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.

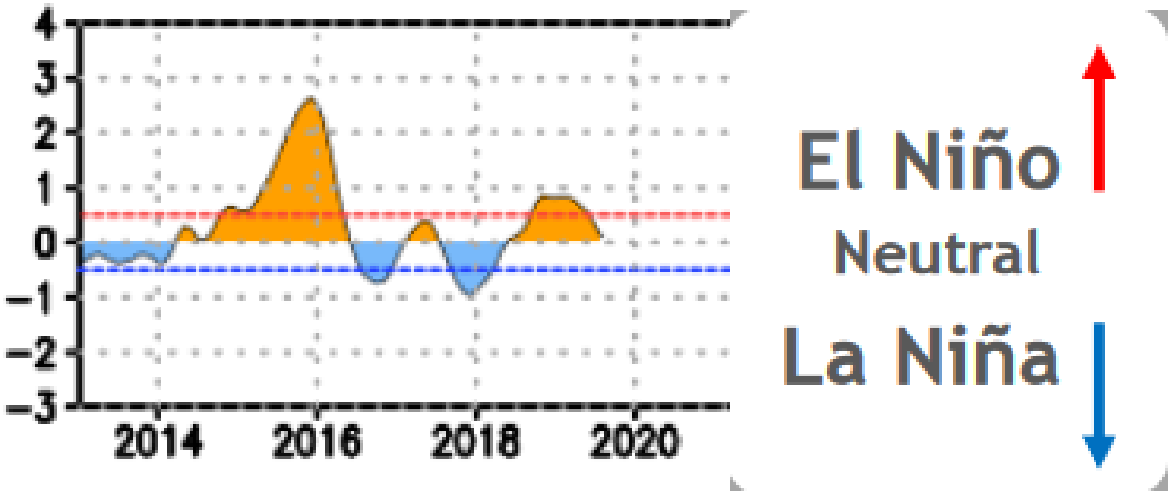


Figure 2. Sea Surface Temperature Anomaly, California Current ecosystem. Accessed October 9 2019 from https://www.integratedecosystemassessment.noaa.gov/regions/california-current/cc-projects-blobtracker.

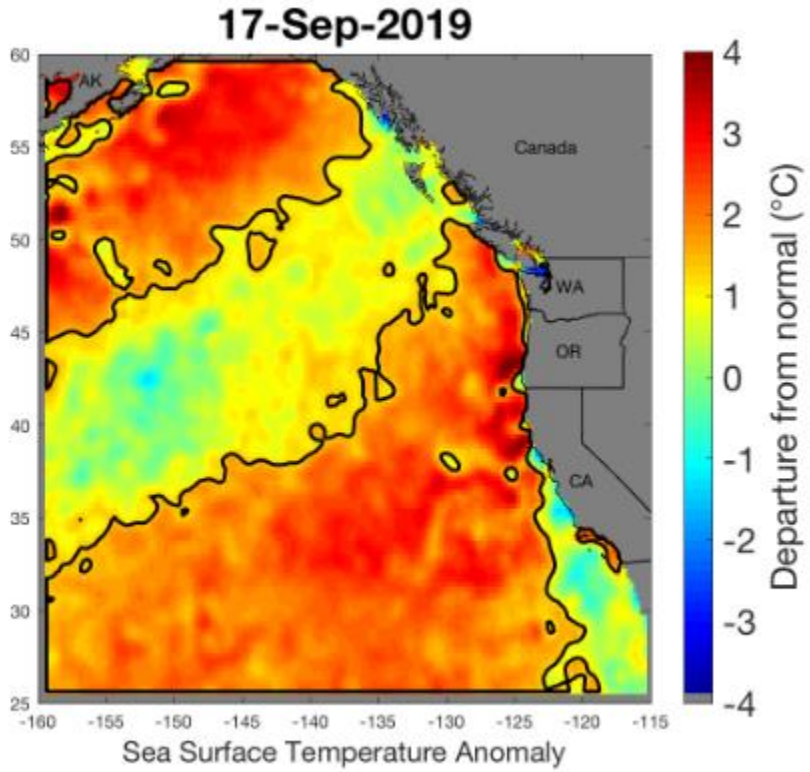


Figure 3a. Abundance of adult anchovy, young-of-the-year anchovy, krill, and Chrysaora (brown sea nettles) during Rockfish Recruitment and Ecosystem Assessment Surveys conducted by NMFS SWFSC. Data through 2018.

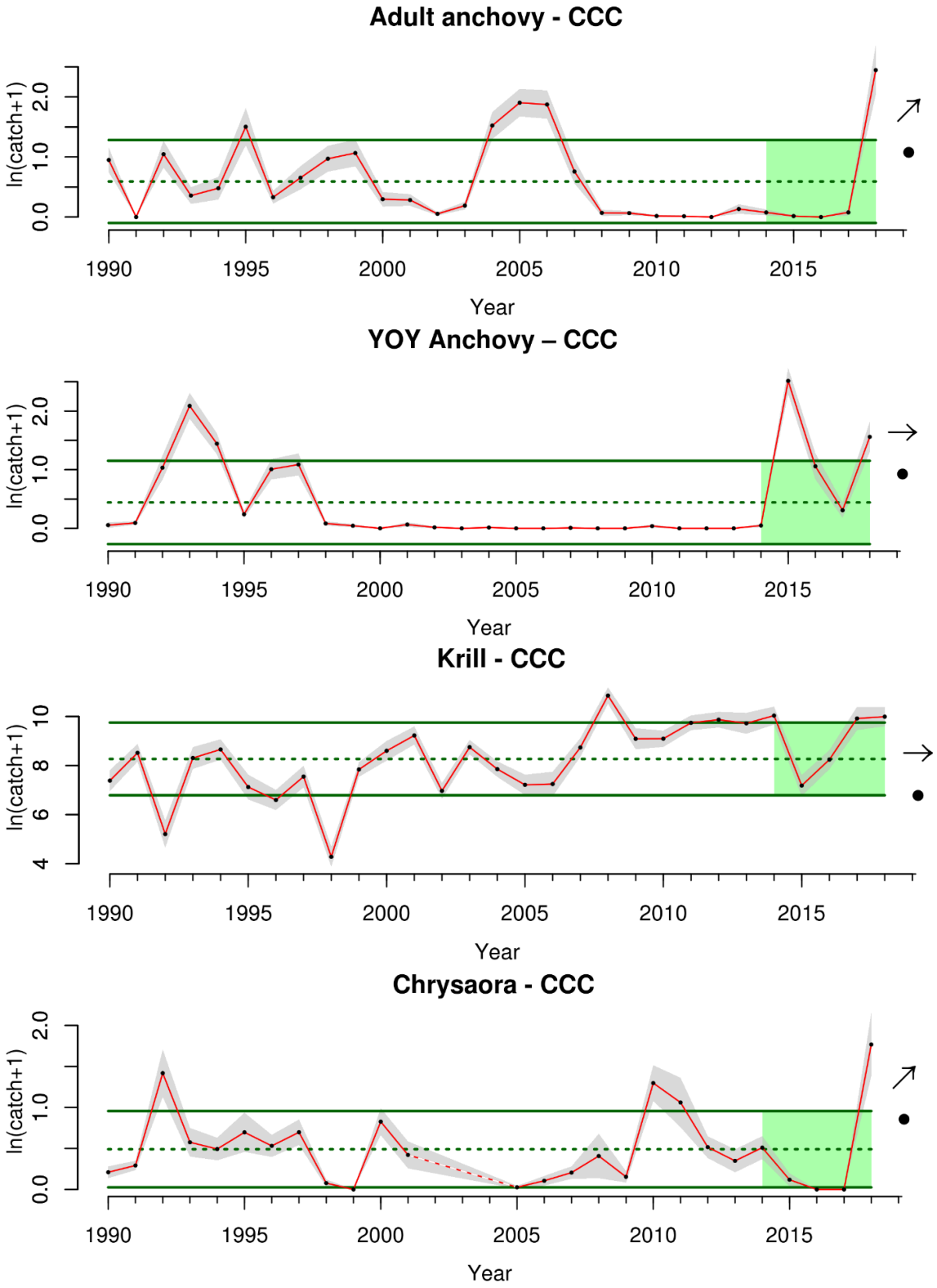


Figure 3b. Abundance of adult anchovy, young-of-the-year anchovy and krill during Rockfish Recruitment and Ecosystem Assessment Surveys conducted by NMFS SWFSC, updated from 2019 by Jarrod Santora.

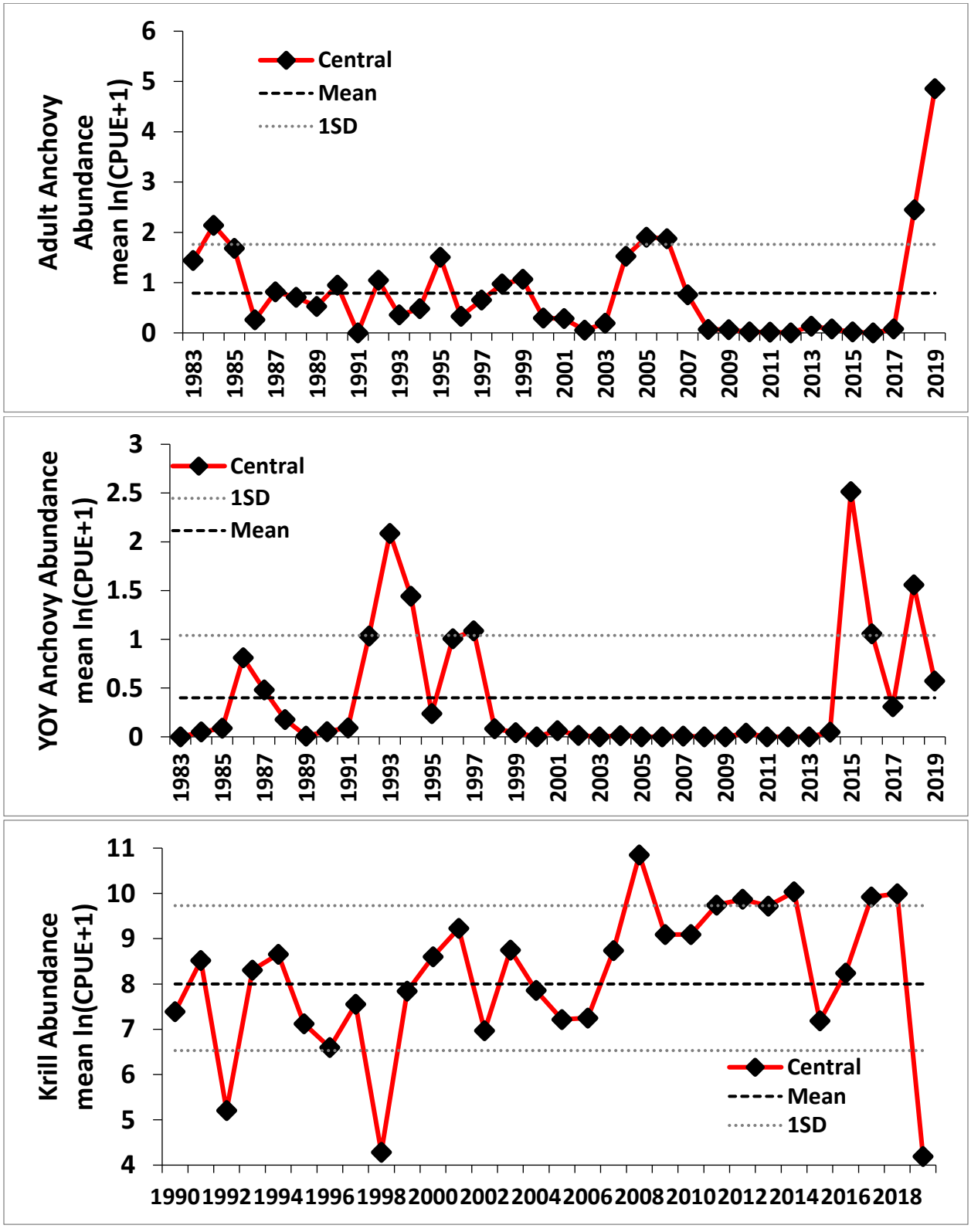


Figure 4. Aerial Survey showing distribution of Humpback Whales, pot gear, and bait balls; September 12-13, 2019.

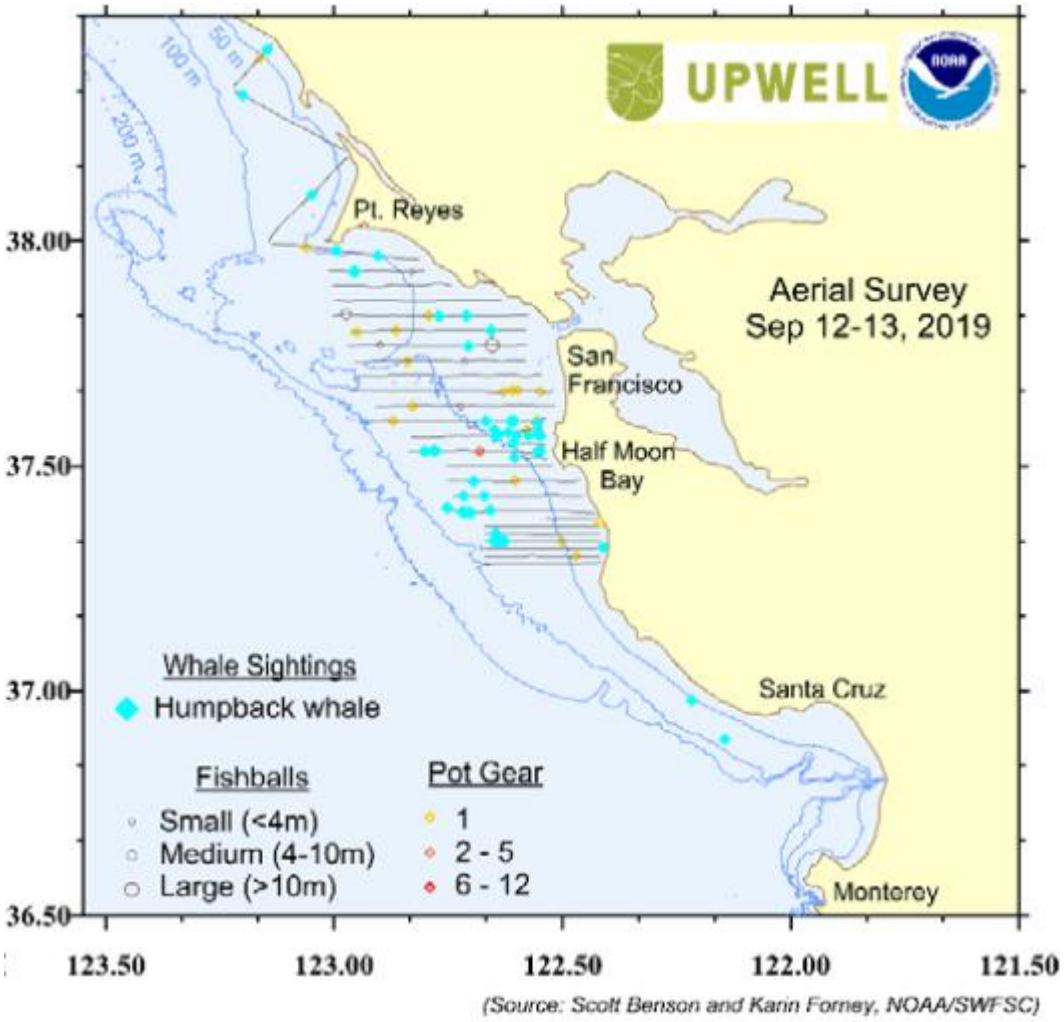


Figure 5. Aerial Survey showing distribution of Humpback Whales, pot gear, and bait balls; September 20, 2019.

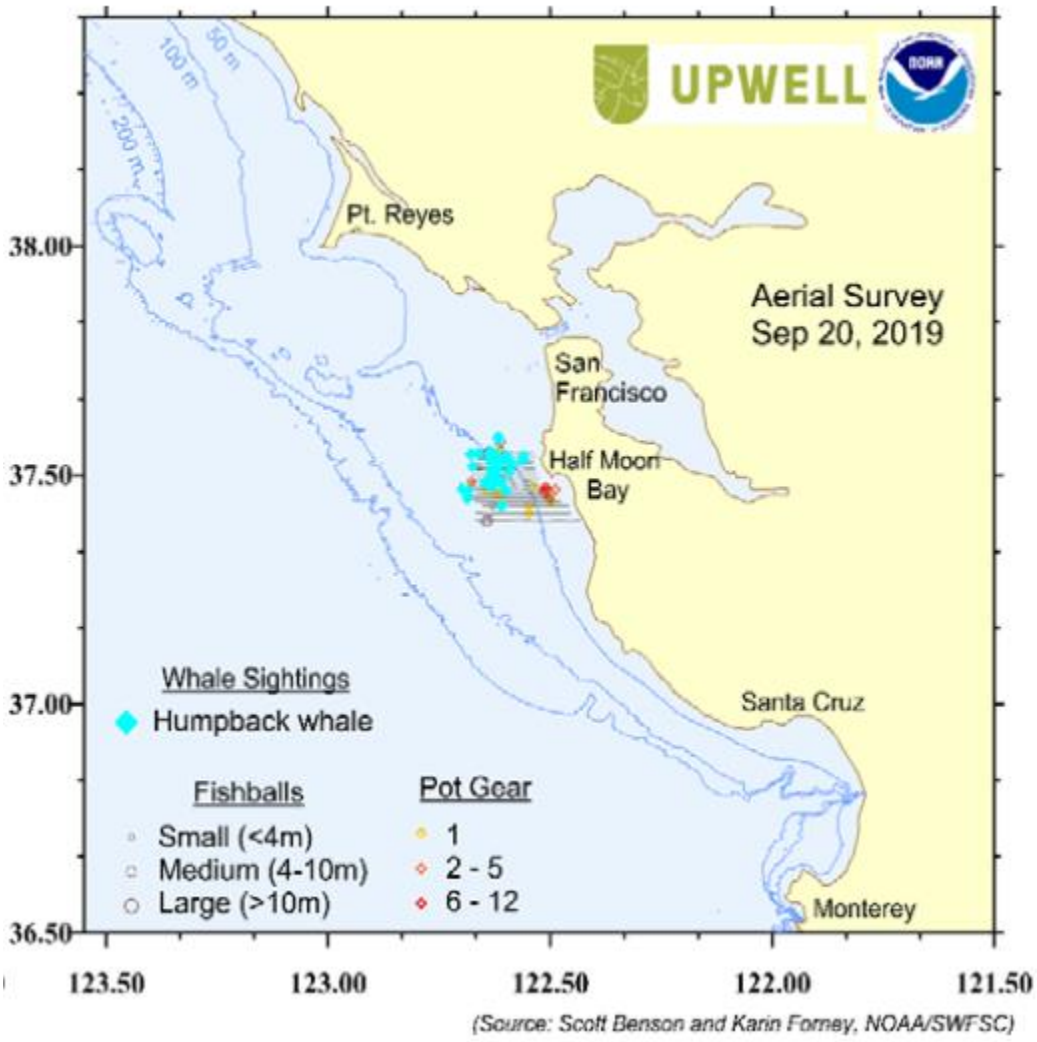
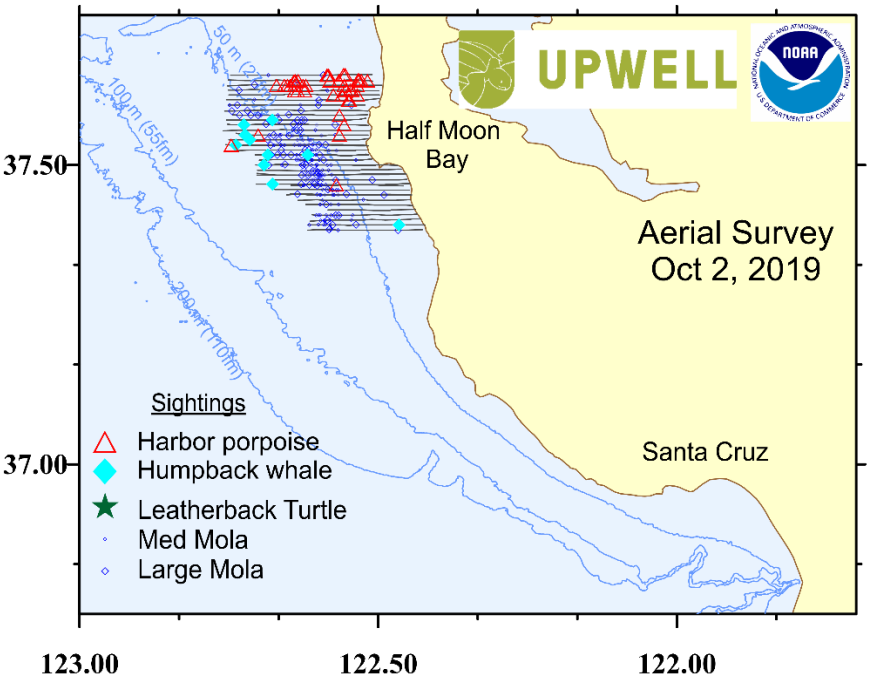
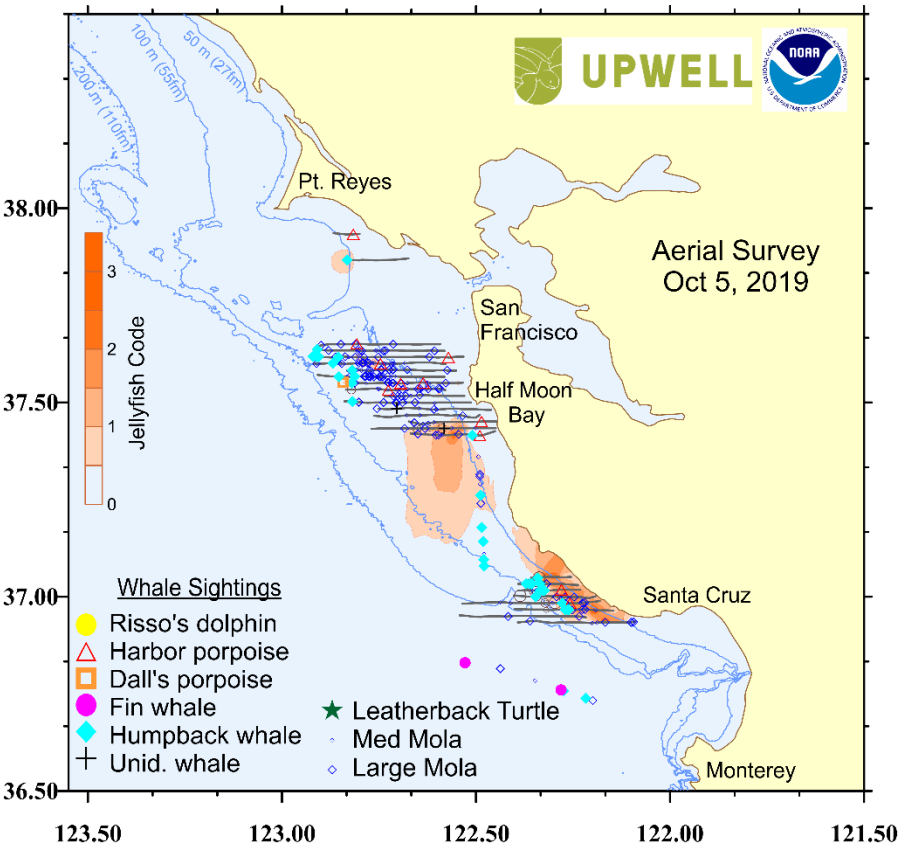


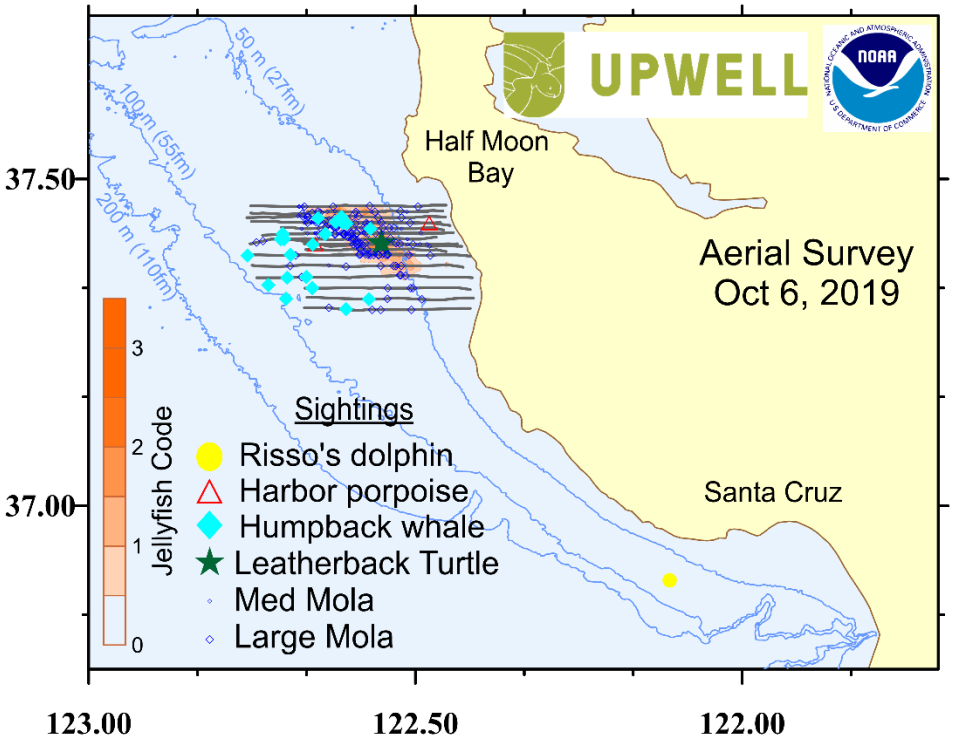
Figure 6. Aerial Survey showing distribution of marine mammals, Leatherback Turtles, Ocean Sunfish, pot gear, Chrysaora patches, and bait balls; October 2-13, 2019.



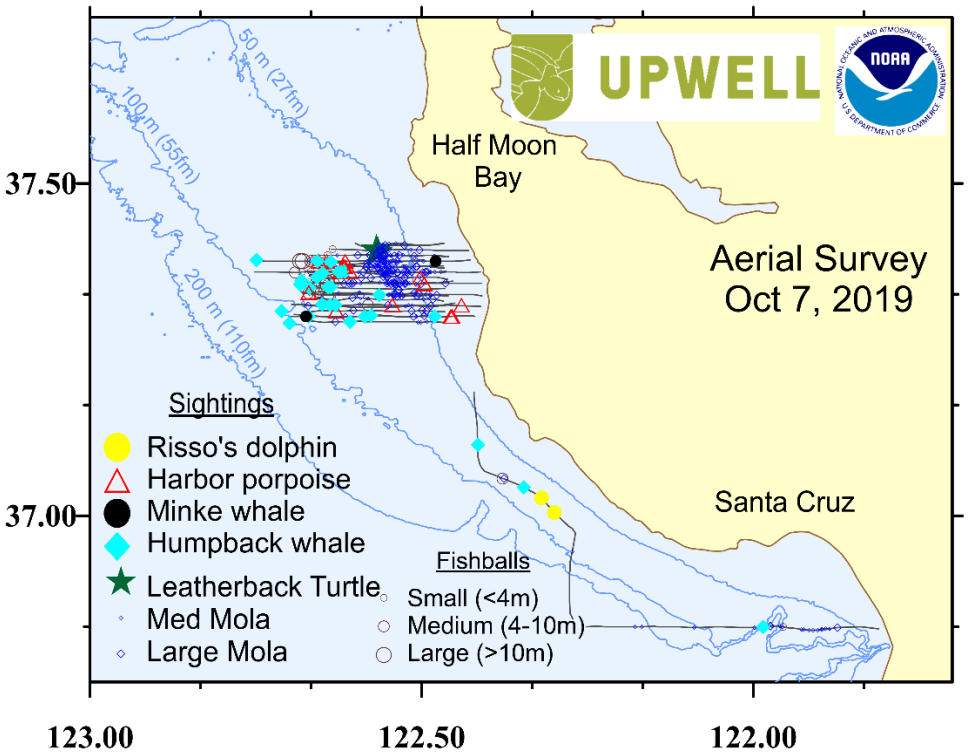
(Source: Scott Benson and Karin Forney, NOAA/SWFSC)



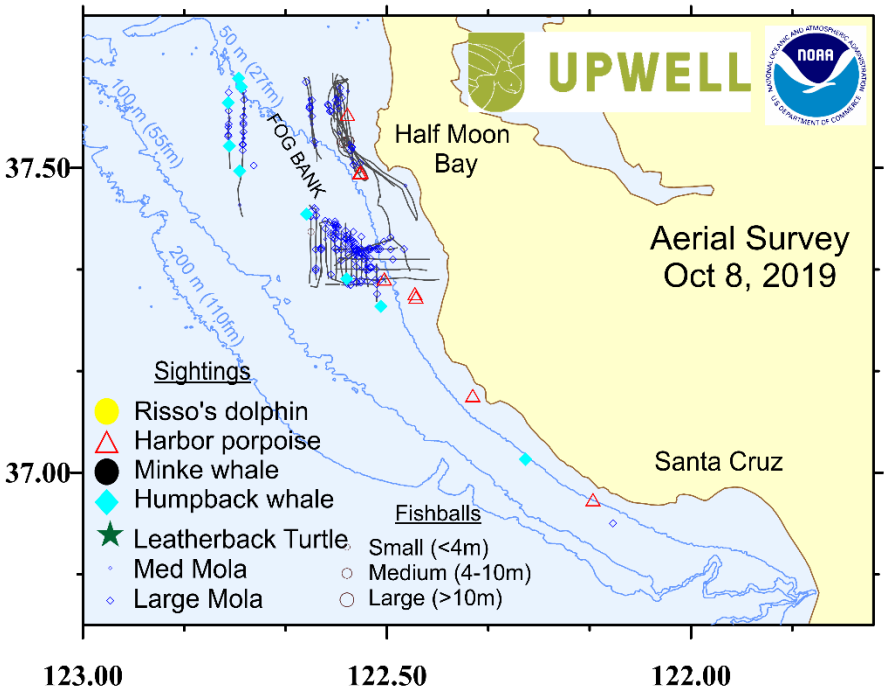
(Source: Scott Benson and Karin Forney, NOAA/SWFSC)



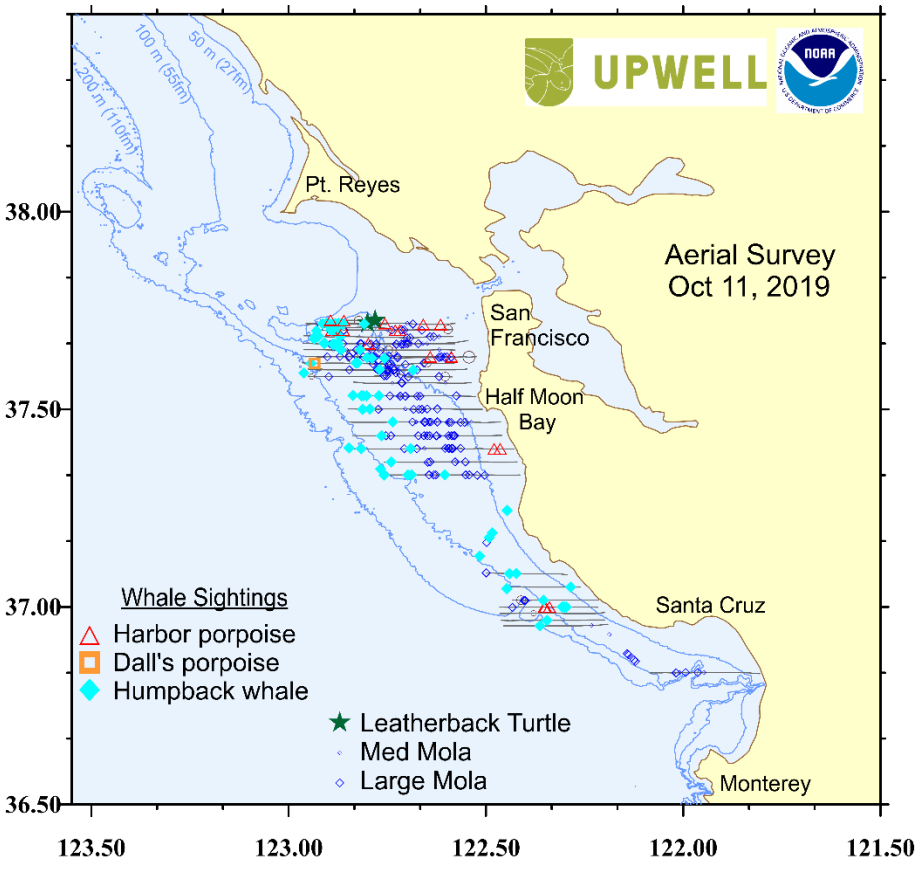
(Source: Scott Benson and Karin Forney, NOAA/SWFSC)



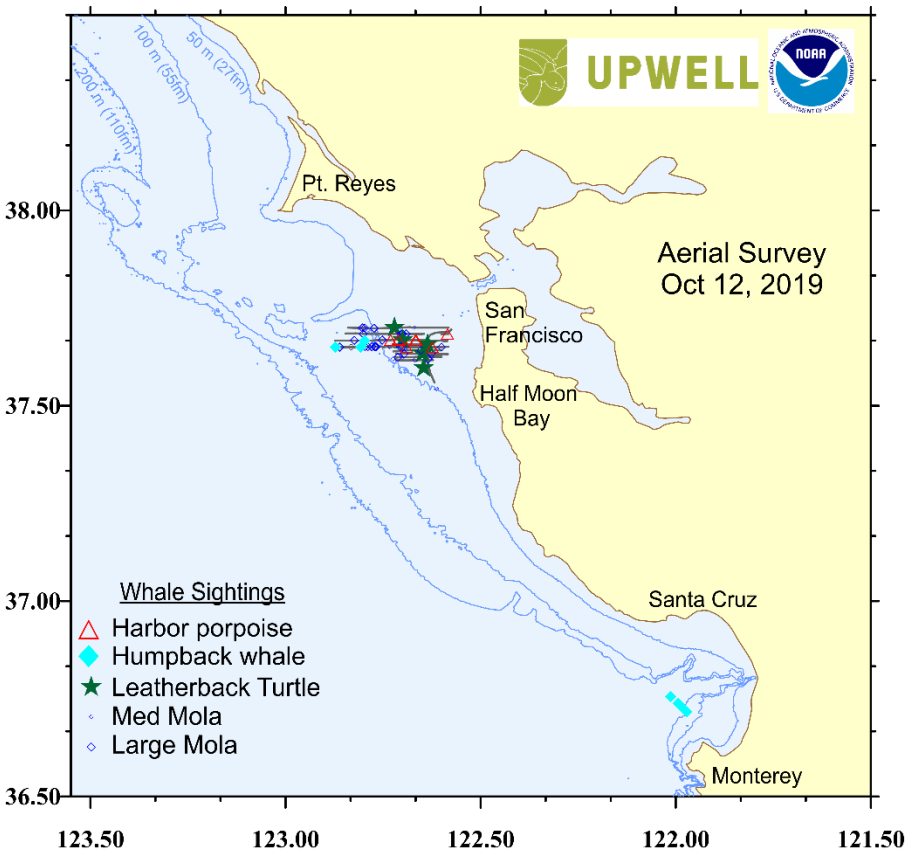
(Source: Scott Benson and Karin Forney, NOAA/SWFSC)



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



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



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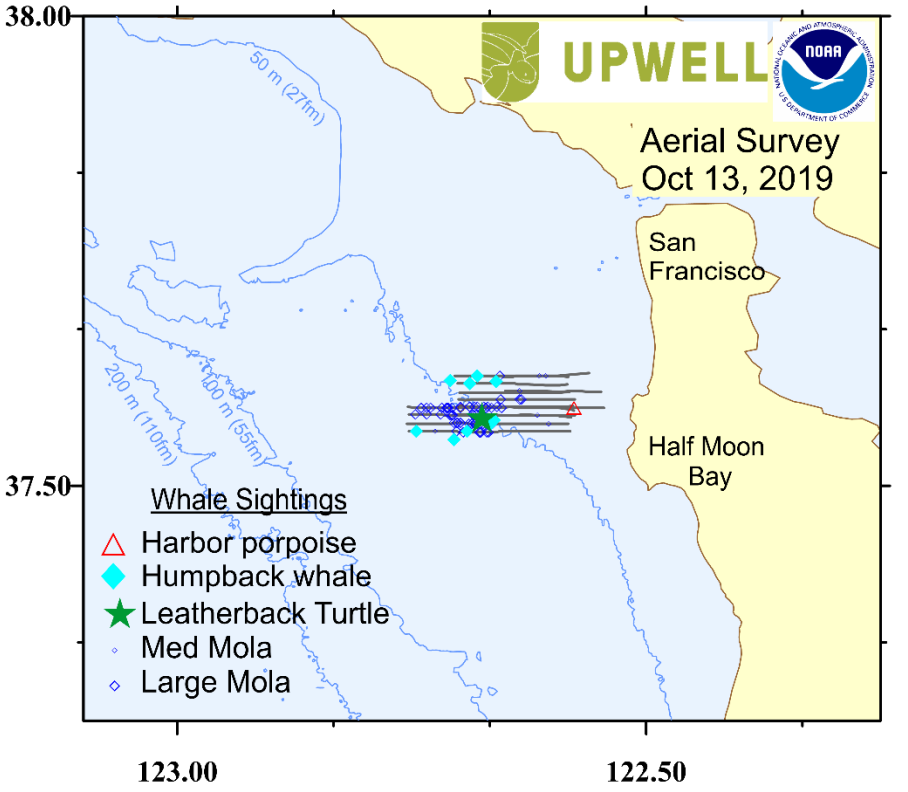


(Source: Scott Benson and Karin Forney, NOAA/SWFSC)

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

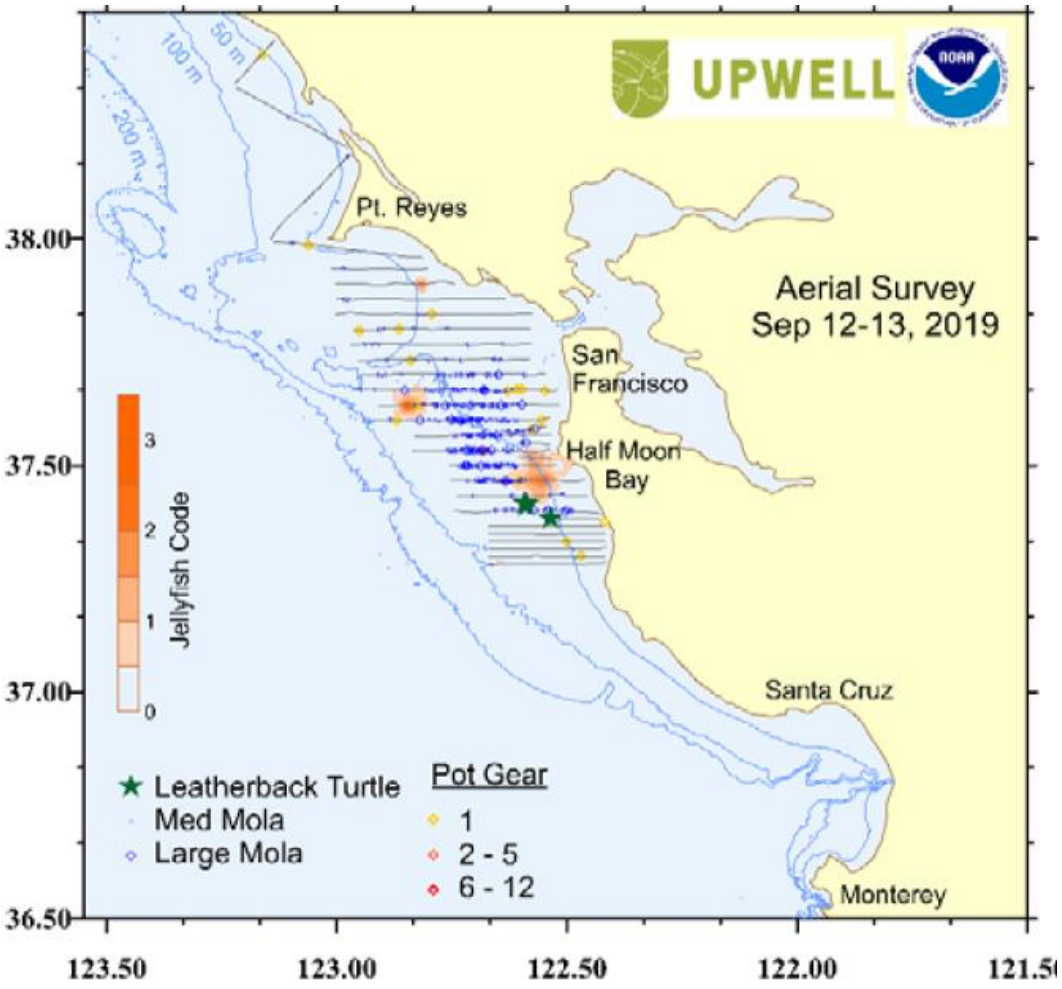


Figure 8. Aerial survey showing distribution of leatherback turtles, pot gear, mola molas, and brown sea nettles; September 20, 2019.

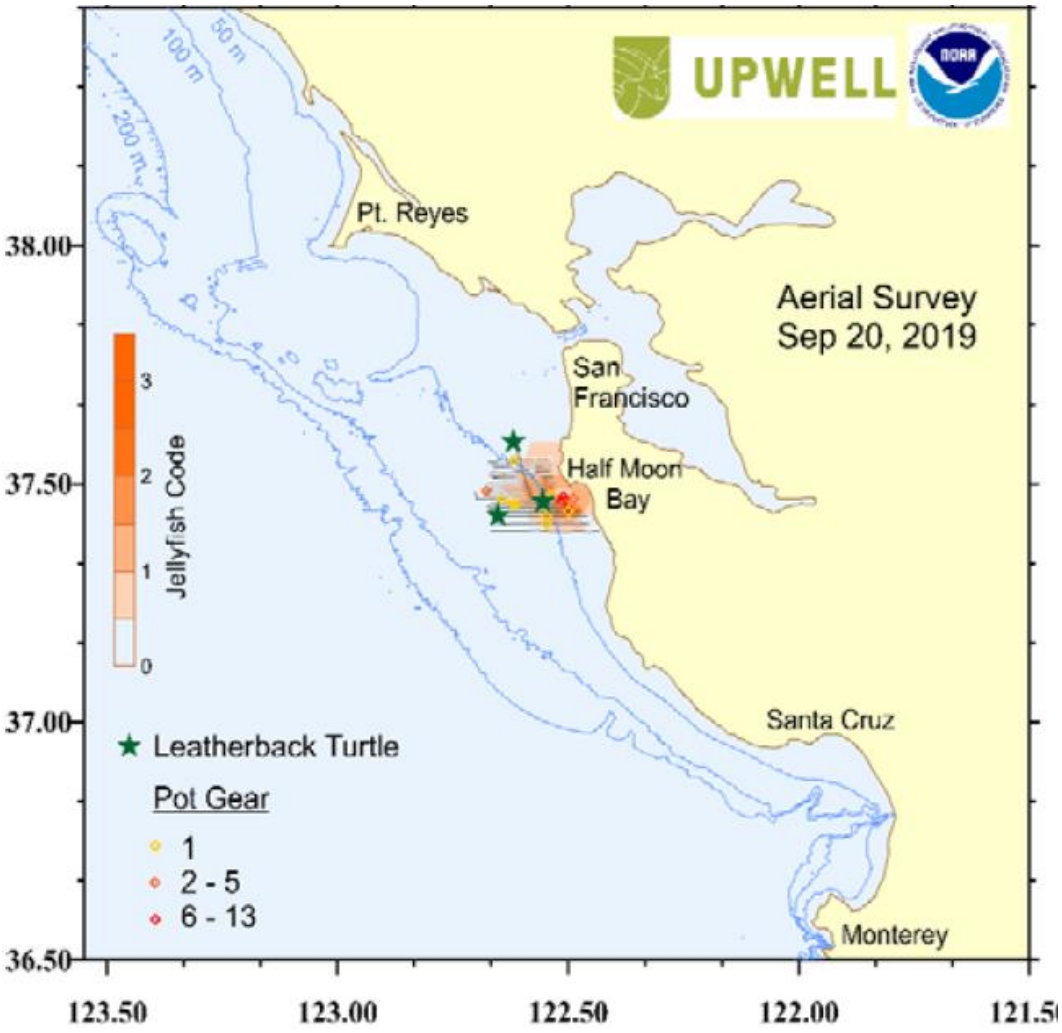
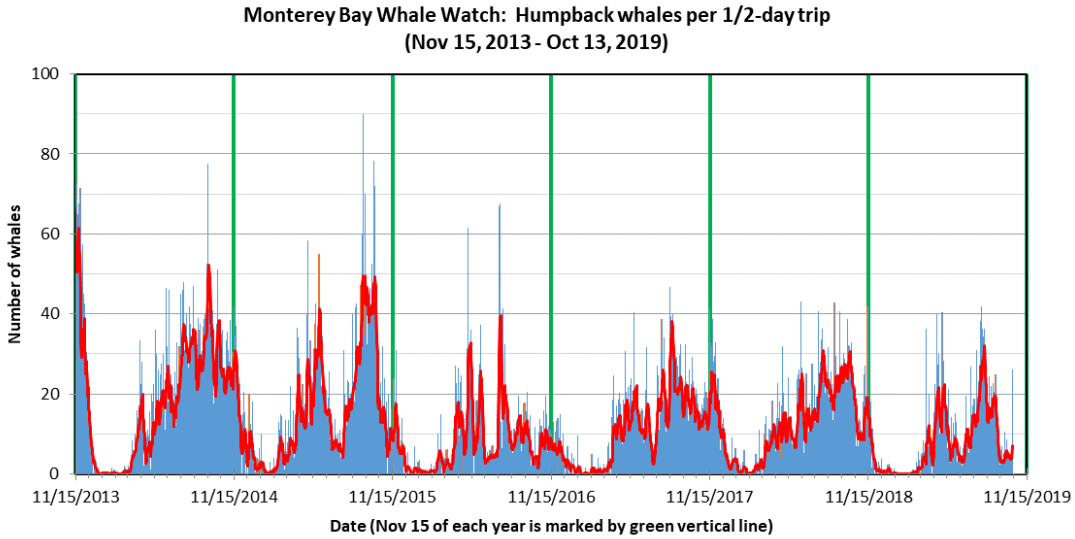
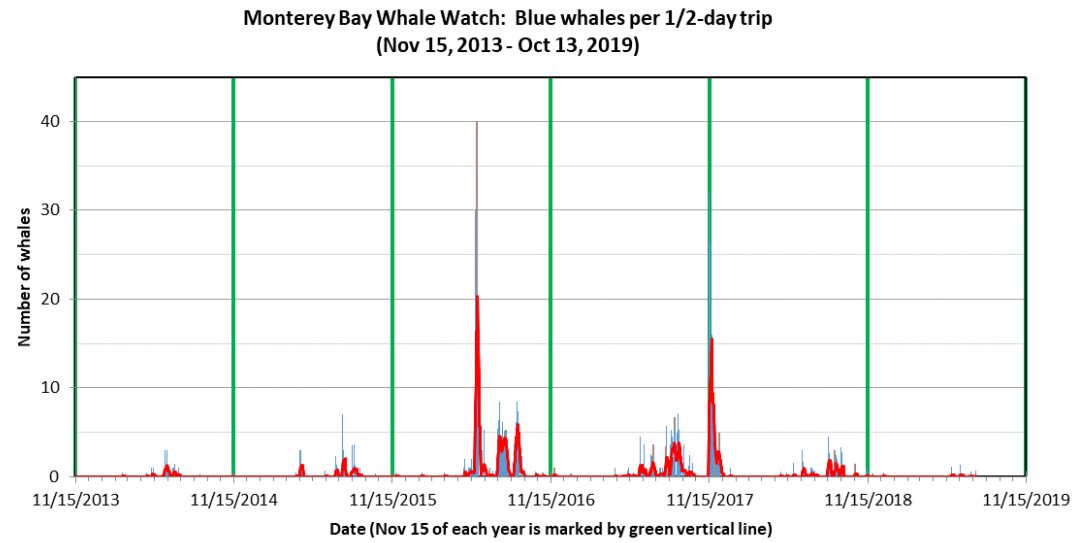


Figure 9.

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.





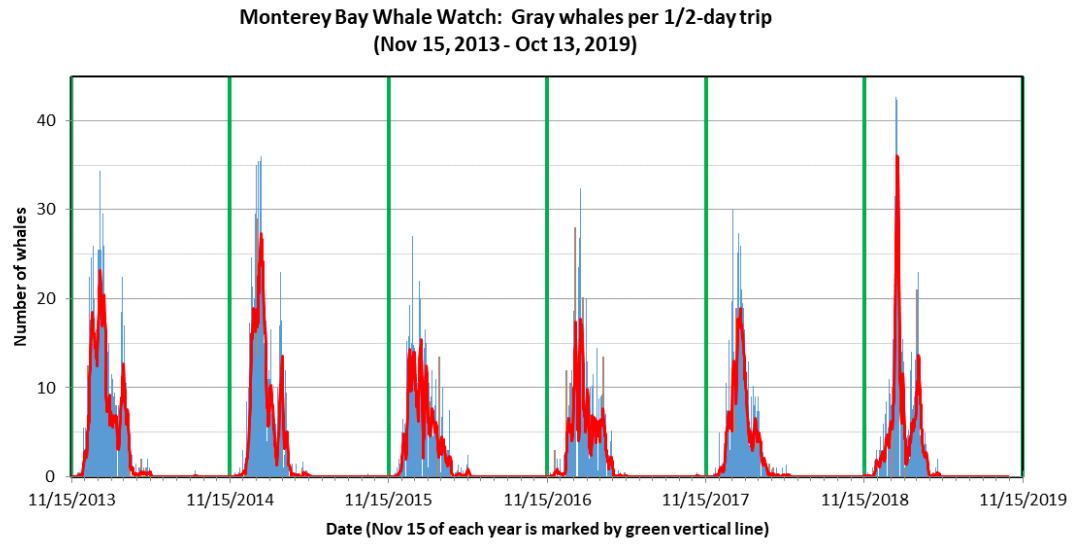


Figure 10. Daily whale counts at the Farallon Islands. For Humpback Whales, low is < 5 whales, medium is 5-9 whales, high is > 9 whales. For Blue Whales, low is < 2 whales and high is > 2 whales.

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

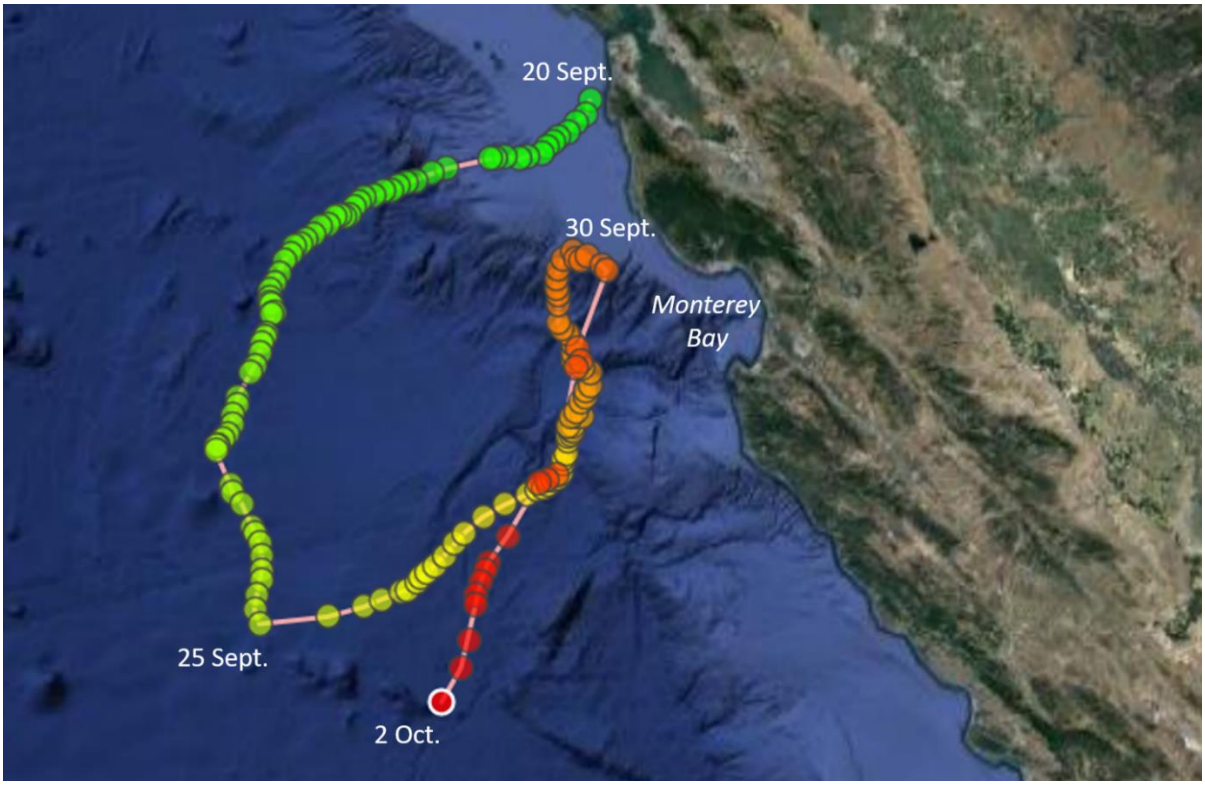


Figure 12. Positions from leatherback turtles tagged on October 6, 12, and 13.

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.

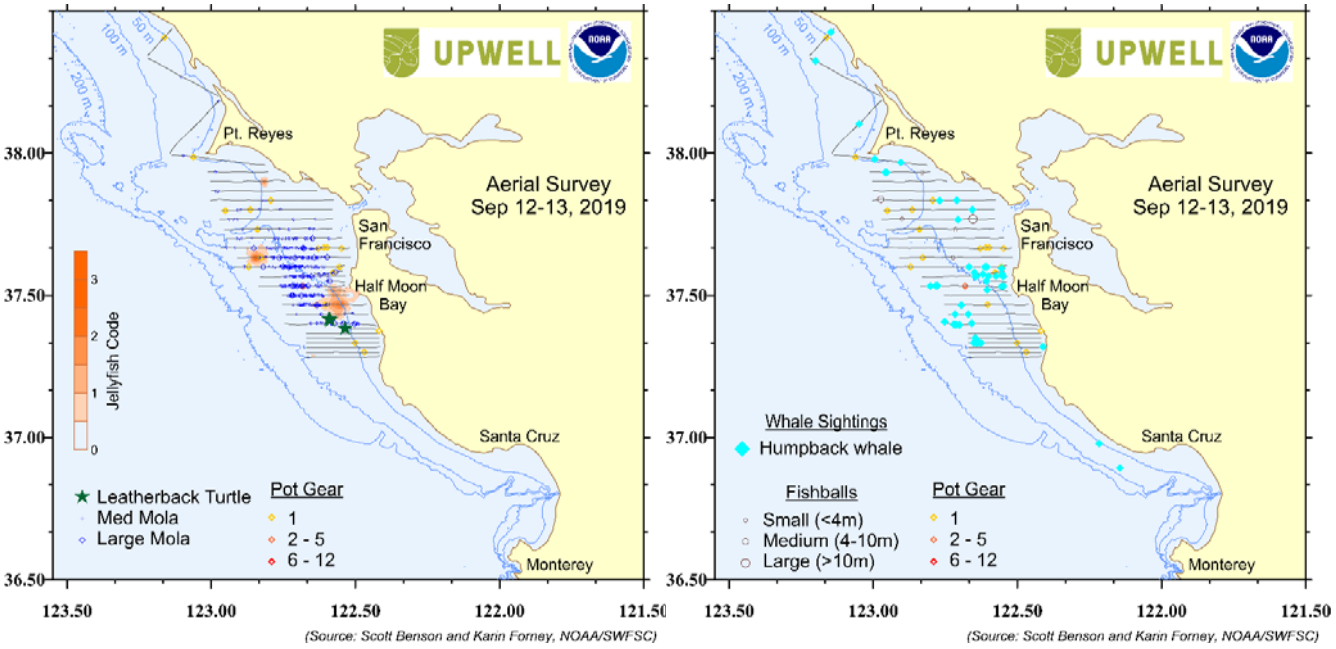


Figure 1. Leatherback Aerial Surveys on Sep 12-13, 2019. **LEFT**: Observations of leatherback turtles, their jellyfish prey (coded 0-3, with 3 being the densest aggregations), medium and large ocean sunfish (*Mola mola*) that also feed on jellies, and pot gear (both fouled and clean). **RIGHT**: Observations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

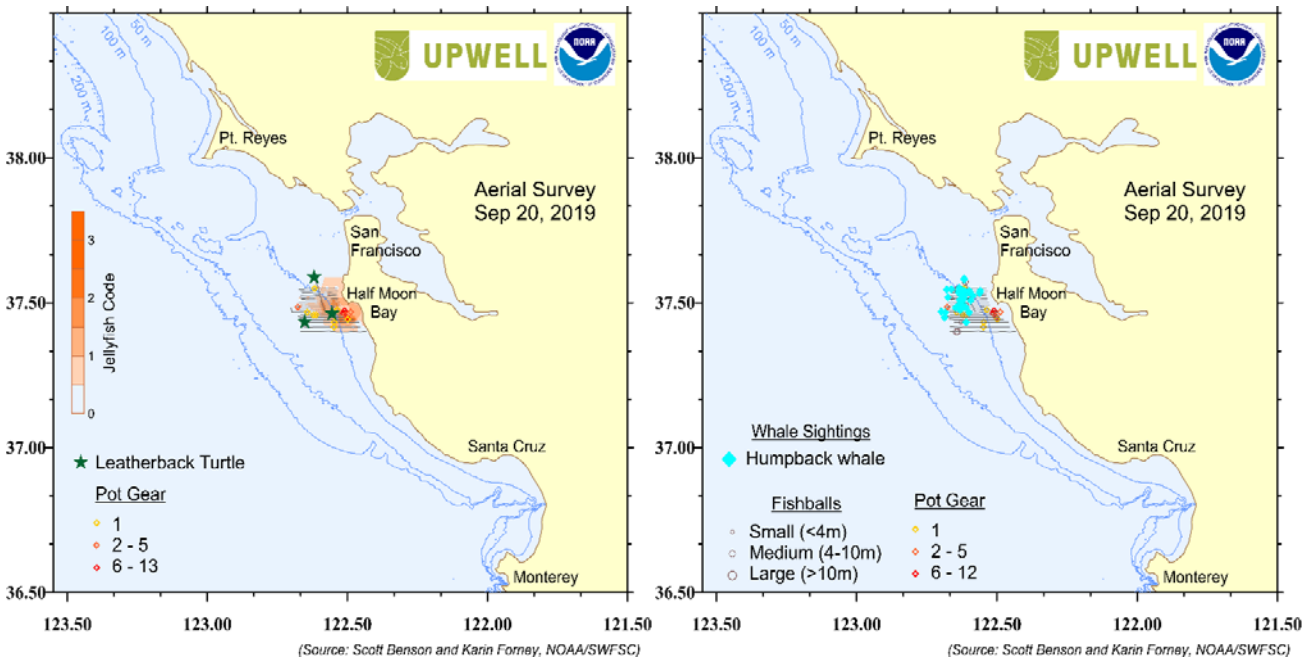


Figure 2. Leatherback Aerial Surveys on Sep 12-13, 2019. **LEFT**: Observations of leatherback turtles, their jellyfish prey (coded 0-3, with 3 being the densest aggregations), medium and large ocean sunfish (*Mola mola*) that also feed on jellies, and pot gear (both fouled and clean). **RIGHT**: Observations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

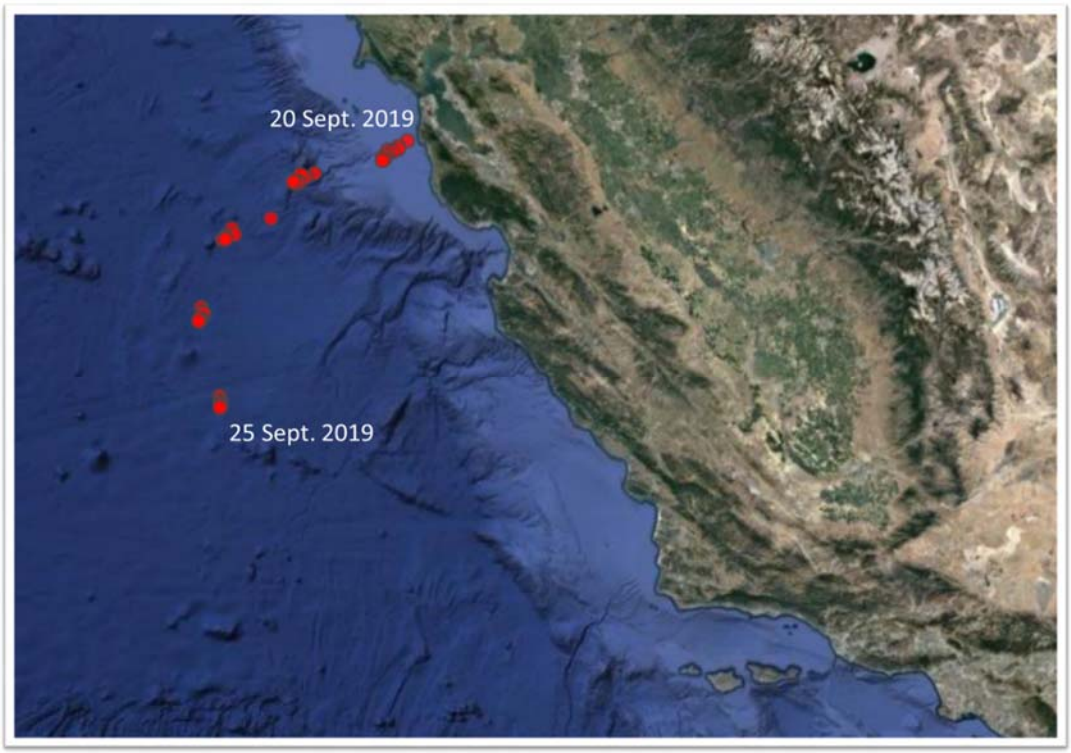


Figure 3. Track of leatherback turtle tagged on 9/20/2019 off Half Moon Bay. The animal was in good body condition, suggesting a successful foraging season, and departed coastal waters after tagging.

Leatherback Aerial Survey and Tagging Summary
2-13 October 2019

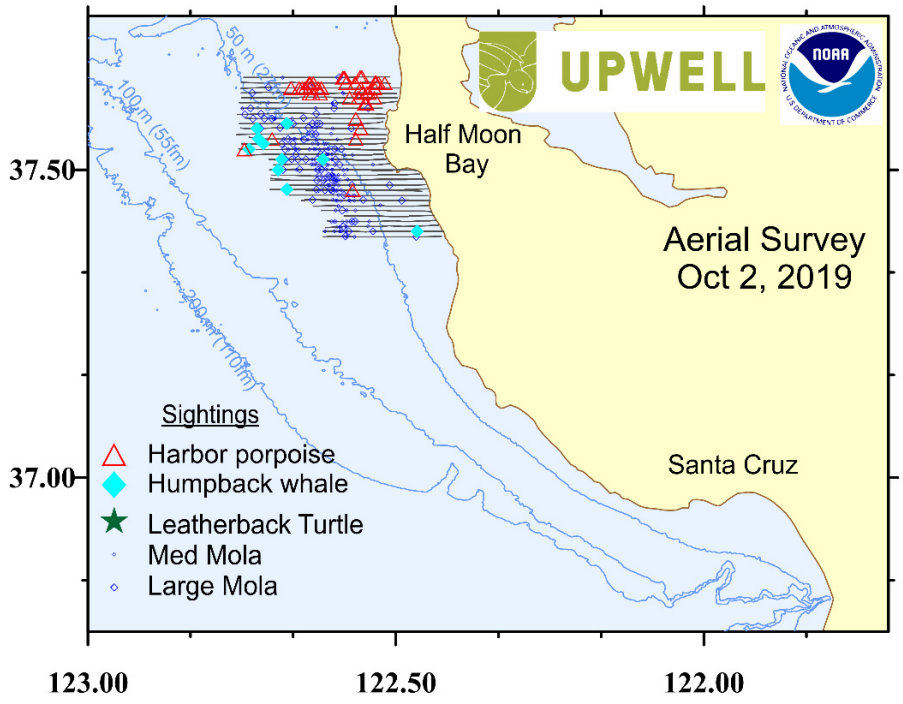
(Prepared 14 Oct 2019 by Karin Forney and Scott Benson, NOAA/SWFSC;
Scientific Advisors to the Dungeness Crab Fishing Gear Working Group)

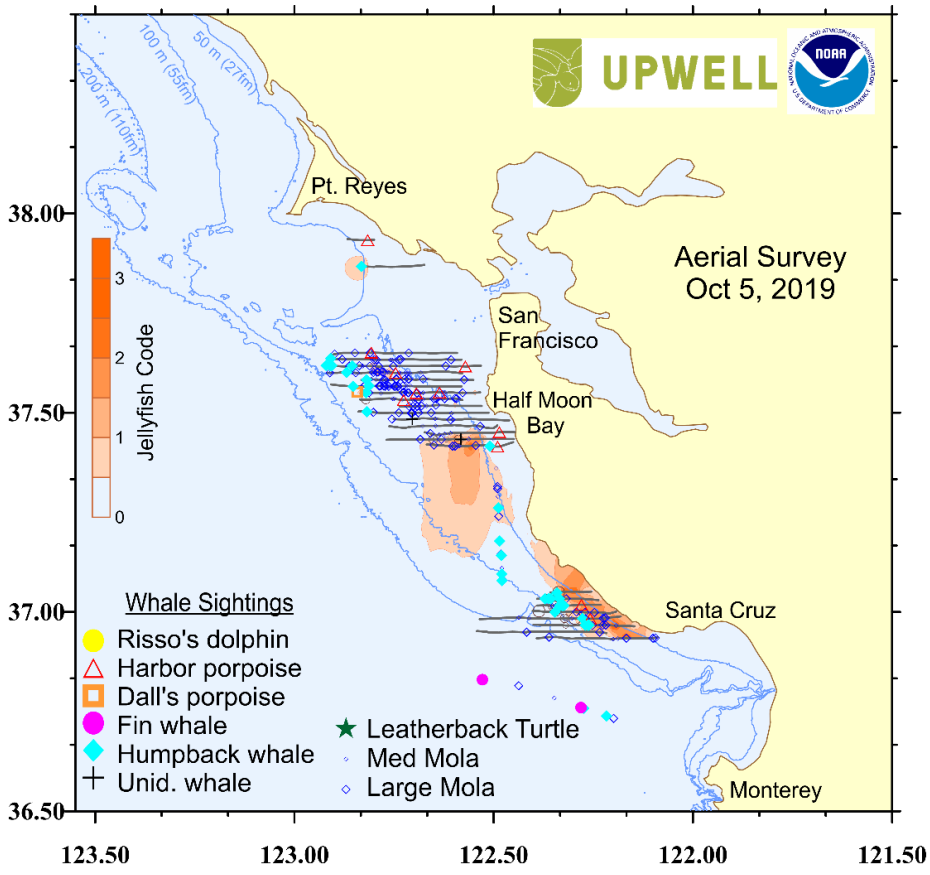
Survey Details:
Aerial surveys were conducted on October 2, 5, 6, 7, 8, 11, 12, and 13, 2019 in support of leatherback capture and tagging operations. The surveys were led by Karin Forney and Erin LaCasella (NOAA/SWFSC), with a team of trained aerial observers from NOAA and a local research partner, 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.

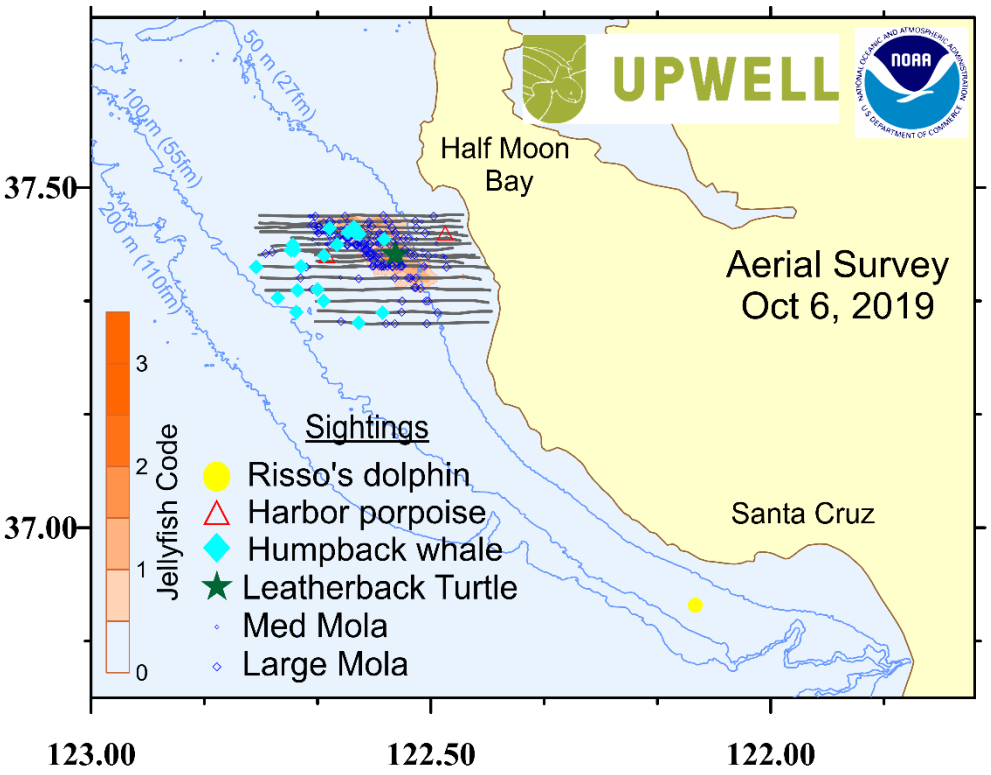
Humpback whales: Humpback whales have been abundant throughout the Gulf of the Farallones during October, as they were in September. Their distribution has varied somewhat as wind-driven processes have moved the patches of their prey (anchovies and krill) into shallower/deeper waters. They have been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

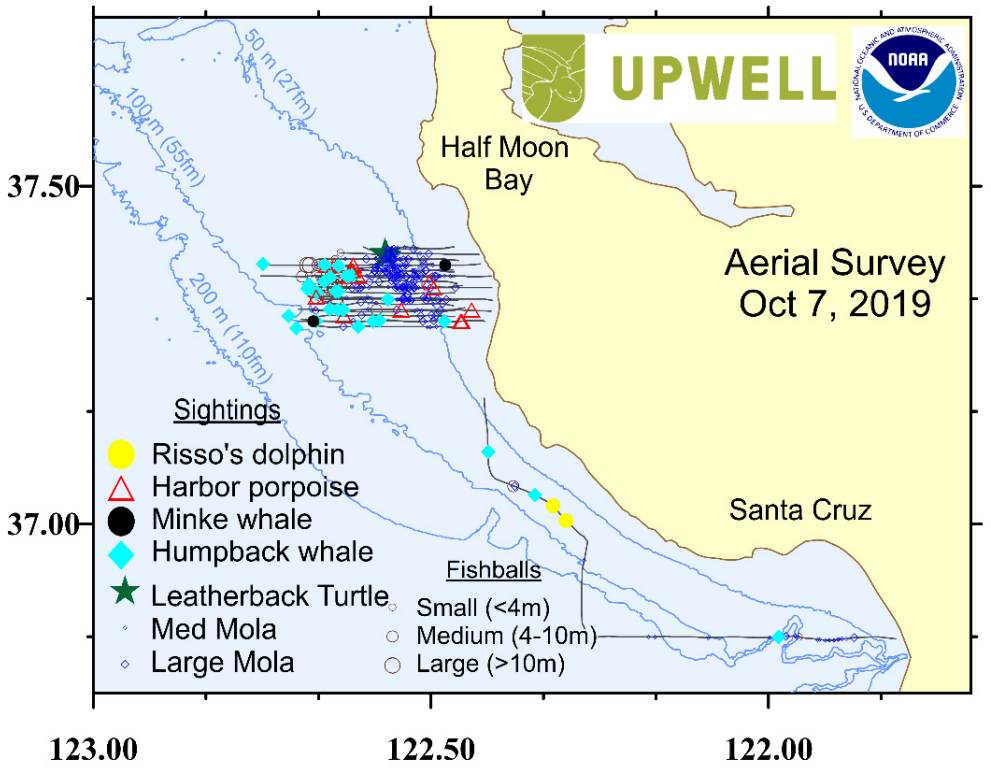
Leatherback Turtles: At least 6 or 7 different leatherbacks were observed during the October aerial surveys, in an area off San Mateo County (from about San Gregorio in the south to Pacifica in the north). Leatherback turtles were observed foraging on dense aggregations of brown sea nettles in waters 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).

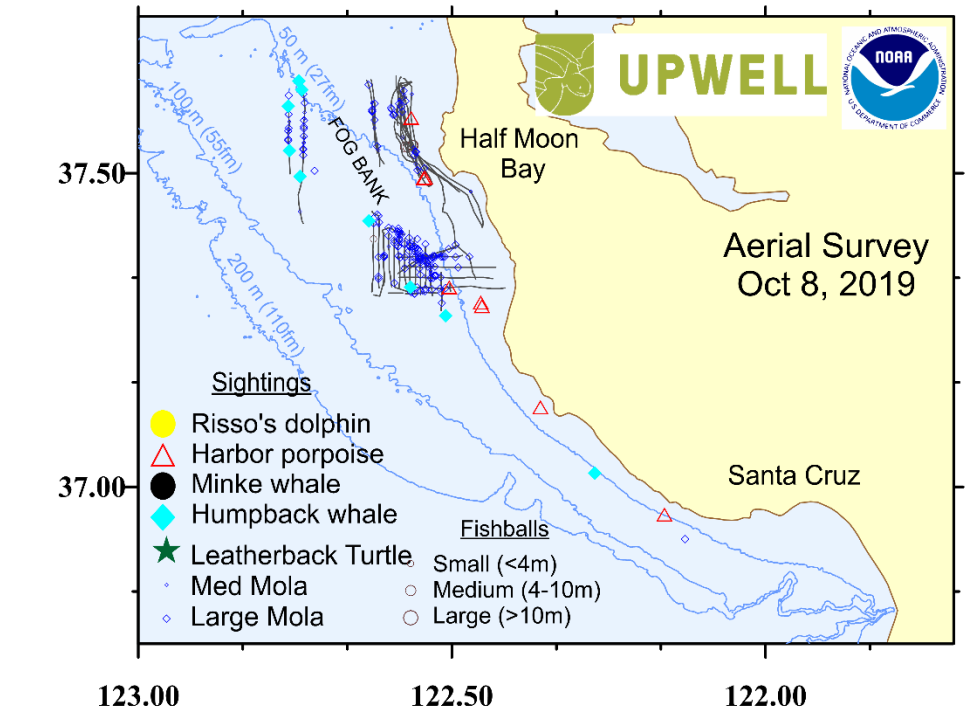
Figures for each of the survey days as well as an updated plot of leatherback turtle tracks are shown below.

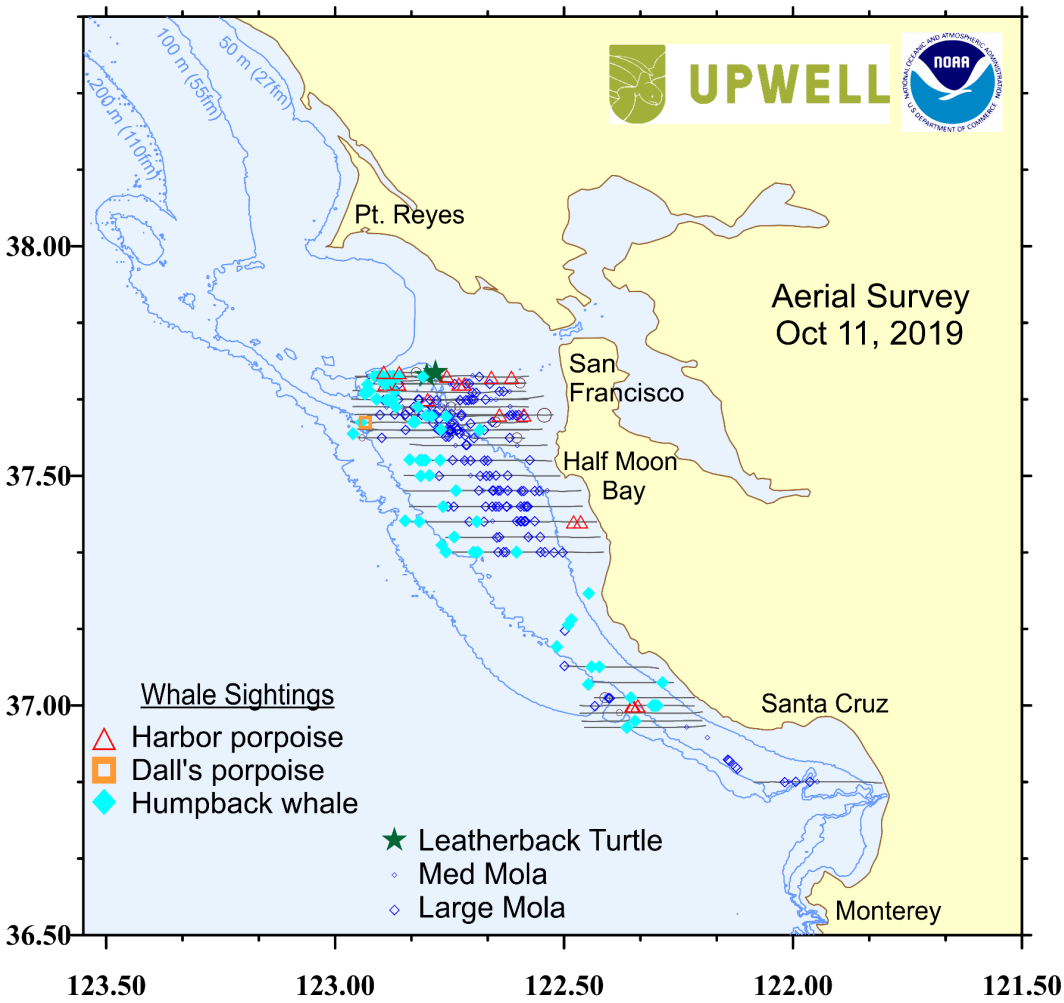

UPWELL
Half Moon Bay
Aerial Survey
Oct 2, 2019
Santa Cruz
Sightings
Harbor porpoise
Humpback whale
Leatherback Turtle
Med Mola
Large Mola
50 m (27fm)
100 m (55fm)
200 m (110fm)
37.50
37.00
123.00
122.50
122.00


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

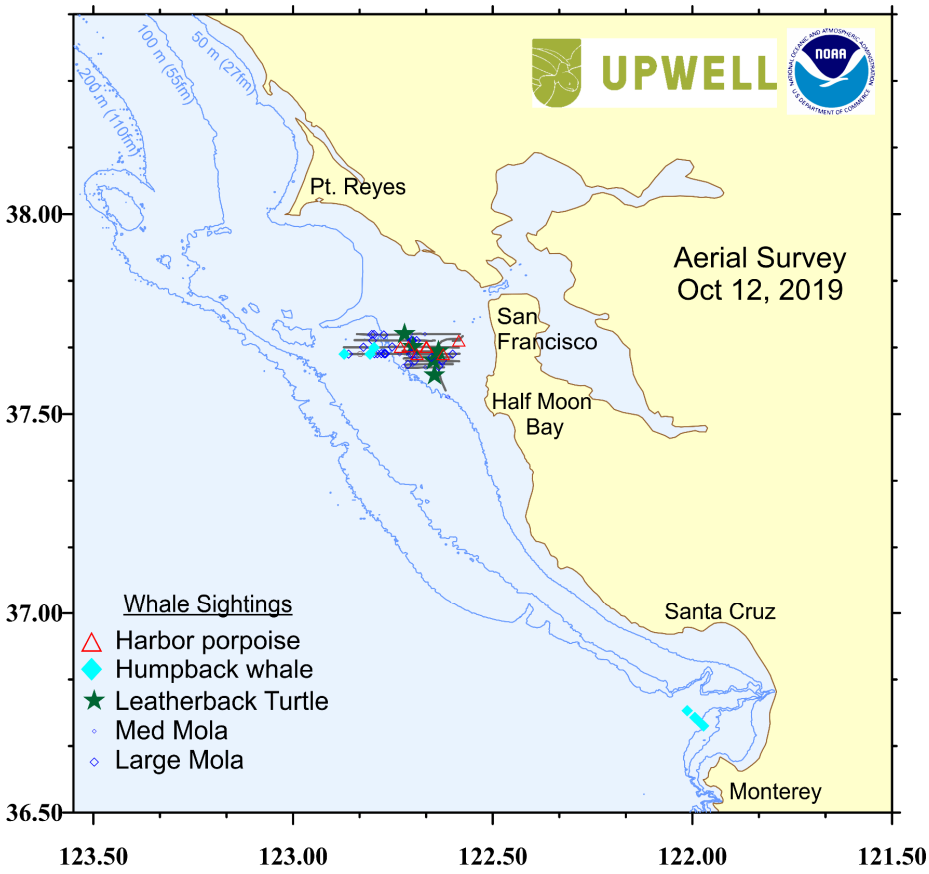

UPWELL
NOAA
Half Moon Bay
Santa Cruz
50 m (27fm)
100 m (55fm)
200 m (110fm)
Aerial Survey
Oct 6, 2019
Jellyfish Code
3
2
1
0
Sightings
Risso's dolphin
Harbor porpoise
Humpback whale
Leatherback Turtle
Med Mola
Large Mola
37.50
37.00
123.00
122.50
122.00


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

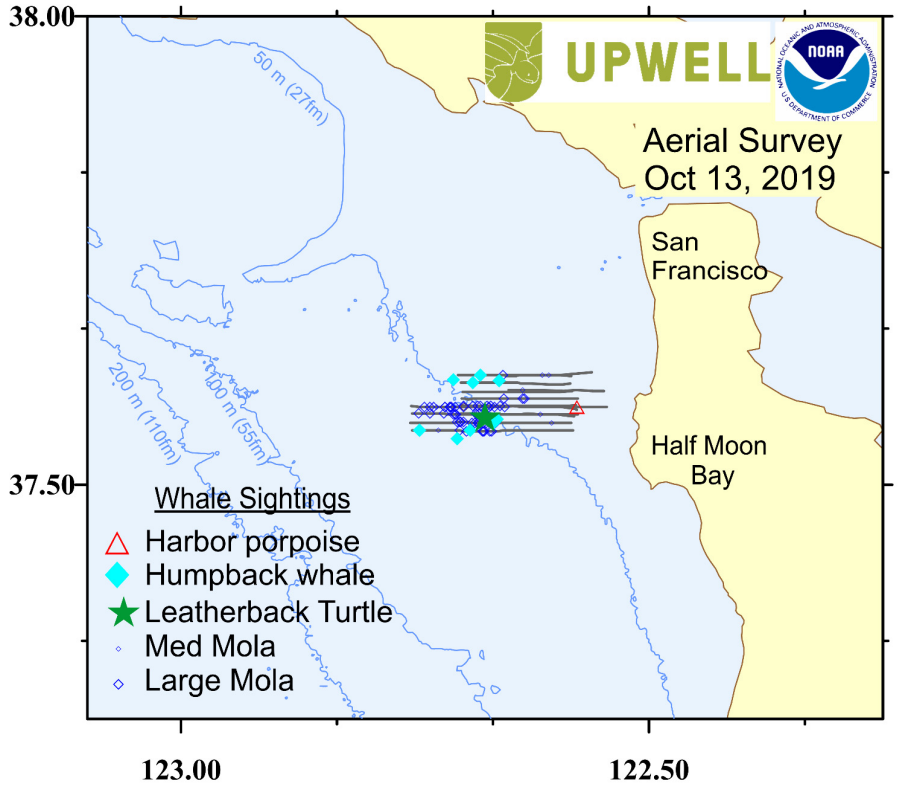




(Source: Scott Benson and Karin Forney, NOAA/SWFSC)



(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.