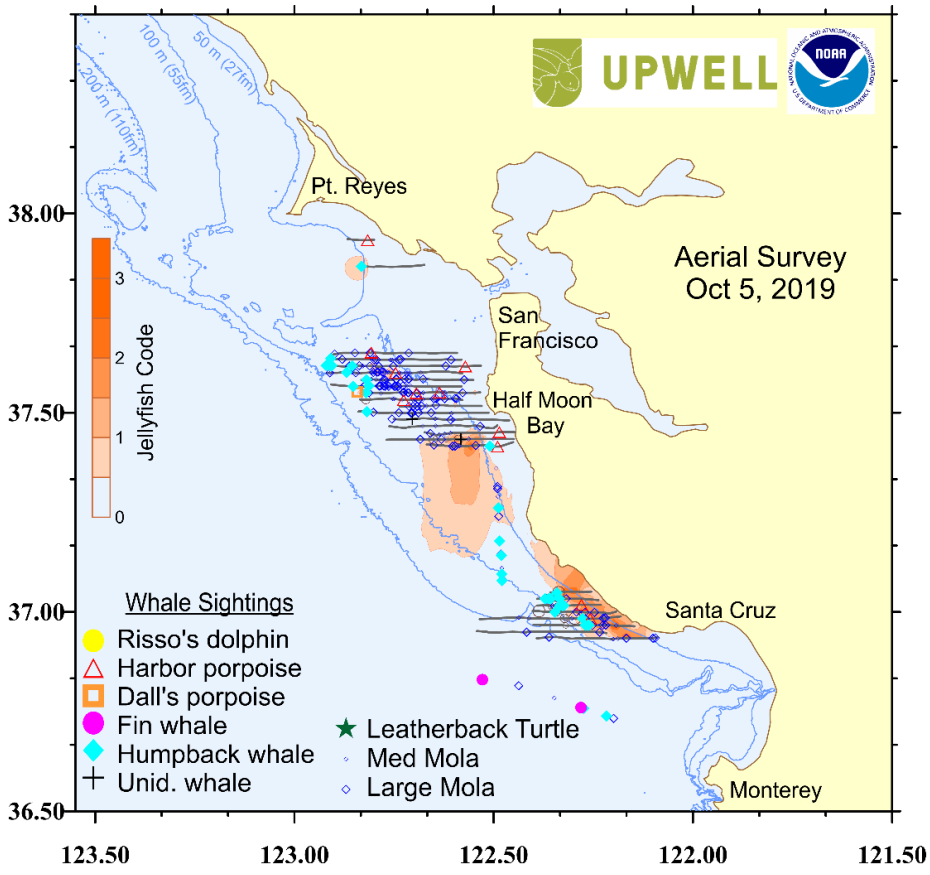
Survey Details:
Aerial surveys were conducted on October 2, 5, 6, 7, 8, 11, 12, and 13, 2019 in support of leatherback capture and tagging operations. The surveys were led by Karin Forney and Erin LaCasella (NOAA/SWFSC), with a team of trained aerial observers from NOAA and a local research partner, Upwell (based in Monterey). Weather conditions were fair-to-good, with light winds and clear to partly cloudy skies, except on Oct 8, when a fog bank restricted the surveys to a few small patches. Observations of marine mammals, turtles and other ecosystem indicators are plotted and summarized in the figures below, in support of the Working Group.

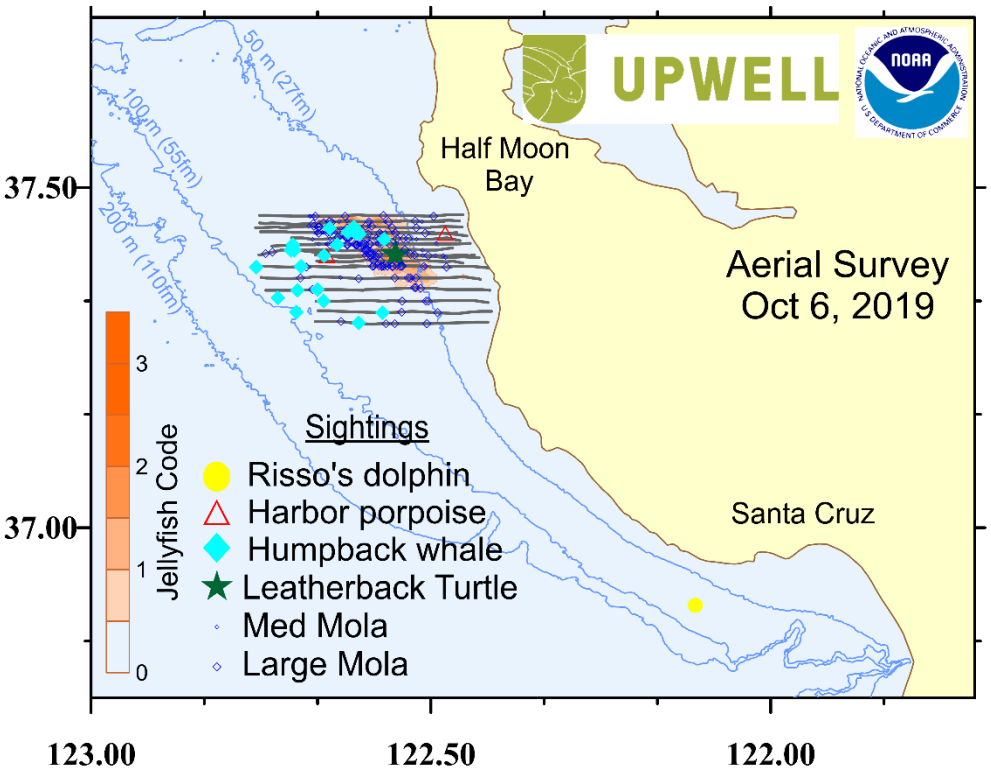
Humpback whales: Humpback whales have been abundant throughout the Gulf of the Farallones during October, as they were in September. Their distribution has varied somewhat as wind-driven processes have moved the patches of their prey (anchovies and krill) into shallower/deeper waters. They have been actively feeding in areas with abundant fish balls (likely anchovies), krill swarms, and many seabirds that also feed on those species.

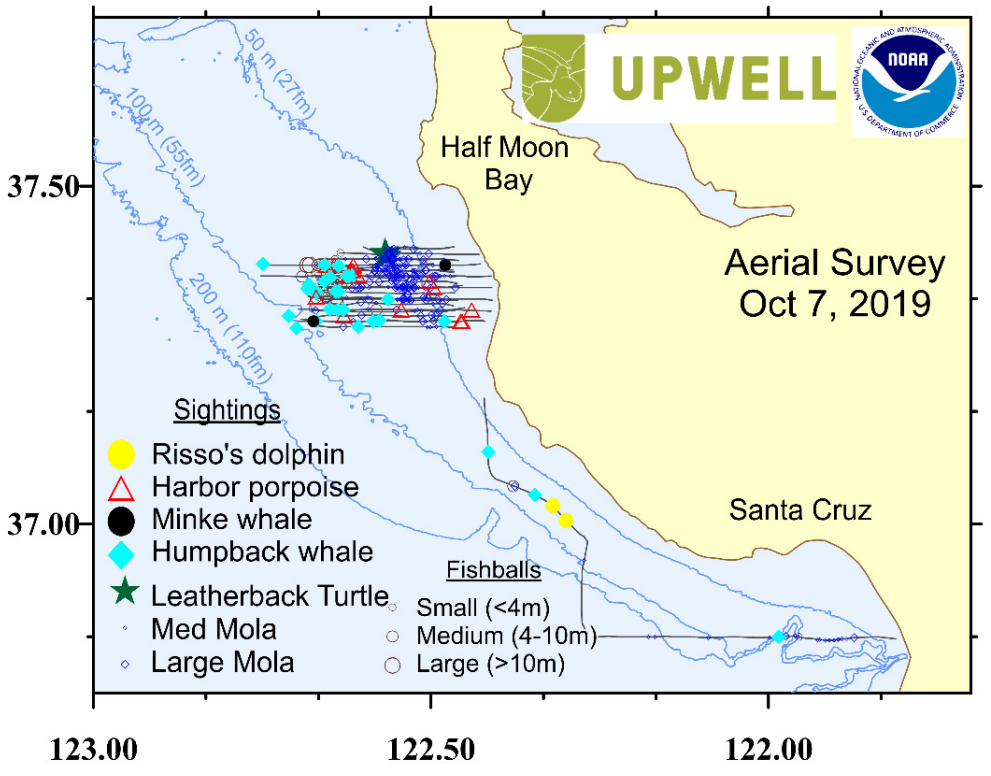
Leatherback Turtles: At least 6 or 7 different leatherbacks were observed during the October aerial surveys, in an area off San Mateo County (from about San Gregorio in the south to Pacifica in the north). Leatherback turtles were observed foraging on dense aggregations of brown sea nettles in waters of about 20-35 fm depth. Ocean sunfish (*Mola mola*), another jelly predator, was also abundant within that region. The vessel-based team led by Scott Benson (NOAA/SWSFSC) captured five leatherback turtles and outfitted them with satellite-linked transmitters, bringing the total number of tagged turtles to 6 (one was tagged in September). Three of the turtles have departed the region and are now in offshore areas or off Southern California, while three turtles are still foraging between Pillar Point and an area just east of the Farallon Islands. The plots below show locations of leatherbacks, molas, and brown sea nettle aggregations (when visible at the surface with sufficient survey coverage).

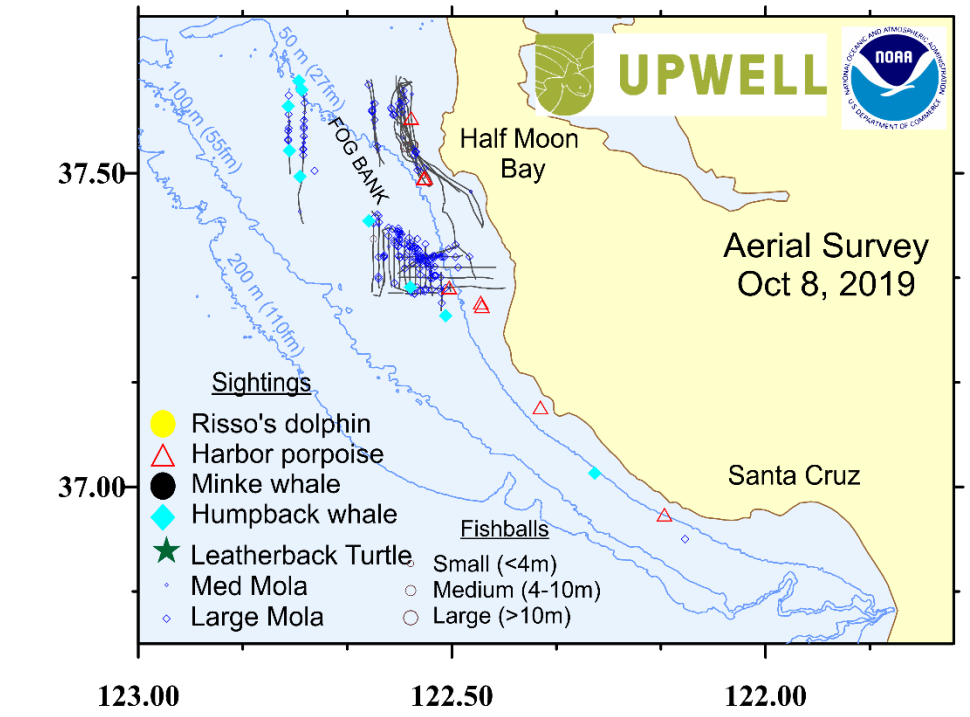
Figures for each of the survey days as well as an updated plot of leatherback turtle tracks are shown below.

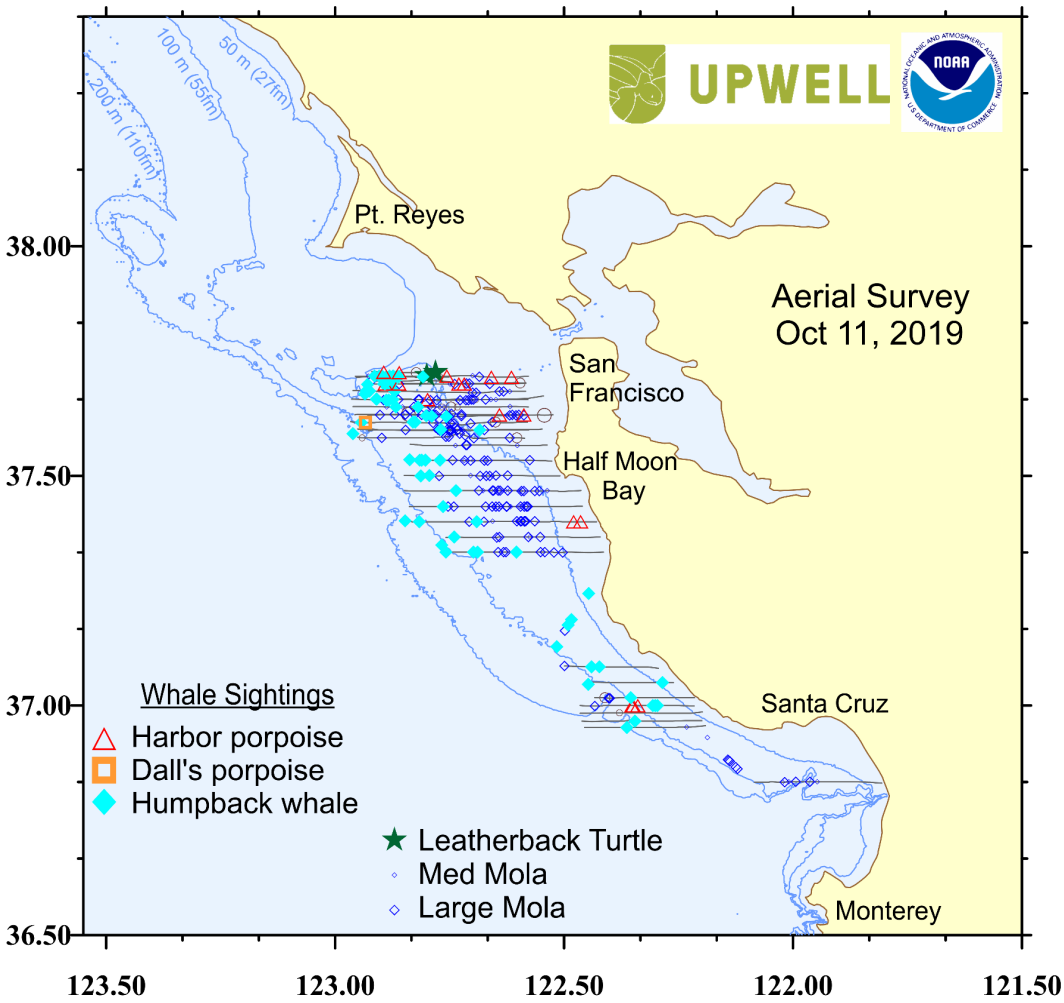

UPWELL
Half Moon Bay
Aerial Survey
Oct 2, 2019
Santa Cruz
Sightings
Harbor porpoise
Humpback whale
Leatherback Turtle
Med Mola
Large Mola
50 m (27fm)
100 m (55fm)
200 m (110fm)
37.50
37.00
123.00
122.50
122.00


UPWELL
Pt. Reyes
Aerial Survey
Oct 5, 2019
San Francisco
Half Moon Bay
Santa Cruz
Monterey
Jellyfish Code
3
2
1
0
Whale Sightings
Risso's dolphin
Harbor porpoise
Dall's porpoise
Fin whale
Humpback whale
Unid. whale
Leatherback Turtle
Med Mola
Large Mola
38.00
37.50
37.00
36.50
123.50
123.00
122.50
122.00
121.50

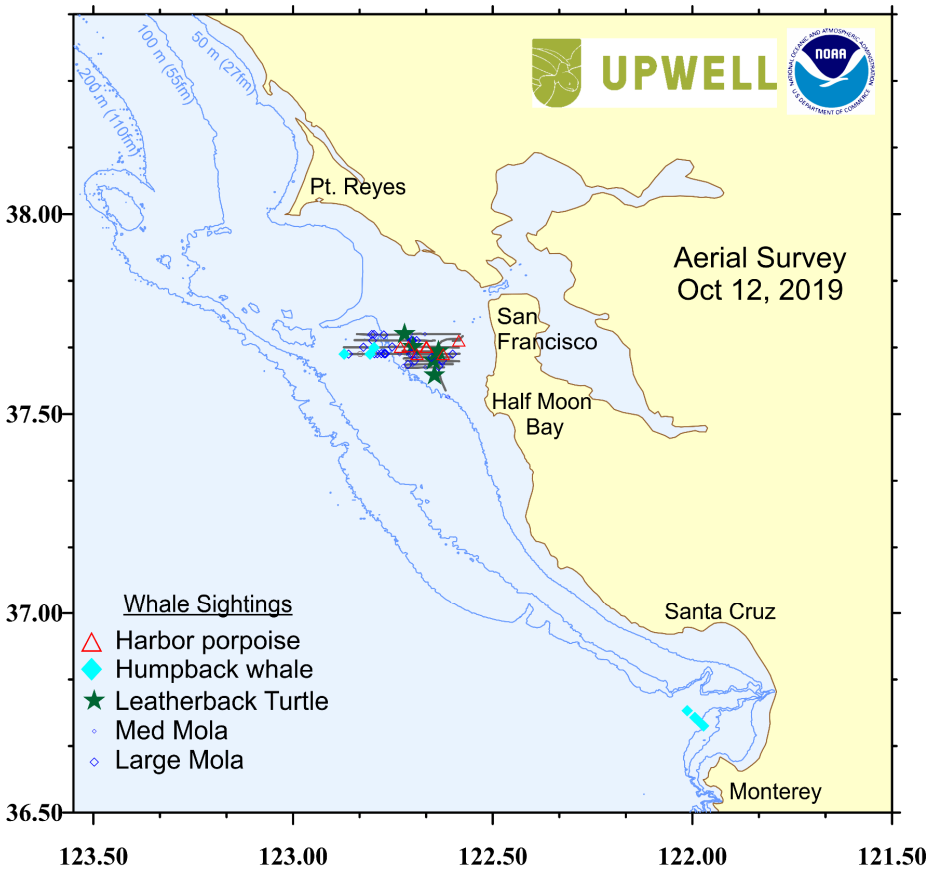

UPWELL
NOAA
Half Moon Bay
Santa Cruz
50 m (27fm)
100 m (55fm)
200 m (110fm)
Aerial Survey
Oct 6, 2019
Jellyfish Code
3
2
1
0
Sightings
Risso's dolphin
Harbor porpoise
Humpback whale
Leatherback Turtle
Med Mola
Large Mola
37.50
37.00
123.00
122.50
122.00


UPWELL
NOAA
Half Moon Bay
Santa Cruz
50 m (27fm)
100 m (55fm)
200 m (110fm)
Aerial Survey
Oct 7, 2019
Sightings
Risso's dolphin
Harbor porpoise
Minke whale
Humpback whale
Leatherback Turtle
Med Mola
Large Mola
Fishballs
Small (<4m)
Medium (4-10m)
Large (>10m)
37.50
37.00
123.00
122.50
122.00

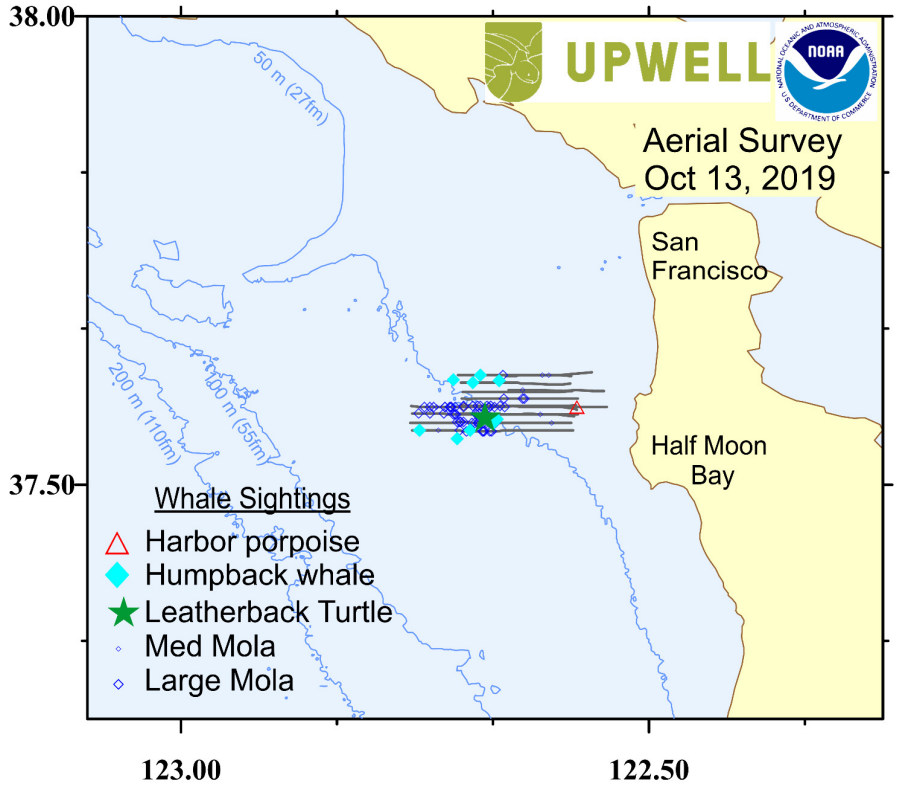




(Source: Scott Benson and Karin Forney, NOAA/SWFSC)



(Source: Scott Benson and Karin Forney, NOAA/SWFSC)



(Source: Scott Benson and Karin Forney, NOAA/SWFSC)

Daily satellite-derived positions, 6-14 October 2019, for three leatherback turtles that were tagged on Oct 6th (red dots), 12th (yellow dots) and 13th (green/black dots), and continued to forage within the greater Gulf of the Farallones.