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

Cruise Report

Date Submitted: October 3, 2017
Platform: NOAA Ship *Reuben Lasker*
Project Number: RL-17-03 (OMAO)
Project Title: Rockfish Recruitment and Ecosystem Assessment
Project Dates: April 26 – June 13, 2017

Prepared by: _____ Dated: October 3, 2017_____
Keith Sakuma
Chief Scientist
NOAA NMFS SWFSC FED

Approved by: _____ Dated: ___October 4, 2017__
Steve Lindley
Laboratory Director
NOAA NMFS SWFSC FED

A. Project period: April 26 – June 13, 2017

Leg 1: April 26 – May 17
Leg 2: May 22 – June 13

B. Operating area and days at sea (DAS)

Operating area: San Diego, CA to Columbia River, OR (see Appendix I and II for station sample dates and locations).

DAS: Scheduled for 45 DAS.
DAS lost due to inclement weather=5
DAS with compromised operations due to inclement weather=14.
DAS lost or compromised due to equipment failure=2.5.

C. Objectives

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

2. Characterize prevailing ocean conditions and examine prominent hydrographic features.

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 fronts for juvenile salmon (*Oncorhynchus* spp.) and their potential prey.

8. Sample for pelagic juvenile YOY rockfish and other epi-pelagic micronekton at NWFSC stations off Oregon and Washington.

9. Collect water samples for eDNA study in the Monterey Bay area, and conduct joint water sample collections with MBARI.

D. Participating organizations

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

NOAA NMFS North West Fisheries Science Center (NWFSC)

NOAA Teacher at Sea

University of California Santa Cruz (UCSC)

Farallon Institute for Advanced Ecosystem Research (FIAER)

Monterey Bay Aquarium Research Institute (MBARI)

Hopkins Marine Station, Stanford University (HMSSU)

School of Engineering, Stanford University (SESU)

Center for Ocean Solutions (COS)

Humboldt State University (HSU)

University of California Davis Bodega Marine Laboratory (UCDBML)

California Polytechnic State University (CPSU)

Ernest F. Hollings Undergraduate Scholar Program (EFHUSP)

J. Craig Venter Institute (JCVI)

Oregon State University (OSU)

Pacific States Marine Fisheries Commission (PSMFC)

Ocean Associates (OA)

E. Personnel

Leg 1 (April 26-May 17)
Night Shift
Keith Sakuma, Fishery Biologist, NMFS SWFSC FED (Chief Scientist)
Lyndsey Lefebvre, Fishery Technician, NMFS SWFSC FED (April 26-May 6)
Heidi Fish, Fishery Biologist, NMFS SWFSC FED (April 26-May 6)
Rebecca Howard, Fishery Intern, NMFS SWFSC FED (April 26-May 6)
Tanya Rogers, Fishery Intern, NMFS SWFSC FED (April 26-May 6)
Cythnia Carrion, Krill Biologist, UCSC (April 26-May 6)
Rebecca Miller, GIS Specialist, NMFS SWFSC FED (May 6-17)
Thomas Adams, Fishery Technician, HSU/NMFS SWFSC FED (May 6-17)
Mary Kane, Krill Biologist, UCSC (May 6-17)
Kristen Elsmore, Ph.D. Student, UCDBML (May 6-17)
Kate Hewitt, Ph.D. Student, UCDBML (May 6-17)
Matt McKechnie, Student, CPSU (May 6-17)
Day Shift
Don Pearson, Fishery Biologist, NMFS SWFSC FED
Mike Force, Ornithologist, FIAER

Brian Wells, Fishery Biologist, NMFS SWFSC FED (April 26-May 6)
Jeff Harding, Fishery Biologist, NMFS SWFSC FED (April 26-May 6)
Whitney Friedman, Fishery Technician, NMFS SWFSC FED (April 26-May 6)
Collin Closek, Ecologist, COS/SESU (April 26-May 6)
Tyler Coale, Ecologist, JCVI (April 26-May 6)

Leg 2 (May 23 – June 14)
Night Shift
Keith Sakuma, Fishery Biologist, NMFS SWFSC FED (Chief Scientist)
Thomas Adams, Fishery Technician, HSU/NMFS SWFSC FED
Ryan Belcher, NOAA Corp., NMFS SWFSC FED
John Field, Fishery Biologist, NMFS SWFSC FED (Principal Investigator) (May 22-26)
Toby Auth, Fishery Biologist, PSMFC/NMFS NWFSC (May 22-June 2)
Paul Chittaro, Ecologist, OA/NMFS NWFSC (May 26-June 2)
Will Fennie, PhD. Student, OSU/NMFS NWFSC (May 26-June 2)
Cherisa Friedlander, NOAA Corp., NMFS SWFSC FED (June 2-13)
Maya Drzeweicki, EFHUSP (June 2-13)
Rachel Zuercher, PhD. Student, UCSC (June 2-13)
David Amidon, NOAA Teacher at Sea (June 2-13)
Day Shift
Ken Baltz, Oceanographer, NMFS SWFSC FED
Mike Force, Ornithologist, FIAER

Scientist duty hours

Nighttime Shift	1800-0600 (5-7 scientists on duty)
Daytime Shift	0600-1800 (2-7 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 CA Current 80 FR 58982 and ESA section 7 biological opinion and associated incidental take statement WCR ESA consultation 2015-2455. Chief Scientist Keith Sakuma.

Operations off Oregon were conducted under the Oregon Department of Fish and Wildlife Scientific Taking Permit 21254. Principal Investigator Richard Brodeur.

Operations within the Channel Islands National Marine Sanctuary (CINMS) were approved under permit CINMS-2015-007, Principal Investigator John Field. Permitted activities included the use of midwater sampling gear as well as CTDs. All other activities were subject to CINMS regulations. 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 YOY rockfish and other epi-pelagic micronekton at SWFSC stations off California

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 pyrosomes (*Pyrosoma* spp). 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. Wire out was determined based on depth recordings collected from TDRs post-trawl and from the ship's Simrad ITI real-time acoustic net sensing system. Unfortunately, the ship's Simrad ITI net headrope depth sensor did not consistently display real-time depth data resulting in using set wire out and ship's speed to approximate target net headrope depth. Fish and select invertebrates from each trawl were sorted, identified and enumerated. Size information was recorded on select species. All pelagic juvenile rockfish were frozen for later laboratory analyses.

A total of 97 midwater trawls were completed within the five sampling regions off California. This was the first cruise using the new Spectra line cable instead of wire cable. Therefore, two test trawls were conducted to determine the amount of wire out necessary to reach standard target headrope depths. In addition, one trawl was cut short due to the appearance of marine mammals while the net was fishing and another trawl was compromised due to an issue with the ship's winches. Therefore, only 93 standardized midwater trawls were completed. The low number of standardized trawls was primarily due to several days of bad weather (high winds and seas), which resulted in cancellation of all operations (5 days), or compromised/restricted sampling (14 days). During periods of bad weather, it was generally worse during the late afternoon and especially bad offshore. Therefore, even on days with bad weather, one or two trawl could still sometimes be completed at the nearshore stations after 0000 hrs. In addition, high densities of Dungeness crab (*Metacarcinus magister*) pot gear were encountered in nearshore areas (out to at least 100 m bottom depth), which restricted trawl operations due to the risk of entanglement with the float lines. Consequently, all nearshore stations were scouted during daylight hours prior to nighttime trawl operations to determine if there was a workable path through the crab gear. Appendix 1 lists the daily event schedule and Appendix II shows the number of planned versus actually sampled stations.

Plots of the annual means of the log-transformed catches of select species/taxa in the five survey regions off California are shown in Appendix III. A total of 13,813 YOY rockfish were collected off California. Relative to last year, YOY rockfish catches were lower in all regions with the exception of the south where catches were the highest observed since sampling began in 2004 in that region. While the catches in the other regions were not as high as last year, they were still above normal. Shortbelly rockfish (*Sebastes jordani*) were the dominant species in the

regions north of Point Conception, comprising 80.3% of the YOY rockfish. The other top five most abundant species were chilipepper (*S. goodei*), brown rockfish (*S. auriculatus*), copper rockfish complex (*Pteropodus* subgenus), and rosy rockfish complex (*Sebastomus* subgenus) comprising 5.6%, 2.4%, 1.6% and 1.4% respectively. In contrast to the regions north of Point Conception, the most abundant species in the south region was the rosy rockfish complex comprising 46% of the YOY rockfish. For that region, the other top five most abundant species were shortbelly rockfish, squarespot rockfish (*S. hopkinsi*), halfbanded rockfish (*S. semicinctus*), and bocaccio (*S. paucispinis*) comprising 15.5%, 11.1%, 9.4%, and 3.7% respectively. YOY Pacific hake (*Merluccius productus*) had mixed trends with relatively high catches in the south and south central regions, moderate catches in the north central region, and lower catches in the core and north regions. Similar to the YOY rockfish, YOY Pacific sanddab (*Citharichthys sordidus*) catches relative to last year were lower in all regions except in the south region. YOY lingcod (*Ophiodon elongatus*) had mixed trends with relatively high catches in the core and north central regions, moderate catches in the south, and reduced catches in the south central and north regions compared to last year.

No adult Pacific sardine (*Sardinops sagax*) were collected this year. In a similar trend as last year, adult northern anchovy (*Engraulis mordax*) were abundant in the south, but relatively rare, or absent in all the other regions of the survey. YOY Pacific sardine were abundant in the south region, had increased catches in the south central and north central regions, and reduced catches in the core and north regions relative to last year. YOY northern anchovy catches in the south region were the highest observed since sampling commenced in the south in 2004. However, catches in the south central, core, and north regions were all lower than last year with a slight increase in catches in the north central region.

Myctophid catches were lower in all regions relative to last year. However, the reduced catches in the north central region could be partially attributed to the lack of offshore sampling in that region due to adverse weather conditions. In contrast, krill catches were higher in all regions compared to last year. Market squid (*Doryteuthis opalescens*) were higher in all regions except for the north compared to last year. Pelagic red crabs (*Pleuroncodes planipes*) were still present in the south, south central, and core regions, but their numbers were reduced relative to last year.

Catches of the salp *Thetys vagina* were much lower this year compared to the past two years. Other salps were also lower in abundance except in the south region where their numbers were higher than in the past two years. Pyrosome catches in the south and north regions were the highest ever observed since counts began in those regions in 2012 and 2013 respectively. While in the other regions pyrosome numbers were lower compared to last year, catches were still well above average in those regions. In contrast to the pyrosomes, no *Aurelia* spp. or *Chrysaora fuscescens* were collected in 2017 in the core region (the region where they are historically most abundant).

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 500 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.

A total of 136 CTD casts were completed off California. This is roughly half the number of CTDs normally completed. The reduced CTD sampling can be partially attributed to the bad weather, which was often at its worst during daylight hours. This adversely affected the sampling of the daytime grid of CTD stations.

3. Map the distribution and abundance of krill

Throughout the project, the EK60 echosounder was operated at 18, 38, 70, 120, 200 and 333 kHz to estimate the biomass of krill between 10 and 750 m depth. Two targeted transect lines were run off Ascension Canyon (near Davenport) and Point Sal (see Appendix II for transect locations). Additionally, 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 a pairovet and bongo net. A total of 30 vertical tows using the 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 8 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 map of the survey effort is shown in Appendix IV, a summary of survey effort in Appendix V, and the top five most numerous seabirds and marine mammals in Appendix VI. Notable results from the 2017 survey for species with higher than average density (greater than one standard deviation) were black-footed albatross (*Phoebastria nigripes*), Bonaparte's gull (*Larus Philadelphia*), common murre (*Uria aalge*), fork-tailed storm-petrel (*Oceanodroma furcata*), and Sabine's gull ((*Larus sabini*). Density of sooty shearwater (*Puffinus griseus*) was lower than average, but within 1 standard deviation of the mean. No seabird species had a

density lower than one standard deviation of the mean. As for marine mammals, the encounter rate for humpback whales (*Megaptera novaeangliae*) was lower than average.

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 dusk and nighttime hours. Large weighted squid jigs were used as lures. Given the time constraints at night and the number of sampling hours lost due to bad weather, fishing opportunities were limited. 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 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. During Leg 2, in addition to the trawl samples, water was collected from 30 m depth at the first and last trawl stations of the night for particulate organic matter.

7. Sample fronts for juvenile salmon (*Oncorhynchus* spp.) and their potential prey

Data from the ship's thermosalinometer was used to identify and target fronts during daylight hours. Once a front was identified, a CTD cast and Methot Isaacs Kidd (MIK) net tow were conducted on either side of the front (i.e. replicate operations on the two sides of the front). As time, logistics, and conditions allowed, a surface trawl with the Cobb midwater trawl was conducted. The MIK net was deployed to a predetermined depth, and then retrieved at a rate of 20 m/minute while maintaining a wire angle of 45^{o} (an oblique tow similar to a CalCOFI bongo). A ReefNet TDR was attached to the MIK net to determine actual depths fished and a flowmeter was attached to determine the volume filtered. Surface trawls were conducted using the modified Cobb midwater trawl. A ReefNet TDR was attached to the center of the footrope to determine the vertical opening of the net. Trawling speed was ~5.6 km/hr (~3 knots) in order to keep the net fishing at the surface. Catches from both the MIK net and surface trawls were sorted at sea as much as possible, with the remainder of the samples frozen for identification back at the laboratory.

Identifying temperature fronts using the ship's thermosalinometer and characterizing differences in the forage community with MIK net trawls and eDNA sampling were successful, with 13 MIK net deployments around four fronts. This included three days of joint survey work with biologists from MBARI on their research vessel *Western Flyer*, who in turn were also operating their long-range autonomous underwater vehicle (LRAUV) which also collected eDNA samples (more detail in eDNA section below). In addition, six surface trawls were completed with very few salmon collected. High densities of crab gear in the nearshore waters (the area where juvenile

salmon are likely to occur) were problematic, requiring the ship to spend time attempting to find a clear path through the gear. Several areas were not trawlable due to the high density of crab gear in the water.

8. Sample for pelagic juvenile YOY rockfish and other epi-pelagic micronekton at NWFSC stations off Oregon and Washington

From May 27 to June 1, three midwater trawls per night were conducted off Oregon using the same midwater trawl protocols listed above. The fixed stations sampled were part of the NWFSC's ongoing pre-recruitment survey. In addition to sorting the trawl catch, size measurements were recorded on up to 30 specimens per species/taxon per trawl. Bongo tows were conducted each night prior to deployment of the trawl. One side of the bongo was preserved in ethanol and the other frozen for stable isotope work. Due to the shorter nighttime period off Oregon, CTD casts were only conducted during daylight hours at the corresponding night's trawl stations and at the adjacent stations. CTD deployments followed the same protocols listed above.

A total of 13 midwater trawls were completed along five transect lines (see Appendix II). Large numbers of pyrosomes were collected in the majority of the trawls with a general trend for increased abundances offshore. Over 150,000 pyrosomes were caught in the 13 trawls off Oregon compared to slightly less than 140,000 off California in 97 trawls. Two of the planned trawl stations off Oregon were not sampled due to the large numbers of pyrosomes. A large catch of pyrosomes on the second Columbia River line station damaged portions of the net, subsequently cancelling the third, more offshore, trawl station. The third most offshore station on the Heceta Head line was also cancelled due to the high abundance of pyrosomes. A total of 157 YOY rockfish were caught with shortbelly rockfish the most commonly occurring species accounting for 48.4%.

A total of 15 bongo tows were completed along with 32 CTDs.

9. Collect water samples for eDNA study in the Monterey Bay area, and conduct joint water sample collections with MBARI

From April 25 to May 5, filtered water samples for environmental DNA (eDNA) were collected. In total, 158 samples were collected from 18 stations across five locations (Point Reyes, Farallone Islands, Pescadero, Davenport, and Monterey Bay (inside and outside)). Seawater samples were collected with Niskin bottles on the ship's CTD rosette from depths of 10, 40, and 80 m. One liter aliquots were filtered through 0.2μm PVDF filters and frozen at -80 °C. For nutrient analysis, 20 ml aliquots were collected and frozen at -20 °C. In addition, when possible samples were collected during daytime trawls. On May 3 and 4, in collaboration with MBARI, trawl and eDNA samplings through oceanic front zones were conducted. These frontal zones are hotspots for biodiversity and were characterized by four of MBARI's autonomous underwater vehicles (AUVs). Coincident with planned trawls on the NOAA ship, eDNA samples were collected with Niskin bottles on the MBARI research vessel *Western Flyer*'s CTD rosette and remotely by their LRAUV. Additional eDNA samples were collected on the NOAA ship from 500ml of concentrated trawl effluent to corroborate eDNA characterization of the species

collected in the trawl net. During this joint-operation 132 samples were collected for further processing. Combined, 290 samples were collected during the 11-day portion of the cruise.

H. Disposition of data

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.

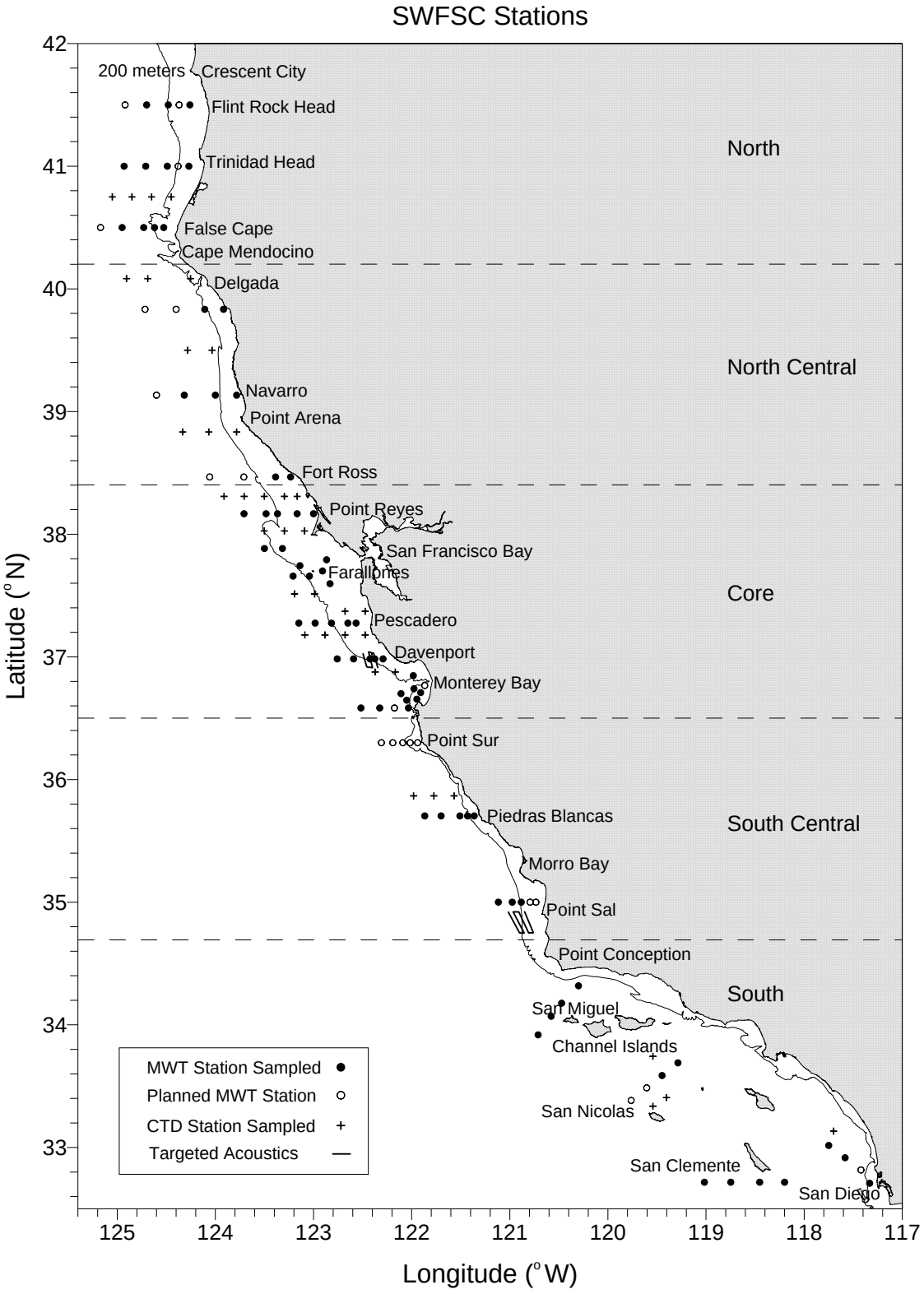
Requests and questions regarding the juvenile salmon/front/MIK net data should be sent to NOAA NMFS SWFSC FED, Brian Wells 831-420-3969 brian.wells@noaa.gov.

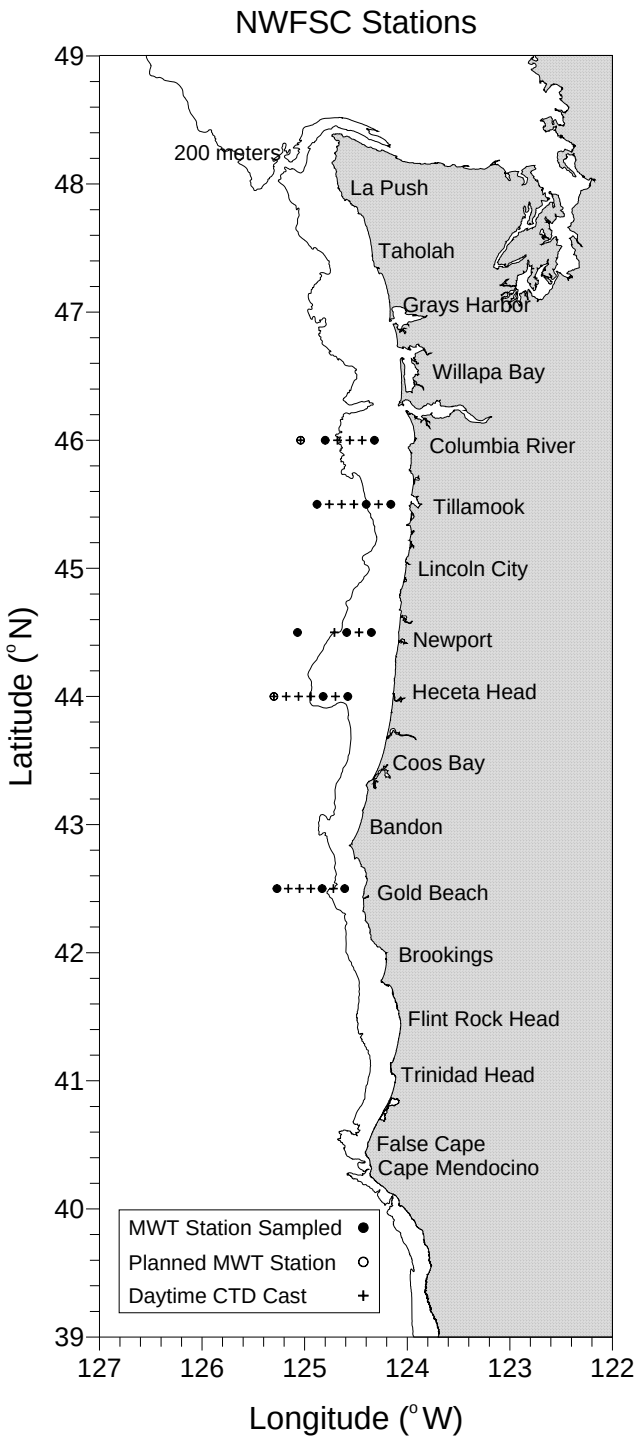
All other data requests should be sent to NOAA NMFS SWFSC FED, Keith Sakuma 831-420-3945 keith.sakuma@noaa.gov.

Appendix I: Daily transect schedule

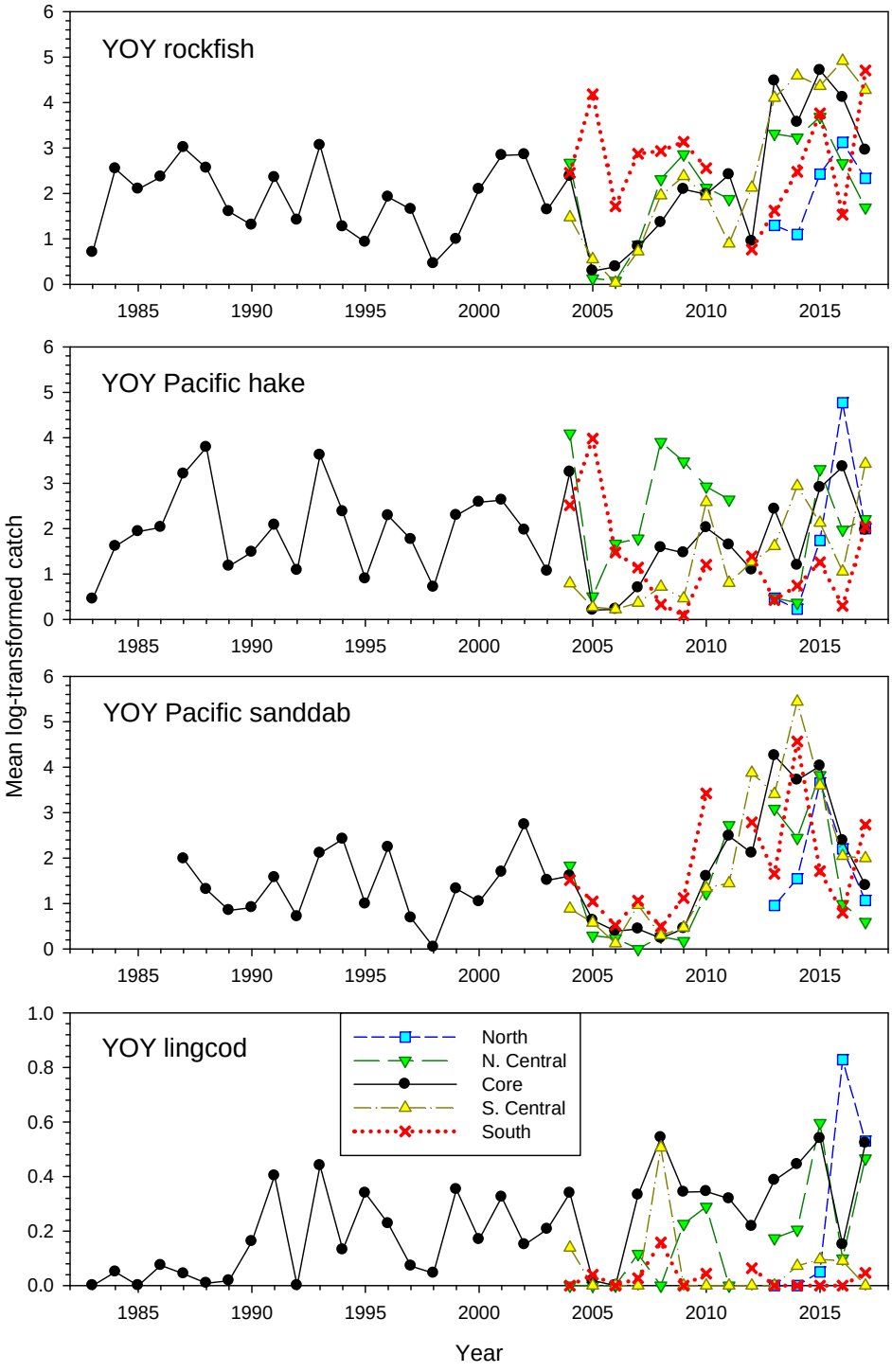
Date	Transect Location	# Sampled	Notes
25-Apr	**S.F. Port**		Load and Set Up Gear
26-Apr	Gulf of Farallones	1	Depart S.F., CA, Begin Leg 1
27-Apr	**Transit**		Bad Weather
28-Apr	Monterey Inside	0.5	Bad Weather, Gear Trials
29-Apr	Pescadero	0.8	Saturday-Bad Weather Offshore
30-Apr	Outside Farallones	0.2	Sunday-Bad Weather
1-May	Point Reyes	0.4	Bad Weather
2-May	Outside Farallones	0.6	Bad Weather
3-May	Davenport	1	MBARI LRAUV work
4-May	Monterey Outside	0.4	MBARI LRAUV work
5-May	**Transit**		Bad Weather, dock S.F.
6-May	**Docked**		Saturday-Bad Weather, docked S.F.
7-May	**Docked**		Sunday-Bad Weather, docked S.F.
8-May	Monterey Inside	1	
9-May	Piedras Blancas	1	
10-May	San Miguel	1	
11-May	Point Sal	0.6	Acoustic Transect
12-May	Monterey Outside	0.6	Bad Weather
13-May	**No Trawls**		Saturday-Bad Weather
14-May	Fort Ross	0.5	Sunday-Bad Weather
15-May	Navarro	0.8	Bad Weather
16-May	Point Reyes	0.6	
17-May	**End Leg 1**		Begin In Port S.F., CA
18-21-May	**S.F. Port**		In Port
22-May	Outside Farallones	1.2	Depart S.F., CA, Begin Leg 2
23-May	Navarro	1.6	Bad Weather
24-May	Delgada	0.5	Bad Weather
25-May	False Cape	0.8	
26-May	**Transit**	1	Skiff Transfer-Eureka, CA pick up NWFSC
27-May	Newport	1	Saturday- Begin NWFSC Stations
28-May	Columbia River	0.7	Sunday-net damaged by pyrosomes
29-May	Tillamook	1	Memorial Day
30-May	Heceta Head	0.7	
31-May	Gold Beach	1	End NWFSC Stations
1-Jun	Flint Rock Head	0.8	
2-Jun	Trinidad Head	1	Skiff Transfer-Eureka, CA
3-Jun	Delgada	1	Saturday-Bad Weather
4-Jun	Gulf of Farallones	1.7	Sunday-Bad Weather
5-Jun	Pescadero	1.8	
6-Jun	**Transit**		Acoustic Transect-Ship Issue
7-Jun	San Clemente	0.8	
8-Jun	**Docked**		Ship Repair in San Diego.
9-Jun	San Clemente	1.3	
10-Jun	San Nicolas	0.5	Saturday-Bad Weather
11-Jun	San Miguel	1.3	Sunday-Bad Weather
12-Jun	San Diego	1	
13-Jun	**Cruise Ends**		Dock In Port San Diego, CA

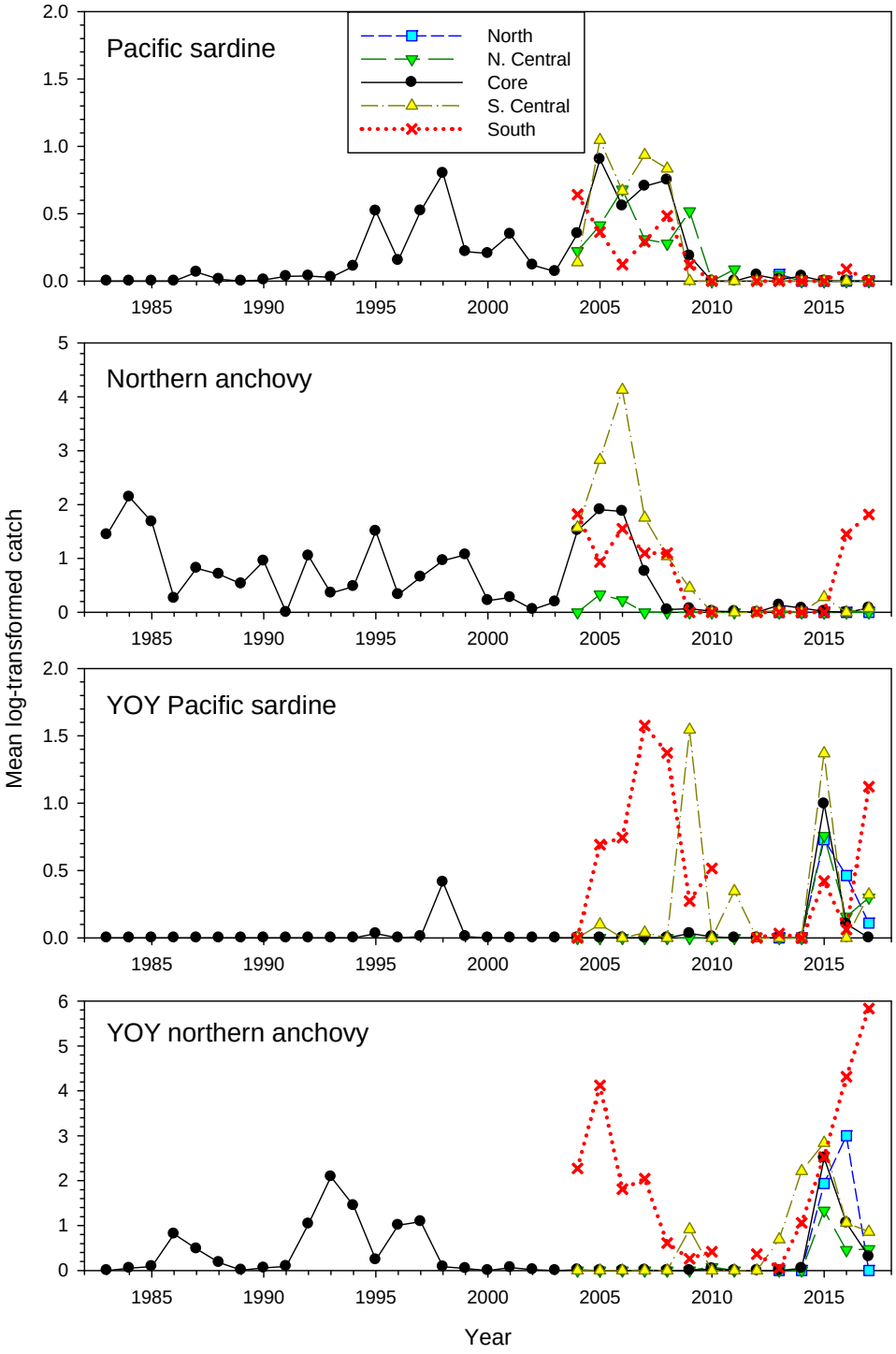
Appendix II: Survey regions and midwater trawl and CTD station locations

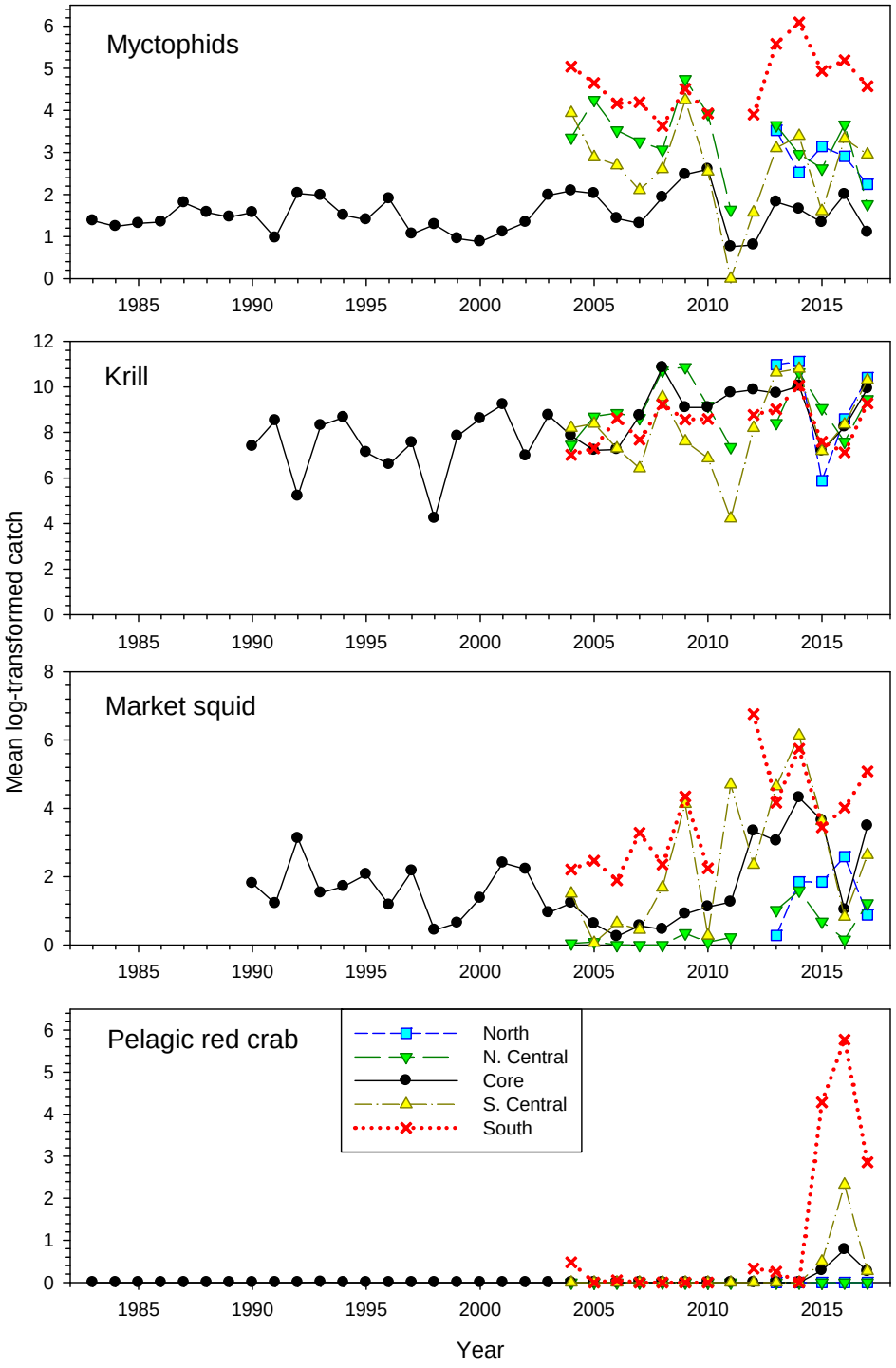


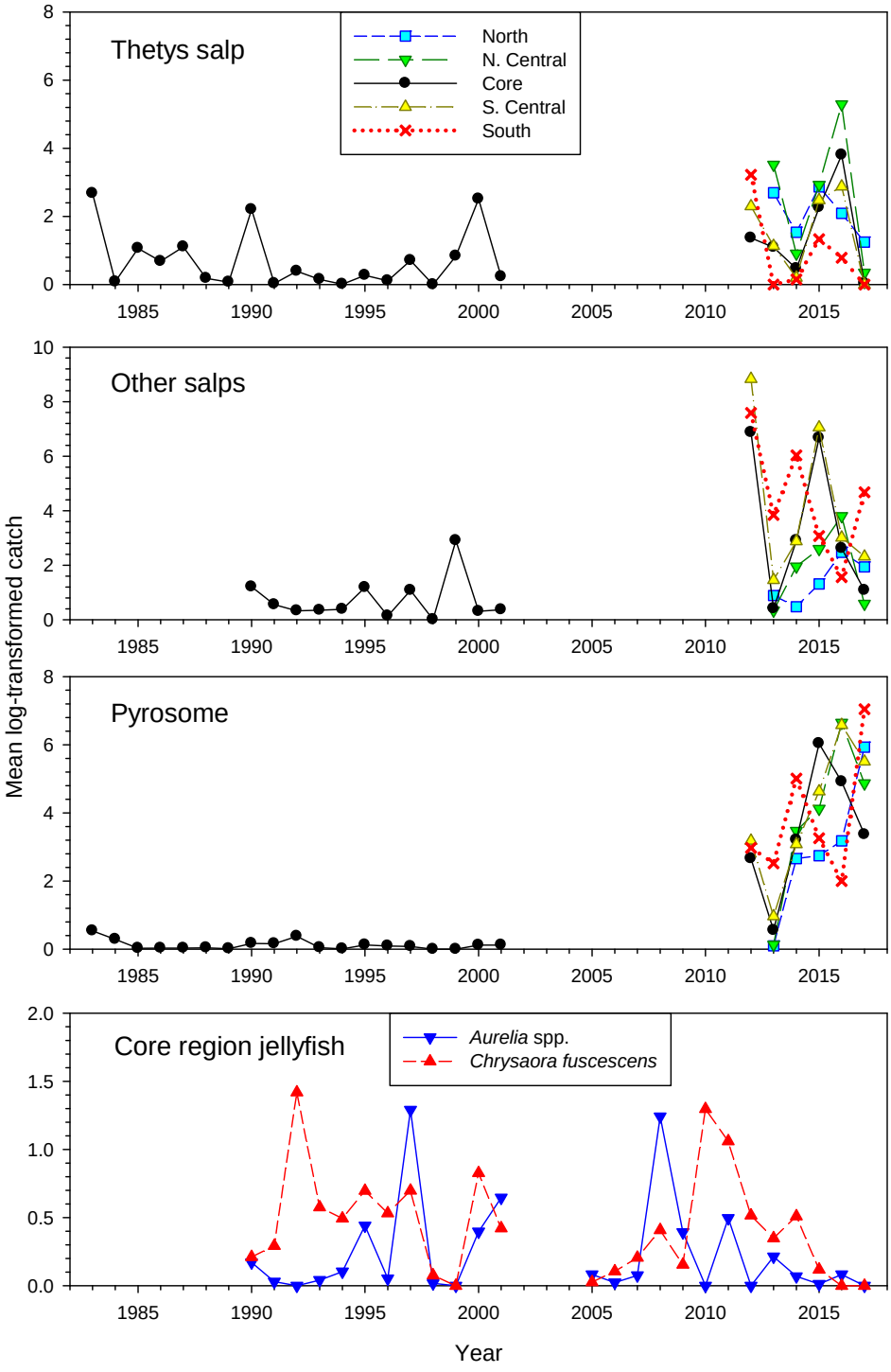

NWFSC Stations
200 meters
La Push
Taholah
Grays Harbor
Willapa Bay
Columbia River
Tillamook
Lincoln City
Newport
Heceta Head
Coos Bay
Bandon
Gold Beach
Brookings
Flint Rock Head
Trinidad Head
False Cape
Cape Mendocino
MWT Station Sampled
Planned MWT Station
Daytime CTD Cast
Latitude (°N)
Longitude (°W)
49
48
47
46
45
44
43
42
41
40
39
127
126
125
124
123
122

Appendix III: Annual catch summaries for select species

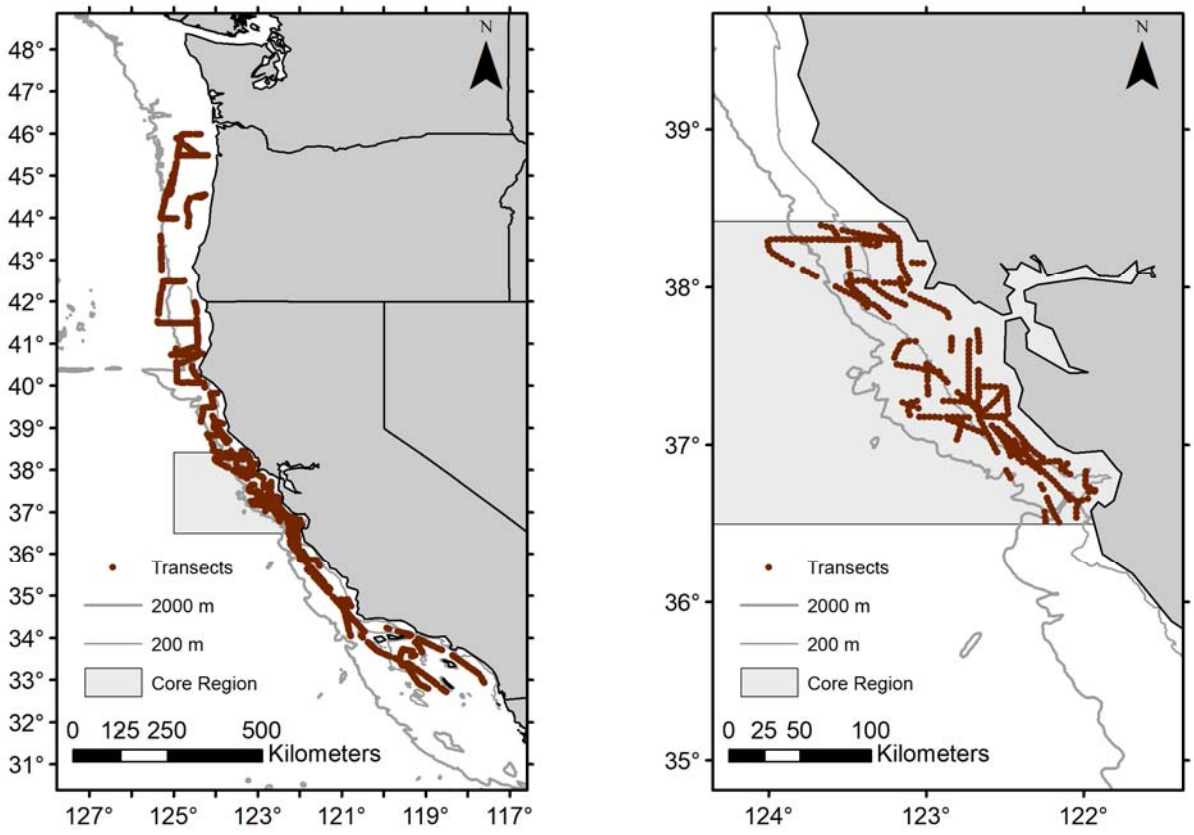



Pacific sardine
North
N. Central
Core
S. Central
South
Northern anchovy
YOY Pacific sardine
YOY northern anchovy
Mean log-transformed catch
Year
1985
1990
1995
2000
2005
2010
2015


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


Thetys salp
North
N. Central
Core
S. Central
South
Other salps
Pyrosome
Core region jellyfish
Aurelia spp.
Chrysaora fuscescens
Mean log-transformed catch
Year

Appendix IV. Seabird and marine mammal transects for the full and core regions. Gaps usually reflect nighttime.



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

	Core Region	Full Region
Start Date	4/27/2017	4/27/2017
End Date	6/12/2017	6/12/2017
Survey Days	18	37
Distance Surveyed (km)	1281	4018
Area Surveyed (birds; km2)	384	1205
Number of Bird Species Obs.	37	53
Overall Bird Density (per km2)	27.3	19.9
Total Birds Observed	10511	23980
Number of Mammal Species	8	21
Overall Mammal Encounter Rate	9	24.5
Total Mammals Observed	115	984

Appendix VI: Top five most numerous seabirds and marine mammals observed. **For seabirds, cell values = total number of individuals seen / number of species sightings / average density (birds per km^2) while for marine mammals cell values = total number of individuals seen / number of species sightings / average density (individuals per 100 km).**

Common Name	Scientific Name	Core Region	Full Region
Sooty Shearwater	*Puffinus griseus*	1143 / 313 / 2.97	8061 / 1217 / 6.69
Common Murre	*Uria aalge*	4162 / 879 / 10.83	6022 / 1347 / 5
Red-Necked Phalarope	*Phalaropus lobatus*	3492 / 168 / 9.08	4118 / 252 / 3.42
Red Phalarope	*Phalaropus fulicaria*	219 / 58 / 0.57	1088 / 163 / 0.9
Fork-Tailed Storm Petral	*Oceanodroma furcata*	89 / 47 / 0.23	947 / 330 / 0.79

Common Name	Scientific Name	Core Region	Full Region
Short-Beaked Common Dolphin	*Delphinus delphis*		295 / 8 / 7.3
Pacific White-Sided Dolphin	*Lagenorhynchus obliquidens*	66 / 9 / 5.2	216 / 19 / 5.4
Humpback Whale	*Megaptera novaeangliae*	17 / 13 / 1.3	87 / 41 / 2.2
Northern Right Whale Dolphin	*Lissodelphis borealis*	10 / 1 / 0.8	87 / 7 / 2.2
Bottlenose Dolphin	*Tursiops truncatus*		73 / 4 / 1.8