UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southwest Fisheries Science Center
Fisheries Ecology Division
110 Shaffer Road
Santa Cruz, California 95060

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
Office of Marine and Aviation Operations
Marine Operations Center, Pacific
2002 SE Marine Science Drive
Newport, Oregon 97365

Cruise Report

Date Submitted:	November 29, 2016
Platform:	NOAA Ship *Reuben Lasker*
Project Number:	RL-16-03 (OMAO)
Project Title:	Rockfish Recruitment and Ecosystem Assessment
Project Dates:	April 26 – June 12, 2016

Prepared by: _____ Dated: November 29, 2016____
Keith Sakuma
Chief Scientist
NOAA NMFS SWFSC FED

Approved by: _____ Dated: November 29, 2016_____
Steve Lindley
Laboratory Director
NOAA NMFS SWFSC FED

A. Project period: April 26 – June 12, 2016

Leg 1: April 26 – May 19
Leg 2: May 23 – June 12

B. Operating area and days at sea (DAS)

Operating area: San Diego, CA to Flint Rock Head, CA (see Appendix I and II for station sample dates and locations).

DAS: Scheduled for 45 DAS.
DAS lost due to inclement weather=3.
DAS with compromised operations due to inclement weather=11.
DAS lost or compromised due to equipment failure=0.

C. Objectives

1. Sample for pelagic juvenile young-of-the-year (YOY) rockfish (*Sebastes* spp.) and other epi-pelagic micronekton.

2. Characterize prevailing ocean conditions.
   a) Examine chlorophyll, primary productivity, and inorganic nutrients.
   b) Collect hydrographic data to support modeling harmful algal blooms (HABs).
   c) Collect water samples for environmental DNA (eDNA).

3. Map the distribution and abundance of krill (Euphausiacea).

4. Observe seabird and marine mammal distribution and abundance.

5. Collect Humboldt squid (*Dosidicus gigas*).

6. Collections for stable isotope analysis.

7. Sample for juvenile salmon (*Oncorhynchus* spp.).

8. Collect adult rockfish for genetics and species identifications.

D. Participating organizations

NOAA National Marine Fisheries Service (NMFS) South West Fisheries Science Center (SWFSC) Fisheries Ecology Division (FED)

University of California Santa Cruz (UCSC)

Farallon Institute for Advanced Ecosystem Research (FIAER)

Pacific States Marine Fisheries Commission (PSMFC)

Monterey Bay Area Research Institute (MBARI)

Hopkins Marine Station, Stanford University (HMSSU)

School of Engineering, Stanford University (SESU)

Humboldt State University (HSU)

Center for Stock Assessment Research (CSTAR)

California Department of Fish and Wildlife (CDFW)

California State University Monterey Bay (CSUMB)

Romberg Tiburon Center for Environmental Studies (RTCES)

E. Personnel

Leg 1 (May 1-21)
Night Shift
Keith Sakuma, Fishery Biologist, NMFS SWFSC FED (Chief Scientist)
John Field, Fishery Biologist, NMFS SWFSC FED (Principal Investigator) (April 26-May 4)
Edward Dick, Fishery Biologist, NMFS SWFSC FED (April 26-May 4)
Heidi Fish, Fishery Biologist, NMFS SWFSC FED (April 26-May 4)
Cythnia Carrion, Krill Biologist, UCSC (April 26-May 4)
Lyndsey Lefebvre, Fishery Technician, NMFS SWFSC FED (May 4-12)
Emily Slesinger, Fishery Intern, NMFS SWFSC FED (May 4-12)
Elizabeth Graham, Student, CSUMB (May 4-12)
Kevin Coll, Krill Biologist, UCSC (May 4-12)
Sabrina Beyer, Fishery Technician, NMFS SWFSC FED (May 12-19)
Morgan Ivens-Duran, Environmental Scientist, CDFW (May 12-19)
Richard Pytak, Krill Biologist, UCSC (May 12-19)
Day Shift
Don Pearson, Fishery Biologist, NMFS SWFSC FED
Mike Force, Ornithologist, FIAER
Brett Stacy, Technician, HSU/UCSC/NMFS SWFSC FED
Collin Closek, Ecologist, SESU (April 26-May 4, May 12-19)
Hilary Starks, Ecologist, SESU (April 26-May 4, May 12-19)

Leg 2 (May 23 – June 14)
Night Shift
Keith Sakuma, Fishery Biologist, NMFS SWFSC FED (Chief Scientist)
Thomas Adams, Fishery Technician, NMFS SWFSC FED
Cherisa Friedlander, NOAA Corp., NMFS SWFSC FED (May 23-31, June 7-12)
Kevin Coll, Krill Biologist, UCSC (May 23-June 7)
Kerry Nickols, Assistant Professor, CSUMB (May 23-31)

Alana Kleven, Student, CSUMB (May 23-31)
Ryan Belcher, NOAA Corp., NMFS SWFSC FED (May 31-June 12)
Rebecca Miller, GIS Technician, NMFS SWFSC FED (May 31-June 12)
Ryan Howard, Krill Biologist, UCSC (May 31-June 12)
Susan Sogard, Fishery Biologist, NMFS SWFSC FED (May 31-June 7)
Nick Grunloh, CSTAR, NMFS SWFSC FED (June 7-12)
Day Shift
Brian Wells, Fishery Biologist, NMFS SWFSC FED (May 23-31)
Ryan Belcher, NOAA Corp., NMFS SWFSC FED (May 23-31)
Mike Force, Ornithologist, FIAER (May 23-31)
Tricia Lee, Graduate Student, RTCES (May 23-31)
Lyndsey Lefebvre, Fishery Technician, NMFS SWFSC FED (May 31-Hune 7)
Jarrod Santora, Ornithologist, FIAER (May 31-June 7)
Collin Closek, Ecologist, SESU (May 31-June 7)
Elizabeth Andruszkiewicz, Ecologist, SESU (May 31-June 7)
John Field, Fishery Biologist, NMFS SWFSC FED (Principal Investigator) (June 8-12)

Scientist duty hours

Nighttime Shift	1800-0600 (5-6 scientists on duty)
Daytime Shift	0600-1800 (1-5 scientists on duty)

F. Licenses and permits

This project was conducted under the NMFS Scientific Research Permit number 19320, the California Department of Fish and Wildlife permit SC-12372, as well as SWFSC's MMPA LOA for the California Current 80 FR 58982 and ESA section 7 biological opinion and associated incidental take statement WCR ESA consultation 2015-2455. Protected species watches were conducted and logged as listed in the project instructions with all completed watch logs sent to Environmental Compliance Specialist Krista Catelani (krista.catelani@noaa.gov).

Operations within the Channel Islands National Marine Sanctuary (CINMS) were approved under permit CINMS-2015-007. Permitted activities included the use of midwater sampling gear as well as CTDs. Operations within any other National Marine Sanctuary were covered under the ONMS concurrence 304(d) received by SWFSC April 14, 2015.

G. Objectives

1. Sample for pelagic juvenile young-of-the-year (YOY) rockfish and other epi-pelagic micronekton

Midwater trawls were conducted within five regions (north, north central, core, south central, and south) encompassing the majority of the coast of California (see Appendix II for regions and trawl station locations) using a modified-Cobb midwater trawl with a 26 m (86') headrope and a 9.5 mm (3/8") codend liner. Trawls were done at standard fixed location stations at night with a target headrope depth of 30 m unless bottom depths were shallow (e.g. less than 55 m) in which case the target headrope depth was 10 m to avoid contact with the bottom. Tow speed was ~3.7

km/hr (~2 knots) with a trawl duration of 15 minutes at target headrope depth. However, in several cases trawl duration was decreased to 5 minutes due to large abundances of pelagic tunicates (primarily pyrosomes [*Pyrosoma* spp.] and Thetys salps [*Thetys vagina*]) and pelagic red crabs (*Plueroncodes plannipes*). Paired 5 versus 15 minute comparison trawls were opportunistically conducted in an ongoing effort to more accurately expand the catches from the 5 minute trawls to the equivalent standard 15 minute trawls. In addition, one night was spent sampling offshore Monterey Bay to examine the epi-pelagic community present beyond the normal survey boundary with three trawls completed from ~107-166 km (~58-90 nm) offshore. Wire out was determined based on depth recordings collected from TDRs post-trawl. Unfortunately, the ship's Simrad ITI real-time acoustic net headrope depth sensor was not functional for the entire survey, so real-time depth data was unavailable.

A total of 137 trawls were completed including eight paired 5 versus 15 minute trawls and three offshore Monterey Bay trawls. The daily sampling schedule is listed in Appendix 1 and Appendix II shows the number of planned versus actually sampled station locations. Trawl sampling was adversely affected by bad weather (high winds and seas) that occurred on 14 of the 43 available sampling nights of the survey with all trawl operations cancelled on three of those nights. Also, high densities of Dungeness crab (*Metacarcinus magister*) pot gear were encountered in nearshore areas (out to at least 100 m bottom depth), which prevented trawl operations due to the risk of entanglement with the float lines. The unusually high densities of crab gear were in large part a consequence of an extremely delayed crab season due to a toxic algal bloom that kept virtually the entire West Coast fishery closed through April of 2016 (the season typically begins in November or December and runs through June). All nearshore stations were scouted during daylight hours prior to the nighttime trawl operations to determine if there was a workable path through the crab gear. Over a dozen nearshore trawls were cancelled due to the prevalence of crab gear in the water. The combination of bad weather (which was worse further offshore) and crab gear (which was more densely encountered nearshore) resulted in very few stations sampled north of the Navarro transect line with only three trawls completed in the north region of the survey. .

Fish and select invertebrates from each trawl were sorted, identified and enumerated at sea. Size measurements were taken on adult and YOY of select coastal pelagic and groundfish species (e.g., northern anchovy [*Engraulis mordax*], Pacific sardine [*Sardinops sagax*], Pacific sanddab [*Citharichthys sordidus*], Pacific whiting [*Merluccius productus*], etc.) as well as salmon. In addition, size measurements were taken on select squids (e.g., market squid [*Doryteuthis opalescens*], blacktip squid [*Abraliopsis felis*], armhook squids [*Gonatus* spp.], etc.), gelatinous organisms (e.g., salps, Thetys salps, pyrosomes, jellyfish [*Chrysaora* spp. and *Aurelia* spp.], etc.), mesopelagics (e.g., northern lampfish [*Stenobrachius leucopsarus*], blue lanternfish [*Tarletonbeania crenularis*], California headlightfish [*Diaphus theta*], California smoothtongue [*Leuroglossus stilbius*], etc.) and other select fish species (e.g., medusafish [*Icichthys lockingtoni*], plainfin midshipman [*Porichthys notatus*], king-of-the-salmon [*Trachipterus altivelis*], etc.). All YOY rockfish were frozen at sea and then worked up later in the laboratory (identifications confirmed, length measurements taken, and genetic tissue samples collected; otoliths pulled on select species).

Plots of the annual means of the log-transformed catches of select species/taxa are shown in Appendix III. Note that in 2011 due to vessel, weather, and logistic constraints only two stations

were sampled south of the core region in 2011 (the two nearshore Piedras Blancas stations) and in 2012 none of the stations north of Point Reyes were sampled. Also, catches from the north region are not presented due to the short time series (only began sampling in 2013). Similar to 2015, YOY rockfish were observed at record high levels in the core and south central regions in 2016. However, numbers were dramatically reduced both in the north central and south regions relative to 2015. As in 2015, shortbelly rockfish (*Sebastes jordani*) was the dominant species comprising 78% of the rockfish collected (Appendix IV). However, unlike 2015 where eight different rockfish species had total raw catches greater than 1000, in 2016 shortbelly rockfish and widow rockfish were the only two rockfish species with total catches over 1000. Similar to YOY rockfish, YOY Pacific hake catches in the core region were the highest observed in the history of the survey, but catches in all other regions were much reduced relative to 2015. In addition, catches of other YOY groundfish such as Pacific sanddab and lingcod (*Ophiodon elongatus*) were also lower in 2016 in all regions relative to 2015.

Catches of adult Pacific sardine remained low in 2016 with only a few specimens encountered in the south region (Appendix III). In contrast, adult northern anchovy catches increased dramatically in the south region compared to the previous seven years, although catches in the other regions remained low. Catches of YOY decreased in all regions relative to 2015 with the exception of northern anchovy in the south, where catches were the highest observed since sampling began in that region in 2004.

In contrast to the groundfish and coastal pelagics, catches of myctophids in 2016 were higher in all regions relative to 2015 (Appendix III). Krill catches in 2016 showed a pattern similar to the YOY rockfish with slightly higher numbers in the core and south central regions, but reduced numbers in the north central and south regions relative to 2015. There was a moderate increase in the catches of market squid in the south region in 2016, but catches in all other regions dropped dramatically compared with 2015. Pelagic red crabs catches in 2016 were at record high levels in the core, south central, and south regions.

While enumeration at sea of gelatinous organisms was discontinued after 2001, enumeration of large jellyfish was resumed in 2005 and other select gelatinous organisms were resumed in 2012 due to abnormally large densities observed that year. In 2016, Theys salps were collected in record numbers in the north central, core, and south central regions, although catches declined in the south region relative to 2015 (Appendix II). Other salps were also more abundant in the north region in 2016 relative to prior year, but numbers declined in all other regions compared to 2015. Similar to Thetys salps, pyrosome catches were at record high levels in the north central and south central regions and relatively high in the core region, but were at reduced levels in the south region. Jellyfish numbers within the core region continued to be at low levels with only a few *Aurelia* spp. and no *Chrysaora* spp. collected.

2. Characterize prevailing ocean conditions

CTD casts were conducted throughout the day at pre-determined stations in the vicinity of the trawl transects and at most trawl stations at night. A Seabird Electronics CTD and water sampling system with conductivity, temperature, depth, fluorometer, transmissometer, photosynthetically active radiation (PAR), and dissolved oxygen sensors was used. The CTD was lowered to a maximum depth of 520 m, as bottom depth allowed. Water were taken during

the upcast for chlorophyll samples from up to two casts during the day and one at night throughout the survey area. Oceanographic data was also collected while underway by the ship's Turner Designs SCUFA fluorometer and SeaBird thermosalinometer. The acoustic echosounder was also used to acoustically characterize the distribution and abundance of macrozooplankton and micronekton, meroplankton and zooplankton associated at prominent oceanographic features and locations.

a) Examine chlorophyll, primary productivity, and inorganic nutrients

A scientist from the Romberg Tiburon Center for Environmental Studies water samples from the area around Point Reyes and the Farallones to examine chlorophyll, primary productivity, and inorganic nutrients. An incubation table was setup outside on the aft deck with a flow-through seawater source. A total of 83 locations were sampled with up to 6 water samples at each location for a total of 496 individual constituent samples. In addition, 36 incubations were also completed, resulting in a grand total of 532 samples

b) Collect hydrographic data to support modeling harmful algal blooms (HABs)

Water bottle samples from the CTD were taken from 2-3 depths per station, usually at the surface, just above the thermocline, and just below the thermocline. Water samples were for nutrient and dissolved phycotoxin analysis (frozen 20 mL scintillation vials), *Pseudo-nitzschia* cell counts (~100-200 mL), and domoic acid analysis (~500 mL filtered onto a GF/F). The only post-processing of samples at sea was the filtration for phycotoxins. Oceanographic data was also collected while underway by the ship's Turner Designs SCUFA fluorometer and SeaBird thermosalinometer. A total of 172 samples from 86 locations were collected.

c) Collect water samples for environmental DNA (eDNA)

Water samples from CTDs were collected at both nighttime trawl stations and during the day coincident with visual seabird and marine mammal surveys in and around the Monterey Bay area. Three replicate water samples were collected from an individual CTD cast. An average of 10 liters of water was collected per CTD at the selected stations. Samples were filtered and processed at sea for later analysis. In total, the eDNA team collected over 350 samples from specified depths across the Monterey Bay National Marine Sanctuary (MBNMS). In the upcoming months, we aim to process a portion of these samples to get a better understanding of the eDNA vertebrate biodiversity detection and distribution across the MBNMS. The resulting sequences from the vertebrate fraction of the seawater samples will identify vertebrates associated with the water column and also be compared to the physical fish counts conducted from the midwater trawls during the survey.

3. Map the distribution and abundance of krill

A series of daytime transects were run, during which the Ship's EK60 acoustic echosounder was used to record and geo-reference the presence and abundance of krill. The acoustic echosounder

was operated at 38, 70, 120 and 200 kHz and interfaced to a data acquisition system to estimate krill biomass between 10 and a maximum of 750 m. Two targeted transect lines were rune off Monterey Bay and Pioneer Canyon (see Appendix II for transect locations). Seabird and marine mammal observations were recorded concurrently along each of these two set transect lines.

Plankton sampling for early life stages of krill included sampling with pairovet and bongo net. A total of 60 vertical tows using a pairovet were completed. Pairovets were deployed prior to the first midwater trawl of the night and after the last midwater trawl in the morning. The pairovet was lowered to a depth of 70 m at a rate of 70 m per minute (or as fast as possible if less than that), held at depth for 10 seconds and then retrieved at a rate of 70 m per minute (or as fast as possible if less than that). The sample from one cod end was preserved in 10% buffered formalin/seawater and the other in 95% alcohol. A total of 16 bongo tows were conducted at Monterey Bay and Gulf of Farallones stations at night at the midwater trawl stations when time allowed. The bongo net was lowered to a depth of either 10 or 30 m (depending upon bottom depth) and towed for a period of 15 minutes. Samples were preserved in 10% buffered formalin/seawater.

4. Observe seabird and marine mammal distribution and abundance

Ornithologists/marine mammal biologists from the Farallon Institute for Advanced Ecosystem Research visually surveyed and estimated abundance and distribution of seabirds and marine mammals from the ship's flying bridge during daylight hours while underway. The observer recorded all birds seen within a 300 m strip transect to one side of the vessel while the ship was underway at greater than 5 knots. Marine mammals were surveyed out to the horizon. Each observation included the species, the number of individuals observed, and their behavior (mostly flying or sitting for birds). Observation data were post-processed using standardized species codes, validation of positioning data, and binning of observations into along-track sections 3 km in length. A summary of survey effort is shown in Appendix V, the top 10 most numerous seabirds in Appendix VI, and the top 10 most numerous marine mammals in Appendix VII.

5. Collect Humboldt squid

As time allowed, hook and line fishing for Humboldt squid was conducted within the survey area at depths down to 300 m during nighttime CTD deployments. Large weighted squid jigs were used as lures. Fishing effort was mostly concentrated in the south central and south regions. No Humboldt squid were encountered or collected during the survey.

6. Collections for stable isotope analysis

Samples of zooplankton, krill and other micronekton were collected to provide baseline samples at multiple trophic levels to explore the potential for developing an "isoscape" analysis of the California Current. This included saving samples (frozen) from one cod-end from the bongo tows and tissue samples from krill, sergestid shrimp (Sergestidae), market squid, adult northern anchovy, adult Pacific sardine, adult and YOY Pacific hake, YOY Pacific sanddab, and also northern lampfish, blue lanternfish, and California headlightfish. The overall idealized objective was to collect net and krill samples from each station, and up to five individuals or tissue samples of each species at each station. For larger fish, samples were taken from muscle tissue

and combined in a single bag (as five individual pieces), smaller individuals were simply frozen whole.

7. Sample for juvenile salmon.

Several days were dedicated for juvenile salmon collection using the modified Cobb midwater trawl fishing at the surface during the day. After some preliminary test trawls, four successful surface tows were completed. Tow duration was 15 minutes once the wire out was set (~70 m) with a tow speed of ~3.5 knots. Additional large polyform floats (size A5) were attached to the net during each deployment to help insure that the net fished at the surface. Typical footrope depth during tows was 18-23 m as determined by a TDR attached to the footrope to verify deployment depth and measure vertical spread. Catches were sorted after each trawl. A total of three salmon were collected (caught in two of the four trawls).

8. Collection of adult rockfish for genetics and species identifications

Hook and line fishing was conducted at select locations to collect genetic samples of adult rockfish. A fingernail size tissue sample was removed from the caudal fin and saved on blotter paper and stored in sample envelopes. In addition, fish were measured (fork length), sexed (when possible), and otoliths were removed. Fish were collected on three occasions, once on the north side of Santa Miguel Island and twice off Point Sur. Off San Miguel Island, 51 vermilion rockfish (*Sebastes miniatus*) were collected. Off Point Sur, seven blue rockfish (*S. mystinus*), one deacon rockfish (*S. diaconus*), eight canary rockfish (*S. pinniger*), and 15 vermillion rockfish were collected.

H. Disposition of data

Requests and questions regarding the primary productivity and inorganic nutrients data should be sent to Romberg Tiburon Center for Environmental Studies, Tricia Lee triciall@sfsu.edu.

Requests and questions regarding the HABs data should be sent to UCSC Institute of Marine Sciences, Clarissa Anderson 831-459-4098 clrander@ucsc.edu.

Request and questions regarding the eDNA data should be sent to School of Engineering, Stanford University, Collin Closek 650-725-9475 closek@stanford.edu.

Requests and questions regarding the seabird and marine mammal data should be sent to the Farallon Institute for Advanced Ecosystem Research, William Sydeman 707-981-8033 wsydeman@comcast.net.

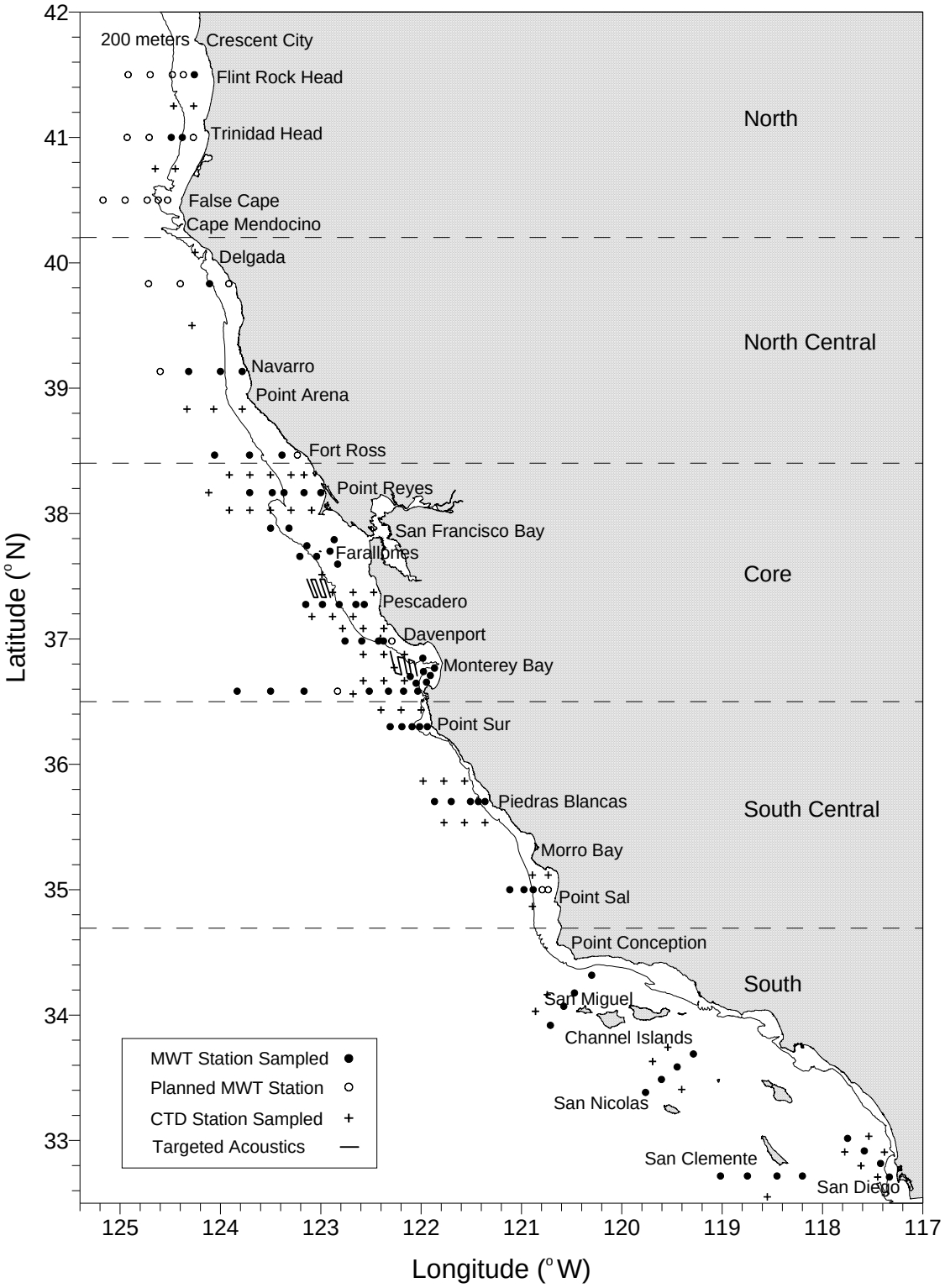
Requests and questions regarding the stable isotope data should be sent to Hopkins Marine Station, Stanford University, Steven Litvin 831-655-6241 litvin@stanford.edu and also to Monterey Bay Area Research Institute, Anela Choy 831-775-2072 anela@mbari.org.

All other data requests should be sent to NOAA NMFS SWFSC FED, Keith Sakuma 831-420-3945 keith.sakuma@noaa.gov.

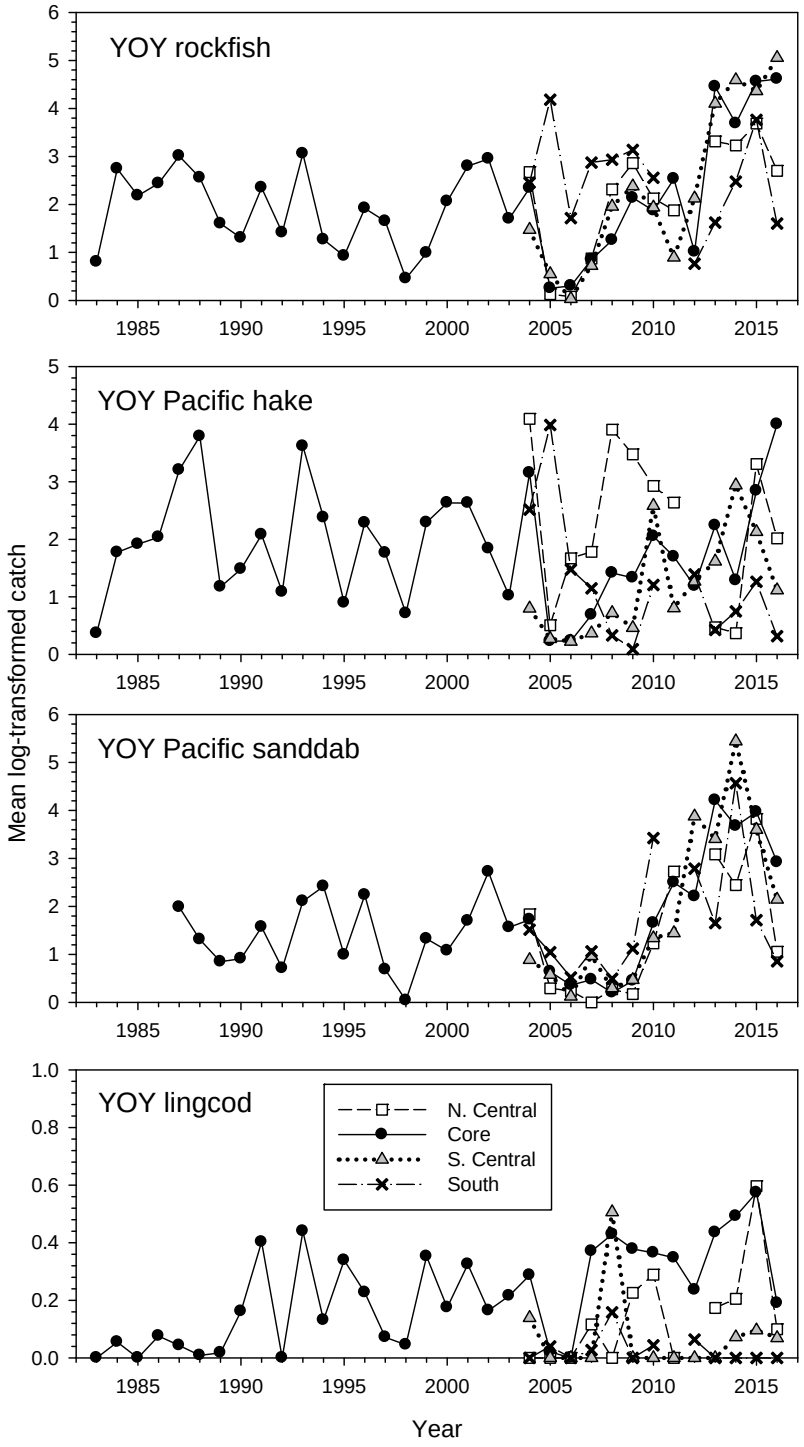
Appendix I: Daily transect schedule

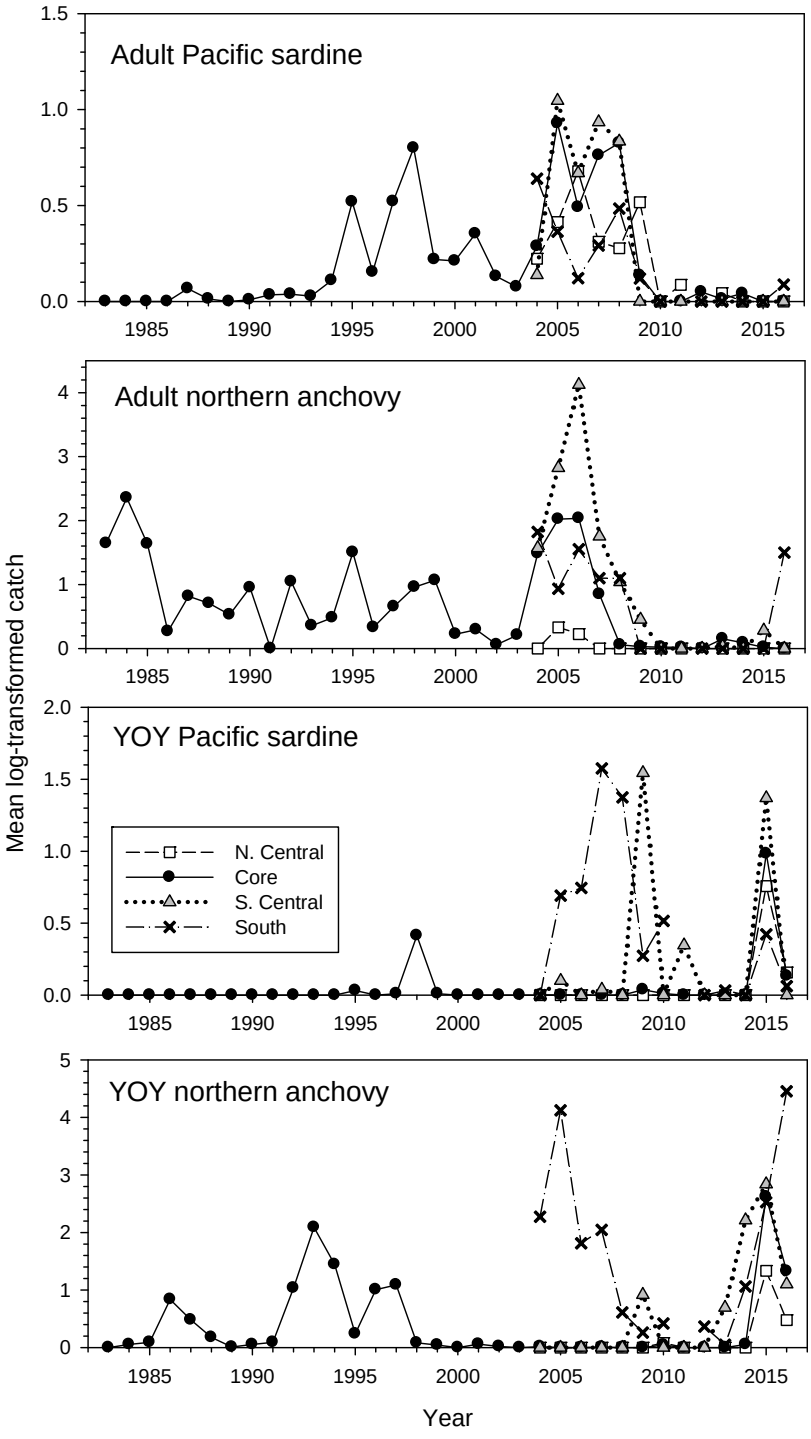
Date	Transect Location	# Sampled	Notes
25-Apr	**S.F. Port**		Load and Set Up Gear
26-Apr	Gulf of Farallones	0.7	Depart S.F., CA, Begin Leg 1 Bad Weather
27-Apr	Monterey Inside	0.5	Bad Weather
28-Apr	Monterey Inside	0.8	Bad Weather
29-Apr	Monterey Outside	0.2	Bad Weather
30-Apr	Transit		Saturday-Bad Weather
1-May	Navarro	0.8	Sunday
2-May	Point Reyes	1	
3-May	Outside Farallones	1	
4-May	Pescadero	0.8	Skiff Transfer Half Moon Bay, CA
5-May	Davenport	0.8	
6-May	Piedras Blancas	1	
7-May	San Miguel	0.8	Saturday
8-May	San Clemente	0.8	Sunday
9-May	San Diego	0.8	
10-May	San Nicolas	1	
11-May	San Miguel	1.8	
12-May	Point Sal	0.6	Skiff Transfer Avila, CA
13-May	Piedras Blancas	1.8	
14-May	Point Sur	1	Saturday
15-May	Monterey Outside	0.6	Sunday
16-May	Monterey Inside	0.8	Bad Weather
17-May	Davenport	1.4	
18-May	Pescadero	1.4	Bad Weather
19-May	**End Leg 1**		Begin In Port S.F., CA
20-May	**S.F. Port**		
21-May	**S.F. Port**		Saturday
22-May	**S.F. Port**		Sunday
23-May	Gulf of Farallones	1.4	Depart S.F., CA, Begin Leg 2
24-May	Fort Ross	0.8	
25-May	Delgada	0.3	Bad Weather
26-May	Flint Rock Head	0.2	Bad Weather
27-May	No Trawls		Bad Weather
28-May	Trinidad Head	0.4	Saturday-Bad Weather
29-May	No Trawls		Sunday-Bad Weather
30-May	Point Reyes	1.8	Memorial Day
31-May	Outside Farallones	1.4	Skiff Transfer-Half Moon Bay, CA
1-Jun	Pescadero	2.2	Pioneer Canyon Acoustic Transect
2-Jun	Davenport	2.2	
3-Jun	Monterey Outside	1.6	Monterey Canyon Acoustic Transect
4-Jun	Monterey Offshore	0.8	Saturday-Offshore sampling
5-Jun	Point Sur	2	Sunday
6-Jun	Piedras Blancas	2.6	
7-Jun	Point Sal	1.2	Skiff Transfer-Avila, CA
8-Jun	San Miguel	2.3	Bad Weather
9-Jun	San Nicolas	1.8	Bad Weather
10-Jun	San Clemente	1.8	
11-Jun	San Diego	1.5	Saturday
12-Jun	**Cruise Ends**		Sunday-Dock San Diego, CA

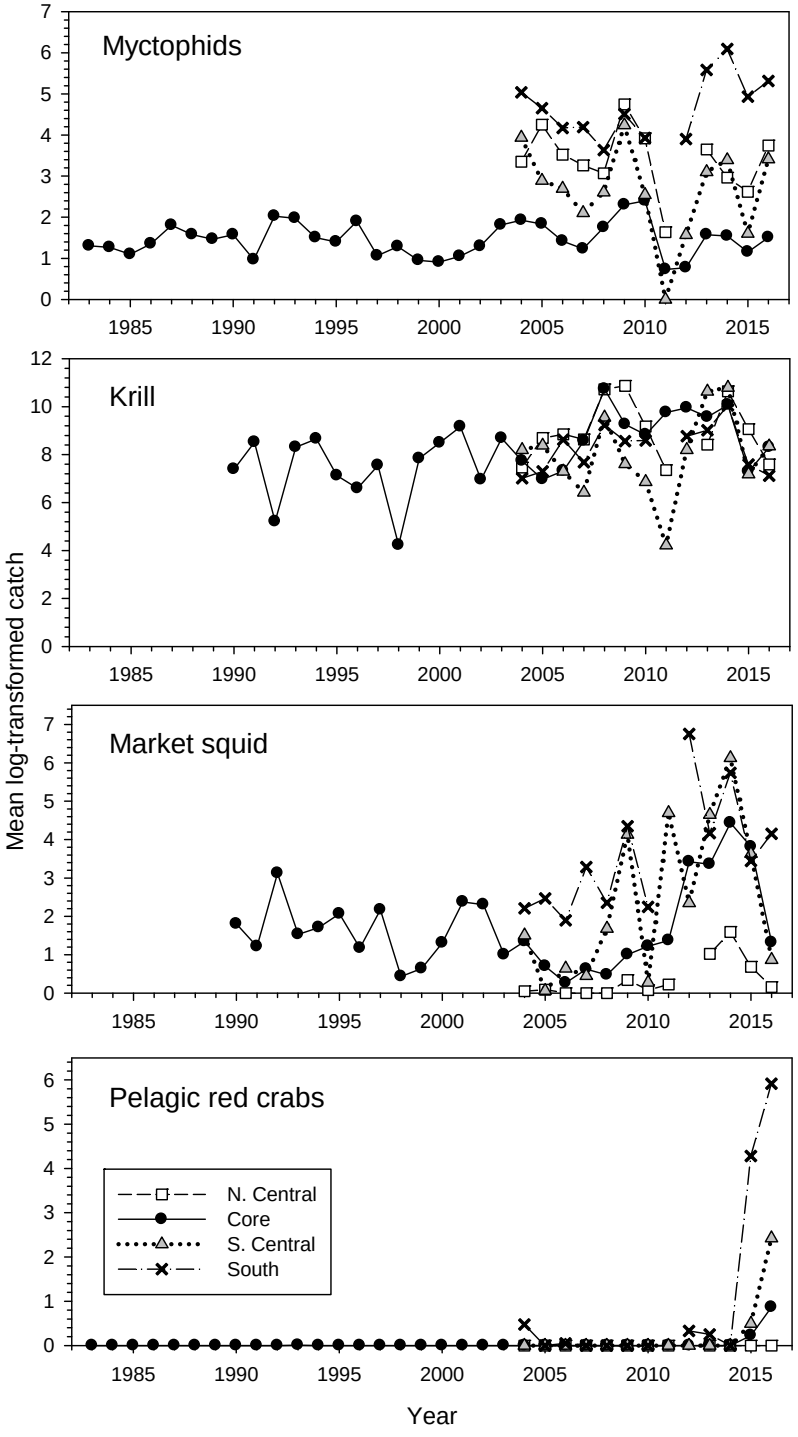
Appendix II: Survey regions and midwater trawl and CTD station locations

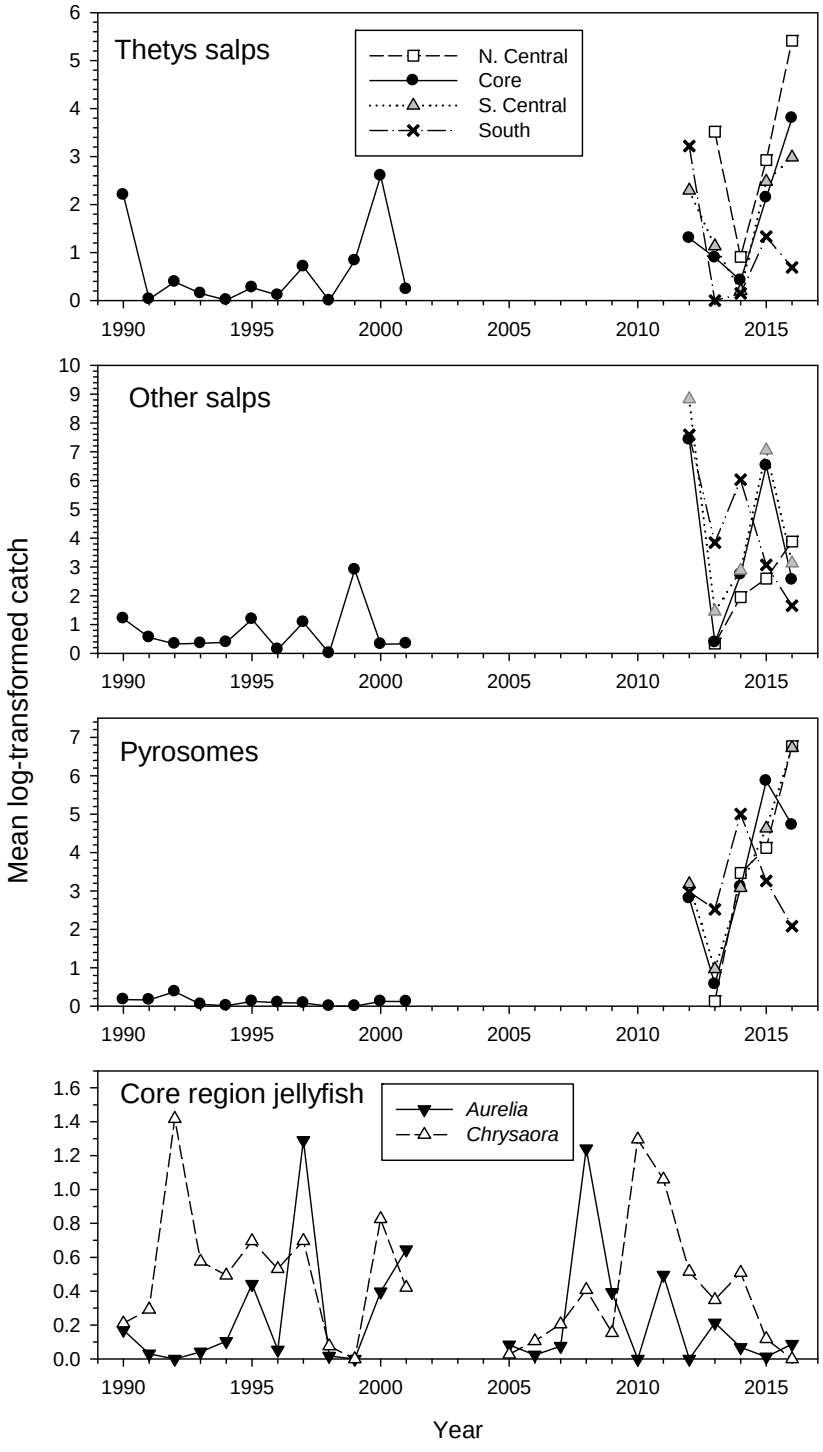


Appendix III: Annual catch summaries for select species




Adult Pacific sardine
Adult northern anchovy
YOY Pacific sardine
YOY northern anchovy
N. Central
Core
S. Central
South
Mean log-transformed catch
Year


Myctophids
Krill
Market squid
Pelagic red crabs
N. Central
Core
S. Central
South
Mean log-transformed catch
Year


Thetys salps
N. Central
Core
S. Central
South
Other salps
Pyrosomes
Core region jellyfish
Aurelia
Chrysaora
Mean log-transformed catch
Year

Appendix IV: Ten most abundant YOY rockfish species in 2016 and 2015

Year	Common Name	Scientific Name	Total No.
2016	Shortbelly Rockfish	*Sebastes jordani*	36773
	Widow Rockfish	*Sebastes entomelas*	3520
	Copper Rockfish Group	*Pteropdus* spp.	791
	Chilipepper	*Sebastes goodei*	659
	Yellowtail Rockfish	*Sebastes flavidus*	627
	Stripetail Rockfish	*Sebastes saxicola*	417
	Rosy Rockfish Group	*Sebastomus* spp	289
	Splitnose Rockfish	*Sebastes diploproa*	268
	Brown Rockfish	*Sebastes auriculatus*	217
	Halfbanded Rockfish	*Sebastes semicinctus*	200
2015	Shortbelly Rockfish	*Sebastes jordani*	70546
	Rosefish Group	*Sebastomus spp*	5214
	Squarespot Rockfish	*Sebastes hopkinsi*	4346
	Halfbanded Rockfish	*Sebastes semicinctus*	2559
	Chilipepper	*Sebastes goodei*	2431
	Widow Rockfish	*Sebastes entomelas*	2189
	Copper Rockfish Group	*Pteropodus* spp.	1964
	Stripetail Rockfish	*Sebastes saxicola*	1288
	Blackgill Rockfish	*Sebastes melanostomus*	727
	Pygmy Rockfish	*Sebastes wilsoni*	520

Appendix V: Summary of survey effort, seabird and mammal community statistics

	Core Region	Expanded Region	Total
Start Date	4/27/2016	4/27/2016	4/27/2016
End Date	6/7/2016	6/7/2016	6/7/2016
Survey Days	32	7	37
Distance Surveyed (km)	2741	732	3473
Area Surveyed (birds; km2)	822	219	1042
Number of Bird Species Obs.	49	32	50
Overall Bird Density (per	16.92	34.26	20.57
Total Birds Observed	13909	7519	21428
Number of Mammal Species	19	19	25
Overall Mammal Encounter	132.1	278.1	162.9
Total Mammals Observed	3621	2035	5656

Appendix VI: Top 10 most numerous seabirds observed. Cell values = total number of individuals seen / number of species sightings / average density (birds per km^2).

Common Name	Scientific Name	Core Region	Expanded Region	Total
Sooty Shearwater	*Puffinus griseus*	5558 / 546 / 6.76	5830 / 289 / 26.56	11388 / 835 / 10.93
Common Murre	*Uria aalge*	3996 / 1203 / 4.86	205 / 53 / 0.93	4201 / 1256 / 4.03
Red-Necked Phalarope	*Phalaropus lobatus*	2259 / 54 / 2.75	772 / 22 / 3.52	3031 / 76 / 2.91
Pink-Footed Shearwater	*Puffinus creatopus*	246 / 157 / 0.3	414 / 96 / 1.89	660 / 253 / 0.63
Cassin's Auklet	*Ptychoramphus aleuticus*	526 / 71 / 0.64	33 / 14 / 0.15	559 / 85 / 0.54
Western Gull	*Larus occidentalis*	500 / 380 / 0.61	59 / 52 / 0.27	559 / 432 / 0.54
Black-Footed Albatross	*Phoebastria nigripes*	314 / 253 / 0.38	15 / 12 / 0.07	329 / 265 / 0.32
Sabine's Gull	*Larus sabini*	132 / 12 / 0.16	17 / 2 / 0.08	149 / 14 / 0.14
Elegant Tern	*Sterna elegans*	26 / 4 / 0.03	64 / 27 / 0.29	90 / 31 / 0.09
Red Phalarope	*Phalaropus fulicaria*	58 / 4 / 0.07		58 / 4 / 0.06

Appendix VII: Top 10 most numerous marine mammals observed. Cell values = total number of individuals seen / number of species sightings / average density (individuals per 100 km).

Common Name	Scientific Name	Core Region	Expanded Region	Total
Northern Right Whale Dolphin	*Lissodelphis borealis*	1928 / 12 / 2.34	200 / 3 / 0.91	2128 / 15 / 2.04
Short-Beaked Common Dolphin	*Delphinus delphis*		1308 / 15 / 5.96	1308 / 15 / 1.26
Pacific White-Sided Dolphin	*Lagenorhynchus obliquidens*	926 / 49 / 1.13	126 / 11 / 0.57	1052 / 60 / 1.01
California Sea Lion	*Zalophus californianus*	291 / 47 / 0.35	260 / 29 / 1.18	551 / 76 / 0.53
Humpback Whale	*Megaptera novaeangliae*	247 / 144 / 0.3	43 / 19 / 0.2	290 / 163 / 0.28
Fin Whale	*Balaenoptera physalus*	48 / 29 / 0.06	22 / 14 / 0.1	70 / 43 / 0.07
Blue Whale	*Balaenoptera musculus*	61 / 28 / 0.07	2 / 1 / 0.01	63 / 29 / 0.06
Dall's Porpoise	*Phocoenoides dalli*	33 / 7 / 0.04	2 / 1 / 0.01	35 / 8 / 0.03
Risso's Dolphin	*Grampus griseus*	19 / 3 / 0.02	15 / 1 / 0.07	34 / 4 / 0.03
Long-Beaked Common Dolphin	*Delphinus capensis*		22 / 3 / 0.1	22 / 3 / 0.02