



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

April 1, 2009

CRUISE REPORT

VESSEL: NOAA Ship **DAVID STARR JORDAN, DS-08-03**

CRUISE DATES: **MAY 4 - JUNE 18, 2008**

PROJECT: **Rockfish Recruitment Assessment,
Fisheries Ecology Division, NOAA NMFS SWFSC**

ITINERARY:

LEG 1: May 4- May 14, 2008

On May 2 scientific gear was staged on the Ship and the laboratories were setup the day prior to the planned departure. The Ship departed San Francisco the morning of May 4 and conducted sea trials for the Simrad ITI system, the mid-water trawl, the Simrad EK500, the Ship's Scientific Computer System (SCS), and the Conductivity-Temperature-Depth profiler (CTD) system. Normal trawling operations and CTD casts began on the night of May 4. From May 4 and until the morning of May 14 the Ship and scientists conducted mid-water trawls, CTD casts, GO-FLO deployments, Bongo tows, Tucker trawls, EK500 bioacoustic recordings, Acoustic Doppler Current Profiler (ADCP) recordings, thermosalinometer recordings, SCUFA fluorometer recordings, bird/marine mammal observations, and opportunistic Humboldt squid (*Dosidicus gigas*) jigging at stations along designated transects between Monterey Bay and Delgada. Twenty-four hours were devoted to each transect. The transects covered during Leg 1, in chronological order, were; Monterey Inside, Monterey Outside, Davenport, Pescadero, Outside Farallones, Point Reyes, Fort Ross, Navarro, Delgada, and Gulf of Farallones.

LEG 2: May 14 - May 22, 2008

An exchange of scientific personnel occurred on May 14 off Santa Cruz Harbor. Beginning the night of May 14 and ending the morning of May 21 the Ship and scientists conducted operations similar to those during Leg 1, between San Francisco and San Diego. Leg 2 operations were curtailed during the last 4 days of the Leg due to heavy weather and the inability of the Ship to transit north past Pt. Conception. The Ship disembarked scientists off Santa Barbara Harbor on May 21. Scientists returned to Santa Cruz for the mid-cruise inport break and the Ship transited to San Diego in order to spend the mid-cruise inport period at its homeport. The transects covered during Leg 2, in chronological order, were:



Davenport, Piedras Blancas, San Miguel, San Nicolas, San Clemente, and San Diego. The planned operations for the transects between San Diego and Monterey Bay were abandoned due to the persistent strong winds and high seas that dominated the latter half of May. Plans for comparative trawls with the Pacific Whiting Conservation Cooperative (PWCC) F/V EXCALIBUR during Leg 2 were also abandoned due to inclement weather conditions. Conducted daylight hook and line fishing for adult groundfish at the San Nicolas and San Clemente (Tanner Bank) transects. Opportunistic jigging for Humboldt squid continued throughout Leg 2.

INPORT

Ship in San Diego: May 22-25

Scientists in Santa Cruz: May 22-26

LEG 3: May 26 – June 8, 2008

The Ship departed San Diego on May 26 with embarked Teacher-at-Sea, Sue White, and transited north to Avila Beach to embark the scientific party. Scientists embarked the Ship via skiff on the afternoon of May 27 at Avila Beach. Beginning the night of May 27 and ending June 7 the Ship and scientists conducted operations similar to those during the previous legs. The transects covered during Leg 3, in chronological order, were: Point Sal, Piedras Blancas, Monterey Bay Outside, Pescadero, Farallones Outside, Point Reyes, Fort Ross, Navarro, Delgada, Point Reyes, and Farallones Outside. Continued opportunistic jigging for Humboldt squid and deployed bongo tows. The Ship anchored in Drake's Bay on from the afternoon of June 6 until the morning of June 7 due to heavy weather conditions. The Ship transited into San Francisco and docked at Pier 27 on the morning of June 7, where several scientists disembarked.

LEG 4: June 8 - June 18, 2008

Scientists, Ship's crewmembers embarked and scientific gear was exchanged on June 8 at Pier 27, San Francisco. The Ship remained at Pier 27 throughout June 8 due to bad weather. The Ship departed San Francisco on June 9 and attempted to conduct operations inside the Gulf of the Farallones, to no avail. Weather continued to be too rough for operations. Limited operations were attempted inside Monterey Bay on June 10. The midwater trawl net was significantly damaged by jellies during the first trawl of June 10. The trawl net was replaced with a backup net during the daylight hours on June 11 while anchored off Santa Cruz. Beginning the night of June 11 and ending the morning of June 18, the Ship and scientists were finally able to conduct consistent operations similar to those during the previous legs. The transects covered during the last 7 days of Leg 4, in chronological order, were: Monterey Bay Inside, Piedras Blancas, Point Sal, San Miguel, San Nicolas, San Clemente, and San Diego. Continued to conduct jigging for Humboldt squid and deploy bongo tows each of the 7 final nights of Leg 4. Scientists and frozen samples disembarked the Ship the morning of June 18 in San Diego to end the cruise. The Scientists returned to Santa Cruz the evening of June 18. Scientific gear was shipped out of Scripps MARFAC, San Diego on June 19.

OBJECTIVES:

1. Sample for pelagic juvenile rockfish (*Sebastes* spp.) and other epi-pelagic micronekton, such as juvenile Pacific whiting (*Merluccius productus*), juvenile lingcod (*Ophiodon elongatus*), Northern anchovy (*Engraulis mordax*), Pacific sardine (*Sardinops sagax*), market squid (*Loligo opalescens*), and krill (*Euphausiacea*), to determine their distribution and abundance between San Diego and Delgada.
2. Characterize prominent oceanographic features between San Diego and Delgada.
3. Acoustically map the distribution and abundance of krill along the continental shelf and shelf break.
4. In cooperation with the NOAA NMFS Northwest Fisheries Science Center (NWFS), conduct side-by-side paired vessels trawls with the PWCC F/V EXCALIBUR.
5. Collect pelagic juvenile rockfish for otolith microchemistry analysis.
6. Collect seawater for microchemical, nutrient, and chlorophyll analysis.
7. Observe seabird and marine mammal distribution and abundance.
8. Collect adult rockfish for genetic and life history information off Southern California.
9. Conduct opportunistic hook and line fishing for Humboldt squid and bongo tows for larvae.
10. Collect sub-sample of Northern anchovy and Pacific sardine for stomach contents analysis.

METHODS:

1. Sample for pelagic juvenile rockfish and other epi-pelagic micronekton to determine the distribution and abundance between San Diego and Delgada:

In general, 5-7 midwater trawls, were conducted each night between 2100-0500 Pacific Standard Time at stations along 16 specific mid-water trawling transects within the survey area, between San Diego and Delgada. Trawl stations remain in the same location and are sampled annually in a consistent manner. A list of the mid-water trawl and CTD stations appears in Appendix A and Figures 1 and 2 show the locations of standard trawl and CTD stations. Target headrope depths were achieved and maintained by a set amount of wire out for the trawl warps and a variable rate of speed through the water. Four SIMRAD ITI acoustic sensors (trawl-eye, depth-temp, port wing spread, starboard wing spread) are attached to the headrope and to the net wings near the center of the breast lines during deployments. The SIMRAD ITI provided real-time information on headrope depth, footrope depth, distance between spread sensors, and seawater temperature at the headrope. The SIMRAD ITI information is refreshed and recorded on a 30 second interval. The standard target headrope depth is 30 m except in areas where the bottom is too shallow, in which case the target headrope depth is 7 m. For a target headrope depth of 30 m, 85 m of warp was used, while for a target headrope depth of 7 m, 25 m of warp was used. During mid-water trawl deployments (setting, fishing, retrieving), the Ship's speed was between 1.5-2.5 knots, (speed through the water). The Ship's speed and direction, during some tows, were altered to achieve the target headrope depth and for aligning of the codend directly astern of the Ship. In addition, a Vemco Temperature-Depth-Recorder (TDR) was also attached to the trawl net's headrope/bridle connection during deployments. The Vemco TDR provided retrospective data on depth and seawater temperature at the headrope. The Vemco TDR records this information every 10 seconds. The standard duration for fishing the trawl net at the target headrope depths was constant, at 15 minutes. In areas of high jellyfish concentrations, "test" trawl deployments were made of 5-minute duration. The fishing at target headrope depth begins when the designated amount of warp is out. All aft deck lights were turned off when the net was at target depth, so that no lights were visible when the net is fishing at depth. An acceptable, standard 30 m, target depth tow normally took 10 minutes to set and 10 minutes to retrieve. The standard tow direction was downwind with following seas astern. If both the wind and seas were calm then the tow direction was towards the next trawl station. In high crosscurrents, the course was altered into or with the current.

Fish, shrimp, cephalopods, and krill from each trawl were sorted, identified and enumerated. Juvenile rockfish, Humboldt squid, selected juvenile groundfish, and juvenile salmon were frozen for laboratory analyses.

2. Characterize prominent oceanographic features within the survey region:

CTD casts using the Ship's port J-frame were conducted throughout the day in the vicinity of the trawl transects and at each trawl station at night. Some CTDs were dropped during daytime and nighttime operations in the interests of the time needed to complete planned mid-water trawls. A Seabird Electronics (SBE) SEACAT 19+ CTD and a SEACAT 19 CTD were used in conjunction with a Seabird Electronics Model 32/33 Carousel Water Sampling System. The CTD was lowered to a maximum depth of 520 m, or 10 m from the bottom, as bottom depth

allowed. Deployment rate: soak CTD for 2 minutes at 10 m depth, then beginning at the surface, 45 m/min for the downcast, and 60 m/min for the upcast. Water samples were collected, on average, three times every 24 hours, for chlorophyll and nutrient samples. Water samples were collected during the upcast, with the Niskin Bottles, which were attached to the SBE carousel. On several occasions the CTD was deployed to 1000 m depth in order to view the location of the oxygen minimum layer.

An RDI ADCP recorded data continuously while underway to determine subsurface current velocity and direction. The hull mounted ADCP recorded horizontal and vertical velocity as a function of depth by using the Doppler effect to measure the radial relative velocity between the instrument and scatterers in the ocean. The CalCOFI ADCP setup configuration was used to input navigational data from the Ship's GPS and gyrocompass into the ADCP Data Acquisition Software (DAS). The ADCP transmits a ping from its transducer elements roughly once per second. Profiles were produced and displayed on a PC by range-gating the echo signal, which produces successive segments called depth bins. The noisy velocity estimates from each ping are vector averaged into ensembles.

A permanently mounted Seabird thermosalinometer continuously recorded seawater temperature and salinity while underway. The thermosalinometer measures water that is continually pumped from a seachest located in the Ship's hull at a water depth of 3 m. This data was used for comparisons with CTD casts, and for a nearly continuous recording of surface salinity and temperature. A Turner Designs SCUFA fluorometer was configured to record relative chlorophyll data continuously, while underway. The fluorometer was bench-mounted with a seawater flow-through system pumping seawater from the Ship's hull at a depth of 3 m. The seawater flow rate was 1000ml/12seconds (5000ml/minute). The fluorometer data was combined with the Ship's GPS location data and with date-time information via the Ship's SCS.

3. Acoustically map the distribution and abundance of krill along the continental shelf and shelf break:

A Simrad EK500 echosounder was used to acoustically characterize the distribution and abundance of macro-zooplankton and micro-nekton, meroplankton and zooplankton. The echosounder's acoustics were configured with down-looking 38, 120, and 200 kilohertz (kHz) transducers mounted in the hull. During the survey, the EK500 was configured to transmit pulses every 2 seconds at 1 kilowatt for 1 millisecond duration. Geographic positions were obtained from the ship's GPS and logged every 60 seconds. Ethernet communications were maintained between the EK500 and a Windows based PC, which logged the EK500 telegrams using EchoLog software. Data were displayed in the aft lab using Sonardata's EchoView software. Specific daytime EK500 transects, and daytime transits, with good EK500 acoustic recording surface weather conditions, were carried out during the course of the survey.

A Tucker trawl was used in order to ground-truth areas that produced strong acoustic signatures for krill. Sampling occurred during daylight hours. The Tucker trawl was deployed for oblique targeted depth tows. The trawl used three 0.505 mm mesh nets with live-well codends. For the sampling within a target depth range the middle net was used to collect the targeted sample. Both upper and lower nets can be used for additional sample collection or alternatively as

drogues to position net. Ship speed was adjusted to maintain 2-2.5 knots of speed through the water. Winch speed for both payout and haul was 30 m per minute. Wire angle was maintained at 45-50 degrees to ensure a 1 m opening in the trawl frame. Net depth was determined by measuring the wire angle with a angle indicator and calculating depth as $\cos(\text{wire angle}) \times \text{wire out}$. The General Oceanics double trip release mechanism was employed directly above the cable termination by use of a weighted messenger

4. In cooperation with the NOAA NMFS Northwest Fisheries Science Center (NWFSC), conduct side-by-side paired vessels trawls with the PWCC F/V EXCALIBUR:
Conduct side-by-side paired vessel trawls with the PWCC F/V EXCALIBUR in order to compare the catches between the two surveys. The Ship and the F/V EXCALIBUR would trawl at the same station, at the same times, within $\frac{1}{4}$ mile of each other. As in previous years, similar gear and protocols would be used. This was a planned cooperative effort between the NOAA NMFS SWFSC Fisheries Ecology Division, the NOAA NMFS NWFSC, and the PWCC.

5. Collect pelagic juvenile rockfish for otolith microchemistry analysis:
Subsamples of juvenile widow rockfish (*S. entomelas*) and shortbelly rockfish (*S. jordani*) were collected with the mid-water trawl and were preserved in ultra-cold conditions within the first hour of capture for subsequent analysis by Brian Wells of the NOAA NMFS SWFSC Fisheries Ecology Division.

6. Collect seawater for microchemical, nutrient, and chlorophyll analysis:
Seawater samples for trace chemical analysis were collected with a General Oceanics GO-FLO sampling bottle. A positive flow hood was setup and protective clothing was worn in order to handle the seawater samples and avoid contamination. Chemicals used on board included: clean water and 500 mL of 12M (35%) hydrochloric acid. At nearly every CTD station and trawl station a GO-FLO water-sampling bottle was deployed manually to 30 m depth. A hand-line attached to a down-rigger, along with a pulley was used to deploy the bottle along with a manual messenger. Once the water was collected, the unopened bottle was moved to the interior hood area. The seawater contents were placed into small sample bottles. Once the bottle sample was collected, it was acidified with a small drop of acid, placed in a small, labeled vial, and frozen for subsequent laboratory analysis.

Water samples were taken, on average, three times every 24 hours, for nutrient samples. Water samples were collected during the CTD deployment upcast, with the Niskin bottles, which were attached to the Seabird Electronics carousel. Seawater samples were frozen in scintillation vials for San Francisco State University's Romberg Tiburon Center for Environmental Studies.

7. Seabird and marine mammal observations:
PRBO Conservation Science ornithologists estimated the distribution and abundance of seabirds and marine mammals while underway during legs 1 and 2. Observers identified and counted birds/mammals continuously from the Ship's flying bridge during daylight hours while the vessel was underway at speeds of 7 knots (9 km /h) or greater. A range-finder was used to estimate the width of the survey transect and only those birds sighted within a 300 m arc from the bow (directly ahead) to 90 ° off the side with best visibility (e.g., least glare) were logged into a field computer. Ship-following birds were recorded the first time they were detected and

were ignored thereafter. The observers estimated the range to marine mammal sightings and recorded them, regardless of their perpendicular distance to the vessel. Marine mammals were observed to the horizon. Distance and angle from the ship to each individual mammal or group of mammals were estimated. Data on marine mammals were entered as observations were made into a field computer.

8. Collection of adult rockfish for genetic and life history information off Southern California: Hook and line fishing with rod /reel for adult rockfish species was conducted during daylight hours at different locations in the Southern California Bight. Length and gender were recorded and fin clips were taken for genetic analysis from all fish captured. Otoliths were removed from select specimens. In addition, selected fish specimens of blue rockfish (*S. mystinus*) and vermillion rockfish (*S. miniatus*) were frozen and brought back to the NOAA NMFS SWFSC Fisheries Ecology Division, Santa Cruz for further study. Locations of the fishing activity were determined by location of the Ship, available time, and operational constraints.

9. Conduct opportunistic hook and line fishing for Humboldt squid and bongo tows for larvae: Hook and line fishing with rod/reel/jig was conducted opportunistically for Humboldt squid (e.g., whenever the squid were caught in the midwater trawl, during nighttime CTD deployments, or if squid were seen near the surface). Jigging gear was deployed over the port side of the ship with multiple rods & reels. Dip nets and gaffs were used to bring the squid aboard. Once the squid were aboard, the mantle lengths were measured, genders determined, and the stomachs and heads removed and frozen. Selected whole specimens were bagged and frozen.

10. Collect subsample of Northern anchovy and Pacific sardine for stomach contents analysis: A subsample of 10 individuals of each species was frozen from areas where there were more than 20 specimens per trawl. Specimens would be later transferred to UCSC.

RESULTS:

1. Sample for pelagic juvenile rockfish and other epi-pelagic micronekton:

A total of 102 nighttime midwater trawls were completed along the California coast, during the four legs of the survey. Table 1 lists the total numbers of juvenile rockfish caught since 1986. Table 2 lists the catches of juvenile rockfish Pacific whiting, and lingcod from the 2004-2008 surveys, based on catches south and north of Point Conception. Table 3 lists the catches of adult Northern anchovy and Pacific sardine south and north of Point Conception. Table 4 lists the total numbers of market squid collected since 1987.

Table 1. Number of YOY rockfish collected at stations by mid-water trawls during surveys (1986-2008)

SPECIES	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08
Shortbelly	9104	6865	107962	1598	4479	2422	2838	2287	949	276	1848	784	69	124	2016	3403	995	206	1235	6412	220	1213	471
Chilipepper	54	586	4418	24	66	343	90	1251	3	32	17	12	3	27	27	126	286	85	212	10	1	6	20
Brown	470	10	-	3	19	265	7	1226	15	5	32	2	-	2	5	117	58	95	27	2	-	9	9
Widow	11	424	257	13	296	623	1	101	24	25	-	49	1	81	80	193	858	227	1247	-	-	23	288
Squarespot	4	177	380	16	649	47	70	25	2	-	-	1	-	-	-	36	16	1	14	896	178	742	127
Canary	46	71	162	39	23	618	-	14	3	-	-	3	-	38	9	31	258	31	314	2	-	75	112
Blue	4	196	366	63	38	220	3	38	11	7	4	5	-	9	10	67	341	140	468	-	-	17	8
Stripetail	2	194	30	6	22	175	5	315	9	6	2	27	14	31	11	185	352	18	213	4	1	7	49
Bocaccio	327	106	60	22	44	114	5	26	4	3	1	7	1	15	24	51	71	2	35	96	6	28	24
Yellowtail	22	85	69	31	27	281	5	31	8	27	3	6	6	1	10	30	58	68	838	-	2	1	65
Copper complex	9	9	1	-	1	15	116	82	54	7	10	42	4	2	4	25	5	-	5	7	1	74	25
Halfbanded	1	9	-	2	77	8	1	5	2	-	6	68	-	1	-	96	7	-	4	1405	3	41	225
Pygmy	2	15	9	12	10	62	8	2	3	-	1	2	-	1	3	34	37	8	25	103	21	101	44
Black	1	22	19	5	4	34	-	6	2	7	7	-	1	5	1	2	29	23	294	-	-	1	13
Olive	-	4	2	6	18	-	-	6	1	-	-	-	-	-	-	13	5	-	7	1	-	1	4
Darkblotched	-	7	5	-	1	9	-	9	-	2	-	-	-	2	1	1	6	3	19	-	-	4	7
Cowcod	1	17	1	1	-	-	5	5	-	-	-	-	-	-	-	-	2	1	5	7	2	3	2
Bank	-	18	4	-	-	-	-	5	-	-	-	-	-	-	1	1	3	-	1	6	1	13	2
Sebastes spp.	2	7	3	-	1	3	8	-	-	1	2	27	-	-	2	2	2	3	423	492	1050	2130	957
Splitnose	1	4	-	-	1	-	19	-	-	-	-	10	-	1	3	-	-	-	1	1	1	8	2
Puget Sound	-	-	-	-	-	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sharpchin	-	-	-	-	-	-	2	-	14	-	-	-	-	1	-	1	3	-	-	1	-	2	8
Grass	1	1	-	-	-	-	8	2	1	-	-	-	2	-	-	3	-	-	-	-	-	-	1
Quillback	2	1	-	-	-	6	-	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Vermillion	-	4	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Copper	-	-	-	-	-	-	1	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-
Greenspotted	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Greenstriped	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30	25	43	437	57
Blackgill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	62	18	71	146	56
Aurora	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	2	1	1	5	2
Calico	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	4
Yelloweye	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Unknown	40	5	-	-	2	4	49	31	13	13	31	49	14	25	29	55	2	45	337	1627	-	1485	136
Totals	10104	8837	113748	1841	5779	5290	3242	5467	1120	411	1971	1095	115	366	2236	4472	3394	957	5818	11113	1603	6572	2718

Table 2. Pelagic juvenile rockfish, Pacific whiting, and lingcod catches south and north of Point Conception.

Species	South 2004	South 2005	South 2006	South 2007	South 2008	North 2004	North 2005	North 2006	North 2007	North 2008
Shortbelly	100	6388	142	804	182	1135	22	78	409	289
Squarespot	74	932	178	742	127	7	-	-	-	-
Halfbanded	2	1410	3	40	191	4	-	-	1	34
Bocaccio	14	96	6	17	5	22	-	-	11	19
Greenstriped	36	25	43	437	57	-	-	-	-	-
Blackgill	63	18	71	146	56	-	-	-	-	-
Cowcod	4	7	2	3	2	1	-	-	-	-
Bank	4	10	1	13	2	1	-	-	-	-
Splitnose	2	1	1	8	2	-	-	-	-	-
Aurora	2	1	1	5	2	-	-	-	-	-
Copper	4	7	1	73	8	4	-	-	1	17
Complex										
<i>Sebastomus</i>	433	491	1050	2130	957	3	1	-	-	-
Sharpchin	2	-	-	1	8	-	1	-	1	-
Speckled	1	-	-	-	-	-	-	-	-	-
Calico	-	4	-	-	3	-	-	-	-	1
Pygmy	66	82	17	85	40	17	24	4	16	4
Stripetail	1	3	-	-	2	212	3	1	7	47
Brown	-	2	-	-	2	27	-	-	9	7
Chilipepper	-	9	-	1	-	212	2	1	5	20
Olive	-	-	-	-	-	7	1	-	-	4
Darkblotched	-	-	-	-	-	19	-	-	4	7
Widow	-	-	-	-	2	1248	-	-	23	286
Yellowtail	-	-	-	-	-	838	-	3	1	65
Black	-	-	-	-	-	294	-	-	1	13
Blue	-	-	-	-	-	470	-	-	17	8
Canary	-	-	-	-	-	314	2	-	75	112
Yelloweye	-	-	-	1	-	-	-	-	-	-
Grass	-	-	-	1	-	-	-	-	-	1
Total	808	9486	1516	4506	1648	4835	56	87	581	934
Rockfishes										
Pacific Whiting	636	13062	234	452	28	46919	91	2013	1295	10624
Lingcod	-	3	-	1	39	369	2	-	120	205

Table 3. Adult Northern anchovy and Pacific sardine catches south and north of Point Conception.

Year	Northern Anchovy		Pacific Sardine	
	South	North	South	North
2004	1516	4878	53	307
2005	457	7503	377	625
2006	1383	18868	11	729
2007	3146	15663	112	1197
2008	2467	488	81	484

Table 4. Total number of market squid caught during 1987-2008

YEAR	TOTAL CATCH
1987	33906
1988	14082
1989	7929
1990	5242
1991	74719
1992	45308
1993	9396
1994	4460
1995	11684
1996	4014
1997	6055
1998	240
1999	1140
2000	5199
2001	26407
2002	8721
2003	2002
2004	5248
2005	2526
2006	835
2007	2467
2008	3714

2. Characterize prominent oceanographic features within the survey region:

183 CTD casts were completed during the survey. All of the CTD casts collected chlorophyll and turbidity data at deployed depths along with salinity and temperature data. Collection of accurate chlorophyll data at the surface layer along the Ship's track was problematic due to a faulty SCUFA fluorometer. The Seabird thermosalinometer collected surface temperature and salinity data along the ship's track throughout the survey. The Ship's ADCP collected subsurface current data along the Ship's track throughout the survey. A significant portion of the days and nights of the survey had strong winds which prevented trawl and CTD deployments.

3. Acoustically map the distribution and abundance of krill along the continental shelf and shelf break:

Bioacoustic data from the Simrad EK500 were collected during all four Legs of the survey. Acoustic data are being used for various studies cooperatively between the NOAA NMFS Fisheries Ecology Division, the Farallon Institute, and the University of California, Santa Cruz, which include acoustic target identification and differentiation, and krill abundance/distribution. Data collected during the daylight hours under relatively low swell and sea wave height conditions, being the most valuable for the krill research. Tucker trawl deployments coincident with significant acoustic plankton patches were conducted to help ground-truth the acoustic recordings.

4. In cooperation with the NOAA NMFS Northwest Fisheries Science Center (NWFSC), conduct side-by-side paired vessels trawls with the PWCC F/V EXCALIBUR, No paired trawls were conducted due to persistently strong winds and rough seas which prevented the two research vessels from occupying the same area at the same time.

5. Collect pelagic juvenile rockfish for otolith microchemistry analysis:

The otoliths from 100 juvenile widow rockfish were removed and prepped for trace element analysis. Elemental composition of the otolith should mirror that of the past surrounding water mass. Otolith chemistries will allow us to link specific fish to different water masses. This data is currently being processed.

6. Collection of seawater for microchemical and nutrient analyses:

Using the GO-FLO bottle, 83 water samples were collected for trace element analysis. The goal is to use a number of elements (e.g., Ba, Sr, Mg, Mn, Cd, and Ca) to describe separate water masses along the coast of Central California. In past years we have been able to separate out masses of upwelling based on a more intense Barium concentration. This appears to be holding true for the 2008 samples.

7. Seabird and marine mammal observations:

PRBO Conservation Science and Farallon Institute researchers conducted observations of marine birds and mammals from the flying bridge during all daylight hours during Legs 1 and 2. Observations of the most numerous species for the period are summarized in Table 5 and Table 6. A total of 40 species of seabirds and 13 species of marine mammals were identified, and over 26,800 individuals were enumerated. Relatively large numbers of phalaropes, shearwaters and northern right-whale dolphins were highlights.

Table 5. Observations of seabirds on legs 1 & 2

Species	Total Observed	% of Total
Red-necked Phalarope	1664	21.68
Sooty/Dark Shearwater	1432	18.66
Red Phalarope	1095	14.27
Common Murre	934	12.17
Western Gull	907	11.82
Unidentified Phalarope	321	4.18
Pink-footed Shearwater	298	3.88
Brandt's Cormorant	257	3.35
Black-footed Albatross	138	1.80
Rhinoceros Auklet	115	1.50
Pacific Loon	75	0.98
Cassin's Auklet	74	0.96
Northern Fulmar	69	0.90
Sabine's Gull	58	0.76
Black Brandt	48	0.63
Unidentified Shorebird	32	0.42
Brown Pelican	28	0.36
Bonapart's Gull	25	0.33
Xantus Murrelet	21	0.27
Ashy Storm Petrel	15	0.20
California Gull	10	0.13
Xantus Murrelet	8	0.10
Unidentified Duck	7	0.09
Unidentified Alcid	9	0.12
Common Loon	5	0.07
Pigeon Guillemot	4	0.05
Whimbrel	4	0.05
Foster's Tern	3	0.04
Unknown Gull	3	0.04
Clarke's Grebe	3	0.04
Pelagic Cormorant	2	0.03
Common Tern	2	0.03
Long-tailed Jaeger	2	0.03
Tufted Puffin	2	0.03
Laysan Albatross	1	0.01
Double-crested Cormorant	1	0.01
Black-legged Kittiwake	1	0.01
Red-throated Loon	1	0.01
Unidentified Tern	1	0.01
Pomarine Jaeger	1	0.01
Total	7676	

Table 6. Observations of marine mammals on legs 1 & 2

Species	Total Observed	% of Total
Northern Right-Whale		
Dolphin	765	53.24
Pacific White-sided Dolphin	258	17.95
California Sea Lion	205	14.27
Risso's Dolphin	108	7.52
Humpback Whale	33	2.30
Sperm Whale	35	2.44
Unidentified Dolphin	12	0.84
Northern Fur Seal	9	0.63
Blue Whale	5	0.35
Fin Whale	3	0.21
Minke Whale	2	0.14
Northern Elephant Seal	1	0.07
Unidentified Whale	1	0.07
Total	1437	

8. Collection of adult rockfish:

Four days were spent hook and line fishing in the Southern California Bight for adult rockfish. Two days were spent fishing on the northwest side of San Nicolas Island and two days on northeast side of Tanner Bank (West of San Clemente Island). A total of 352 fish from 11 species were captured.

Table 7. Adult rockfish captured off Southern California.

Species	Total # Caught
Bocaccio	109
Starry	62
Rosy	59
Olive	47
Copper	34
Vermilion	22
Honeycomb	10
Squarespot	4
Yellowtail	3
Blue	2
Flag	1

9. Conduct opportunistic hook and line fishing for Humboldt squid and bongo tows for larvae: Humboldt squid were caught at various stations throughout the survey during trawl operations and by jigging with rod/reel gear. For the fourth year in a row Humboldt squid were caught in the midwater trawl during normal nighttime operations. Thirty-three squid were caught throughout the survey in five separate trawls. Several dozen more Humboldt squid were opportunistically caught with squid jigs via rod and reel gear. Mantle lengths were measured, stomachs, and heads of the squid were collected from all specimens caught and frozen for post cruise processing and analysis. Whole squid specimens were also frozen for post cruise laboratory analyses and for educational outreach activities. Bongo tows were consistently deployed just before sunset, during the survey, in order to sample for Humboldt squid paralarvae and krill. The plankton samples from the bongo tows were preserved in ethanol and formalin and are currently being processed.

10. Collect subsample of Northern anchovy and Pacific sardine for stomach contents analysis: A subsample of 40 Northern anchovy from four different areas and a subsample of 30 Pacific sardine from three different areas were frozen and transferred to UCSC.

DISPOSITION OF DATA:

1. Juvenile rockfish specimens, midwater trawl catch data, CTD, SIMRAD EK500, chlorophyll, thermosalinometer, ADCP, data - Keith Sakuma, NOAA NMFS SWFSC Fisheries Ecology Division, 110 Shaffer Road, Santa Cruz CA 95060.
2. Adult rockfish data - Don Pearson, NOAA NMFS SWFSC Fisheries Ecology Division, 110 Shaffer Road, Santa Cruz CA 95060.
3. Ship's logistics information, staffing, and sampling station information - Ken Baltz, NOAA NMFS SWFSC Fisheries Ecology Division, 110 Shaffer Road, Santa Cruz CA 95060.
4. Seabird and marine mammal data – Bill Sydeman, Farallon Institute, P.O. Box 750756 Petaluma, CA 94975, and Jaime Jahncke, Point Reyes Bird Observatory, 4990 Shoreline Hwy, Stinson Beach, CA 94970.
5. Humboldt squid data - John Field, NOAA NMFS SWFSC Fisheries Ecology Division, 110 Shaffer Road, Santa Cruz CA 95060.
6. GO-FLO data - Brian Wells, NOAA NMFS SWFSC Fisheries Ecology Division, 110 Shaffer Road, Santa Cruz CA 95060.
7. Northern anchovy and Pacific sardine stomach contents data – Baldo Marinovic, UCSC Long Marine Laboratory, 100 Shaffer Road CA 95060.

SCIENTIFIC PERSONNEL:

Leg 1 (May 4 - May 14)

Ken Baltz, Oceanographer, NMFS SWFSC FED (Cruise Leader)
Keith Sakuma, Fish Biologist, NMFS SWFSC FED (Chief Scientist)
Don Pearson, Fish Biologist, NMFS SWFSC FED
Steve Ralston, Fish Biologist, NMFS SWFSC FED
Heidi Fish, Fish Biologist, NMFS SWFSC FED
Brian Wells, Post-Doc, NMFS SWFSC FED
Lindsay Starrett, Contract Researcher, NMFS SWFSC FED
Clint Collins, Krill Biologist, UC Santa Cruz
Jason Mulsow, Krill Biologist, UC Santa Cruz
Jarrod Santora, Ornithologist, Farallon Institute
Michael Bentley, Ornithologist, Farallon Institute

Leg 2 (May 14 - May 24)

Ken Baltz, Oceanographer, NMFS SWFSC FED (Cruise Leader)
Keith Sakuma, Fish Biologist, NMFS SWFSC FED (Chief Scientist)
Edward Dick, Fish Biologist, NMFS SWFSC FED
John Field, Fish Biologist, NMFS SWFSC FED
Brian Wells, Post-Doc, NMFS SWFSC FED
Moriah Sevier, Krill Biologist, UC Santa Cruz
Todd Hallenbeck, Volunteer, PSMFC
Sophie Webb, Ornithologist, Farallon Institute
Michael Bentley, Ornithologist, Farallon Institute

Leg 3 (May 27 - June 7)

Ken Baltz, Oceanographer, NMFS SWFSC FED (Cruise Leader)
Keith Sakuma, Fish Biologist, NMFS SWFSC FED (Chief Scientist)
Brian Wells, Post-Doc, NMFS SWFSC FED
Gabe Singer, seawater collection volunteer, UC Santa Cruz
Ben Gire, Student, Humboldt State University
Robert Cimitile, Volunteer, Nature Conservancy
Sophie Webb, Ornithologist, H. T. Harvey & Associates/PRBO
Dawn Breese, Ornithologist, H. T. Harvey & Associates/PRBO
Susan White, Teacher at Sea, Kansas
Bill Matsubu, Student, Humboldt State University

Leg 4 (June 7 - June 18)

Ken Baltz, Oceanographer, NMFS SWFSC FED (Cruise Leader)
Keith Sakuma, Fish Biologist, NMFS SWFSC FED (Chief Scientist)
John Field, Fish Biologist, NMFS SWFSC FED
Sam Parker, Student, Humboldt State University
Isaac Simpson, Krill Biologist, UC Santa Cruz
Brian Wells, Post-Doc, NMFS, Santa Cruz, CA
Megan Gunvalson, assistant for seawater collections, UC Santa Cruz
Meisha Key, Biologist, CDF&G
Julia Stewart, Student, Hopkins Marine Station, Stanford University

JUVENILE ROCKFISH MIDWATER TRAWL AND CTD STATIONS

DAY: CTD - SAN DIEGO

<i>OPS</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Depth(m)</i>	<i>Wire Out(m)</i>	<i>Station</i>
CTD	32° 42.5'	117° 27'	350	340	4041
CTD	32° 47.9'	117° 37'	1020	520	4042
CTD	32° 54.5'	117° 46.7'	1040	520	4043
CTD	33° 08'	117° 42'	810	520	4045
CTD	33° 02'	117° 32.3'	700	520	4046
CTD	32° 54.4'	117° 23'	550	520	4047

NIGHT: TRAWL & CTD - SAN DIEGO

<i>OPS</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Depth(m)</i>	<i>Wire Out(m)</i>	<i>Station</i>
CTD	33° 01'	117° 45'	750	520	481
trawl	33° 01'	117° 45'	750	85	481
CTD	32° 55'	117° 35'	850	520	482
trawl	32° 55'	117° 35'	850	85	482
CTD	32° 49'	117° 25.3'	700	520	483
trawl	32° 49'	117° 25.3'	700	85	483
trawl	32° 42.5'	117° 20'	100	85	484
CTD	32° 42.5'	117° 20'	100	90	484

DAY: CTD - SAN CLEMENTE

<i>OPS</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Depth(m)</i>	<i>Wire Out(m)</i>	<i>Station</i>
CTD	32° 43'	117° 57'	520	510	4048
CTD	32° 33'	117° 57'	963	520	4049
CTD	32° 33'	118° 09'	1900	520	4050
CTD	32° 33'	118° 21'	1385	520	4051
CTD	32° 33'	118° 33'	1111	520	4052

NIGHT: TRAWL & CTD - SAN CLEMENTE

<i>OPS</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Depth(m)</i>	<i>Wire Out(m)</i>	<i>Station</i>
CTD	32° 43'	118° 09.3'	1000	520	401
trawl	32° 43'	118° 09.3'	1000	85	401
CTD	32° 43'	118° 27.2'	270	260	402
trawl	32° 43'	118° 27.2'	270	85	402
CTD	32° 43'	118° 44.9'	1284	520	403
trawl	32° 43'	118° 44.9'	1284	85	403
trawl	32° 43'	119° 03'	500	85	404
CTD	32° 43'	119° 03'	500	490	404

DAY: CTD - SAN NICOLAS

<i>OPS</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Depth(m)</i>	<i>Wire Out(m)</i>	<i>Station</i>
CTD	33° 24.4'	119° 24.2'	963	520	4002
CTD	33° 20.2'	119° 32.5'	85	75	4003
CTD	33° 12.6'	119° 44.3'	460	450	4004
CTD	33° 32.5'	119° 51.4'	330	320	4006
CTD	33° 37.8'	119° 41.6'	1366	520	4007
CTD	33° 44.6'	119° 32.5'	1930	520	4008

NIGHT: TRAWL & CTD - SAN NICOLAS

<i>OPS</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Depth(m)</i>	<i>Wire Out(m)</i>	<i>Station</i>
CTD	33° 41.4'	119° 17.2'	886	520	411
trawl	33° 41.4'	119° 17.2'	886	85	411
CTD	33° 35.2'	119° 26.9'	1874	520	412
trawl	33° 35.2'	119° 26.9'	1874	85	412
CTD	33° 29.2'	119° 36.3'	769	520	413
trawl	33° 29.2'	119° 36.3'	769	85	413
trawl	33° 23'	119° 45.8'	107	85	414
CTD	33° 23'	119° 45.8'	107	97	414

DAY: CTD - SAN MIGUEL

<i>OPS</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Depth(m)</i>	<i>Wire Out(m)</i>	<i>Station</i>
CTD	33° 49.3'	120° 33.1'	1819	520	4010
CTD	34° 01.8'	120° 51.6'	948	520	4011
CTD	34° 09.8'	120° 44.6'	738	520	4012

NIGHT: TRAWL & CTD - SAN MIGUEL

<i>OPS</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Depth(m)</i>	<i>Wire Out(m)</i>	<i>Station</i>
CTD	33° 55.1'	120° 42.7'	1848	520	425
trawl	33° 55.1'	120° 42.7'	1848	85	425
CTD	34° 04.2'	120° 34.7'	159	150	424
trawl	34° 04.2'	120° 34.7'	159	85	424
CTD	34° 10.6'	120° 28.3'	149	140	423
trawl	34° 10.6'	120° 28.3'	149	85	423
trawl	34° 18.9'	120° 18'	355	85	422
CTD	34° 18.9'	120° 18'	355	345	422

DAY: CTD - PT. SAL

<i>OPS</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Depth(m)</i>	<i>Wire Out(m)</i>	<i>Station</i>
CTD	35° 07'	120° 44'	38	30	4070
CTD	35° 07'	120° 53.5'	154	144	4069
CTD	35° 07'	121° 03'	457	447	4068
CTD	35° 07'	121° 12.6'	579	520	4067
CTD	34° 52'	121° 12.6'	564	520	4066
CTD	34° 52'	121° 03'	415	105	4065
CTD	34° 52'	120° 53.5'	221	211	4064
CTD	34° 52'	120° 44'	62	52	4063

NIGHT: TRAWL & CTD - PT. SAL

<i>OPS</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Depth(m)</i>	<i>Wire Out(m)</i>	<i>Station</i>
CTD	35° 00'	120° 44'	55	45	491
trawl	35° 00'	120° 44'	55	25	491
CTD	35° 00'	120° 47.6'	94	84	492
trawl	35° 00'	120° 47.6'	94	85	492
CTD	35° 00'	120° 53'	192	182	493
trawl	35° 00'	120° 53'	192	85	493
CTD	35° 00'	120° 58.5'	374	364	494
trawl	35° 00'	120° 58.5'	374	85	494
trawl	35° 00'	121° 07'	543	85	495
CTD	35° 00'	121° 07'	543	520	495

DAY: CTD - PIEDRAS BLANCAS

<i>OPS</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Depth(m)</i>	<i>Wire Out(m)</i>	<i>Station</i>
CTD	35° 32.1'	121° 21.8'	516	506	4023
CTD	35° 32.1'	121° 34.1'	848	520	4024
CTD	35° 32.1'	121° 46.3'	1007	520	4025
CTD	35° 52'	121° 46.4'	968	520	4028
CTD	35° 52'	121° 34'	510	500	4029

NIGHT: TRAWL & CTD - PIERAS BLANCAS

<i>OPS</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Depth(m)</i>	<i>Wire Out(m)</i>	<i>Station</i>
CTD	35° 42.2'	121° 21.8'	60	50	441
trawl	35° 42.2'	121° 21.8'	60	85	441
CTD	35° 42.2'	121° 25.8'	167	155	442
trawl	35° 42.2'	121° 25.8'	167	85	442
CTD	35° 42.2'	121° 30.5'	557	520	443
trawl	35° 42.2'	121° 30.5'	557	85	443
CTD	35° 42.2'	121° 42'	885	520	444
trawl	35° 42.2'	121° 42'	885	85	444
trawl	35° 42.2'	121° 52'	1040	85	445
CTD	35° 42.2'	121° 52'	1040	520	445

NIGHT: TRAWL & CTD - MONTEREY BAY INSIDE

<i>OPS</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Depth(m)</i>	<i>Wire(m)</i>	<i>Station</i>	<i>Strata</i>
CTD	36° 50.8'	121° 59'	91	81	119	
trawl	36° 50.8'	121° 59'	91	85	119	MI
CTD	36° 46'	121° 52'	73	63	114	
trawl	36° 46'	121° 52'	73	85	114	MI
CTD	36° 44.4'	121° 58.6'	238	228	116	
trawl	36° 44.4'	121° 58.6'	238	85	116	MI
CTD	36° 42.5'	121° 54.5'	91	81	115	
trawl	36° 42.5'	121° 54.5'	91	85	115	MI
CTD	36° 38.5'	121° 51.5'	37	30	111	
trawl	36° 38.5'	121° 51.5'	37	25	111	MI
trawl	36° 39.3'	121° 56.8'	73	85	112	MI
CTD	36° 39.3'	121° 56.8'	73	63	112	

DAY: CTD - MONTEREY BAY OUTSIDE

<i>OPS</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Depth(m)</i>	<i>Wire Out(m)</i>	<i>Station</i>
CTD	36° 40'	122° 10'	1134	520	1002
CTD	36° 46.3'	122° 16.1'	823	520	1003
CTD	36° 46.3'	122° 28.4'	2103	520	1004
CTD	36° 40'	122° 22.3'	1737	520	1005
CTD	36° 33.7'	122° 16.2'	2560	520	1006
CTD	36° 33.7'	122° 28.4'	2743	520	1007
CTD	36° 40'	122° 34.6'	2377	520	1008
CTD	36° 46.3'	122° 40.7'	2149	520	1009
CTD	36° 33.7'	122° 40.7'	2743	520	1010

NIGHT: TRAWL & CTD - MONTEREY BAY OUTSIDE

<i>OPS</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Depth(m)</i>	<i>Wire(m)</i>	<i>Station</i>	<i>Strata</i>
CTD	36° 35'	122° 10.5'	2323	520	110	
trawl	36° 35'	122° 10.5'	2323	85	110	MO
trawl	36° 35'	122° 10.5'	2323	25	110	MO
CTD	36° 35'	122° 02'	530	520	109	

trawl	36° 35'	122° 02'	530	85	109	MO
CTD	36° 38.8'	122° 03'	914	520	113	
trawl	36° 38.8'	122° 03'	914	85	113	MO
CTD	36° 42'	122° 06.5'	1920	520	117	
trawl	36° 42'	122° 06.5'	1920	85	117	MO
trawl	36° 46.4'	122° 09'	914	85	118	MO
CTD	36° 46.4'	122° 09'	914	520	118	

DAY: CTD - DAVENPORT

<i>OPS</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Depth(m)</i>	<i>Wire Out(m)</i>	<i>Station</i>
CTD	36° 52.6'	122° 10'	91	81	1011
CTD	36° 52.6'	122° 22.3'	823	520	1012
CTD	36° 52.6'	122° 34.6'	1600	520	1013
CTD	36° 52.6'	122° 47'	2286	520	1014
CTD	36° 52.6'	122° 59.3'	2697	520	1015
CTD	36° 59'	122° 53'	1372	520	1016
CTD	37° 05'	122° 47'	686	520	1017
CTD	37° 05'	122° 34.6'	119	110	1018
CTD	37° 05'	122° 22.3'	59	50	1019

NIGHT: TRAWL & CTD - DAVENPORT

<i>OPS</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Depth(m)</i>	<i>Wire(m)</i>	<i>Station</i>	<i>Strata</i>
CTD	36° 59'	122° 17.5'	82	72	123	
trawl	36° 59'	122° 17.5'	82	85	123	SS
CTD	36° 59'	122° 22.5'	128	118	124	
trawl	36° 59'	122° 22.5'	128	85	124	DS
CTD	36° 59'	122° 25.5'	457	445	125	
trawl	36° 59'	122° 25.5'	457	85	125	DS
CTD	36° 59'	122° 35.5'	402	390	126	
trawl	36° 59'	122° 35.5'	402	85	126	DS
trawl	36° 59'	122° 45.5'	1006	85	127	DS
CTD	36° 59'	122° 45.5'	1006	520	127	

DAY: CTD - PESCADERO

<i>OPS</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Depth(m)</i>	<i>Wire Out(m)</i>	<i>Station</i>
CTD	37° 10.7'	122° 28.4'	68	58	1020
CTD	37° 10.7'	122° 40.7'	110	100	1021
CTD	37° 10.7'	122° 53'	421	410	1022
CTD	37° 10.7'	123° 05.3'	869	520	1023
CTD	37° 16.5'	123° 11.4'	1189	520	1024
CTD	37° 22.3'	123° 05.3'	823	520	1025
CTD	37° 22.3'	122° 53'	201	190	1026
CTD	37° 22.3'	122° 40.7'	88	78	1027
CTD	37° 22.3'	122° 28.4'	27	20	1028

NIGHT: TRAWL & CTD - PESCADERO

<i>OPS</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Depth(m)</i>	<i>Wire(m)</i>	<i>Station</i>	<i>Strata</i>
CTD	37° 16.5'	122° 34'	82	75	131	
trawl	37° 16.5'	122° 34'	82	85	131	SS
CTD	37° 16.5'	122° 39'	95	85	132	
trawl	37° 16.5'	122° 39'	95	85	132	SS
CTD	37° 16.5'	122° 49'	165	155	133	
trawl	37° 16.5'	122° 49'	165	85	133	DS
CTD	37° 16.5'	122° 59'	549	520	134	

trawl	37° 16.5'	122° 59'	549	85	134	DS
trawl	37° 16.5'	123° 09'	1006	85	135	DS
CTD	37° 16.5'	123° 09'	1006	520	135	

NIGHT: TRAWL & CTD - GULF OF THE FARALLONES

OPS	Latitude	Longitude	Depth(m)	Wire	Out(m)	Station
CTD	37° 47.5'	122° 52'	55	45		139
trawl	37° 47.5'	122° 52'	55	25		139
CTD	37° 42'	122° 54.5'	55	45		138
trawl	37° 42'	122° 54.5'	55	25		138
CTD	37° 35.8'	122° 49.9'	55	45		237
trawl	37° 35.8'	122° 49.9'	55	25		237

DAY: CTD - FARALLONES OUTSIDE

OPS	Latitude	Longitude	Depth(m)	Wire	Out(m)	Station
CTD	37° 30.8'	122° 59.3'	229		220	1029
CTD	37° 30.8'	123° 11.6'	1280		520	1030
CTD	37° 30.8'	123° 24'	2377		520	1031
CTD	37° 30.8'	123° 36.3'	2652		520	1032
CTD	37° 38.4'	123° 36.3'	3338		520	1033
CTD	37° 46.2'	123° 36.3'	2697		520	1034
CTD	37° 46.2'	123° 24'	1509		520	1035
CTD	37° 46.2'	123° 11.6'	128		118	1036

NIGHT: TRAWL & CTD - FARALLON OUTSIDE

OPS	Latitude	Longitude	Depth(m)	Wire(m)	Station	Strata
CTD	37° 39.5'	123° 02.5'	119	110	152	
trawl	37° 39.5'	123° 02.5'	119	85	152	DN
CTD	37° 39.5'	123° 12.5'	1244	520	154	
trawl	37° 39.5'	123° 12.5'	1245	85	154	DN
CTD	37° 44.6'	123° 08.3'	91	81	156	
trawl	37° 44.6'	123° 08.3'	91	85	156	SN
CTD	37° 53'	123° 19'	91	81	160	
trawl	37° 53'	123° 19'	91	85	160	SN
trawl	37° 53'	123° 30'	1463	85	162	DN
CTD	37° 53'	123° 30'	1463	520	162	

DAY: CTD - PT. REYES

OPS	Latitude	Longitude	Depth(m)	Wire	Out(m)	Station
CTD	38° 1.6'	123° 05.5'	64		54	1046
CTD	38° 1.6'	123° 17.8'	119		110	1045
CTD	38° 1.6'	123° 30.1'	137		127	1037
CTD	38° 1.6'	123° 42.4'	2560		520	1038
CTD	38° 1.6'	123° 54.7'	3475		520	1039
CTD	38° 10'	124° 07'	3658		520	1040

NIGHT: TRAWL & CTD - PT. REYES

OPS	Latitude	Longitude	Depth(m)	Wire(m)	Station	Strata
CTD	38° 10'	123° 0'	55	45	165	
trawl	38° 10'	123° 0'	55	25	165	SN
CTD	38° 9.5'	123° 5'	73	63	166	
trawl	38° 9.5'	123° 5'	73	85	166	SN
CTD	38° 10'	123° 10'	91	81	167	
trawl	38° 10'	123° 10'	91	85	167	SN

CTD	38° 10'	123° 17'	128	118	168	
trawl	38° 10'	123° 17'	128	85	168	DN
CTD	38° 10'	123° 22'	183	173	170	
trawl	38° 10'	123° 22'	183	85	170	DN
trawl	38° 10'	123° 29'	285	85	171	DN
CTD	38° 10'	123° 29'	400	390	171	

DAY: CTD - FORT ROSS

OPS	Latitude	Longitude	Depth(m)	Wire Out(m)	Station
CTD	38° 18.5'	123° 10'	83	73	1048
CTD	38° 18.5'	123° 17.8'	110	100	1044
CTD	38° 18.5'	123° 30.1'	275	265	1043
CTD	38° 18.5'	123° 42.4'	1463	520	1042
CTD	38° 18.5'	123° 54.7'	2835	520	1041
CTD	38° 18.5'	124° 07.7'	3600	520	4030
CTD	38° 28'	124° 24.0'	3500	520	4031

NIGHT: TRAWL & CTD - FORT ROSS

OPS	Latitude	Longitude	Depth(m)	Wire Out(m)	Station
CTD	38° 28'	124° 05'	3350	520	455
trawl	38° 28'	124° 05'	3350	85	455
CTD	38° 28'	123° 42.6'	910	520	454
trawl	38° 28'	123° 42.6'	910	85	454
CTD	38° 28'	123° 23.2'	115	105	453
trawl	38° 28'	123° 23.2'	115	85	453
trawl	38° 28'	123° 14'	53	25	183
CTD	38° 28'	123° 14'	53	43	183

DAY: CTD - NAVARRO

OPS	Latitude	Longitude	Depth(m)	Wire Out(m)	Station
CTD	38° 50.0'	123° 47.0'	111	100	4032
CTD	38° 50.0'	124° 04'	1805	520	4033
CTD	38° 50.0'	124° 20.0'	3300	520	4034
CTD	38° 50.0'	124° 37.0'	3500	520	4035

NIGHT: TRAWL & CTD - NAVARRO

OPS	Latitude	Longitude	Depth(m)	Wire Out(m)	Station
CTD	39° 08'	124° 37'	3300	520	465
trawl	39° 08'	124° 37'	3300	85	465
CTD	39° 08'	124° 19'	2000	520	464
trawl	39° 08'	124° 19'	2000	85	464
CTD	39° 08'	124° 00'	500	490	463
trawl	39° 08'	124° 00'	500	85	463
trawl	39° 08'	123° 46.3'	50	25	461
CTD	39° 08'	123° 46.3'	50	40	461

DAY: CTD - DELGADA SOUTH

OPS	Latitude	Longitude	Depth(m)	Wire Out(m)	Station
CTD	39° 30'	124° 02'	630	520	4036
CTD	39° 30'	124° 17'	1800	520	4037
CTD	39° 30'	124° 35'	2300	520	4038
CTD	39° 30'	124° 53'	2807	520	4039

NIGHT: TRAWL & CTD - DELGADA

<i>OPS</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Depth(m)</i>	<i>Wire Out(m)</i>	<i>Station</i>
CTD	39° 50'	124° 45'	1300	520	475
trawl	39° 50'	124° 45'	1300	85	475
CTD	39° 50'	124° 24'	1500	520	474
trawl	39° 50'	124° 24'	1500	85	474
CTD	39° 50'	124° 06.5'	300	290	473
trawl	39° 50'	124° 06.5'	300	85	473
trawl	39° 50'	123° 55'	60	85	471
CTD	39° 50'	123° 55'	60	50	471

DAY: CTD - DELGADA NORTH

<i>OPS</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Depth(m)</i>	<i>Wire Out(m)</i>	<i>Station</i>
CTD	40° 05'	124° 15.2'	160	150	4055
CTD	40° 05'	124° 28.3'	678	520	4056
CTD	40° 05'	124° 41.3'	1000	520	4057
CTD	40° 05'	124° 54.3'	1200	520	4058
CTD	39° 50'	124° 58'	1830	520	4059