



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

June 7, 2007

CRUISE REPORT

VESSEL: NOAA Ship DAVID STARR JORDAN, DS-06-03

CRUISE DATES: MAY 5 - JUNE 18, 2006

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

BACKGROUND:

Rockfish (*Sebastes* spp.) are an important component of both the recreational and commercial fisheries off the west coast of North America. Many adult rockfish are often unavailable to commercial fishing gears until they are 3-7 years old, so a current preview of future stocks can be valuable in modeling population growth and determining allowable harvest levels. This can be accomplished by sampling rockfish during their pelagic juvenile stage. Since 1983, personnel from the Fisheries Ecology Division of the NOAA National Marine Fisheries Service (NMFS), Southwest Fisheries Science Center (SWFSC), along with the NOAA Ship DAVID STARR JORDAN have conducted annual surveys off central California to assess the spawning success and future recruitment of various rockfish species. In addition, Pacific whiting (*Merluccius productus*), a significant groundfish fishery species, and krill (euphausiids) an important ecosystem prey species, are also sampled during these annual surveys.

ITINERARY:

LEG 1: May 5- May 18, 2006

Two days were spent inport in San Francisco prior to getting underway for the survey. On May 4 scientific gear was staged on the Ship and the laboratories were setup. On May 5 the Ship was delayed from getting underway due to staffing needs. Freezer repairs and final electrical repairs were taken care of during May 5 while alongside the pier. The Ship departed San Francisco at 1000 on May 6 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 6, starting first along the Pescadero transect. From May 6 and until the morning of May 16 the Ship and scientists conducted mid-water trawls, CTD casts, GO-FLO deployments, EK500 bioacoustic recordings, Acoustic Doppler Current Profiler (ADCP) recordings, thermosalinometer recordings, SCUFA



fluorometer recordings, and bird/marine mammal observations at stations along the designated transects between San Francisco and San Diego. 24 hours were devoted to each transect. The transects covered during Leg 1, in chronological order, were; Pescadero, Davenport, Monterey Bay Inside, Monterey Bay Outside, Piedras Blancas, Point Sal, San Miguel, San Nicolas, San Clemente, and San Diego. The Ship was required to inport in San Diego from May 16-18 to effect needed repairs.

LEG 2: May 18 - May 26, 2006

The Ship transited from San Diego to Monterey Bay on May 18, after needed repairs were completed in port. Beginning the night of May 20 and ending the morning of May 26 the Ship and scientists conducted operations similar to those during Leg 1, between Monterey Bay and Fort Ross. The transects covered during Leg 2, in chronological order, were: Monterey Bay Inside, Monterey Bay Outside (conducted paired trawls with the Pacific Whiting Conservation Cooperative [PWCC] F/V EXCALIBUR), Farallones Outside, Point Reyes, Fort Ross, and Gulf of the Farallones. Opportunistic hook and line fishing for Humboldt squid (*Dosidicus gigas*) was conducted at the Farallones Outside and Fort Ross transects. The Ship ended Leg 2 in San Francisco with arrival to Pier 27 on May 26.

INPORT San Francisco: May 27-28

The Ship docked at Pier 27 in San Francisco, where fueling and scientists exchanges occurred.

LEG 3: May 29 – June 9, 2006

Scientists embarked the morning of May 29 and the Ship departed Pier 27, San Francisco shortly before noon. Beginning the night of May 29 and ending the morning of June 9 the Ship and scientists conducted operations similar to those during the previous legs. The transects covered during Leg 3, in chronological order, were: Point Reyes (paired trawls with PWCC F/V EXCALIBUR), Fort Ross (paired trawls with PWCC F/V EXCALIBUR), Navarro, Delgada (twice in a row), Navarro, Fort Ross, Gulf of the Farallones, Point Reyes, Farallones Outside, and Pescadero. Opportunistic hook and line fishing for Humboldt squid was conducted at the Delgada transect.

LEG 4: June 9 - June 18, 2006

Scientists, Ship's crewmembers, and frozen samples were exchanged the morning of June 9 at the Santa Cruz Municipal Wharf. Beginning the night of June 9 and ending the morning of June 18, the Ship and scientists conducted operations similar to those during the previous legs. The transects covered during Leg 5, in chronological order, were: Monterey Bay Inside, Davenport, Monterey Bay Outside, Piedras Blancas, Point Sal, San Miguel, San Nicolas, San Clemente, and San Diego. Scientists disembarked the Ship the morning of June 18 in San Diego to end cruise DS-06-03. The scientific gear was off loaded from the ship on June 18 and shipped to Santa Cruz the following day. The Scientists returned to Santa Cruz the evening of June 18 via commercial airline.

OBJECTIVES:

1. Sample for pelagic juvenile rockfish to determine the distribution and abundance between San Diego and Delgada.
2. Characterize prominent oceanographic features between San Diego and Delgada.
3. Map the distribution and abundance of krill along the continental shelf and shelf break.
4. Conduct side-by-side paired vessels trawls with the Pacific Whiting Conservation Cooperative (PWCC) F/V EXCALIBUR, in cooperation with the NOAA NMFS Northwest Fisheries Science Center, in order to compare the two surveys methodologies.
5. Collect pelagic juvenile rockfish for RNA:DNA analysis.
6. Collect seawater for microchemical analysis and chlorophyll analysis.
7. Observe seabird and marine mammal distribution and abundance.
8. Collect adult rockfish and Humboldt squid.

PIGGYBACK PROJECTS:

1. Collect seawater samples at discrete depths for nutrient analysis in cooperation with San Francisco State University – Romberg Center.
2. Collect lengths and specimens of market squid (*Loligo opalescens*) for NOAA NMFS SWFSC Fisheries Resources Division and for the University of California, Santa Cruz.
3. Opportunistically catch and save various fish and cephalopod specimens for the NMFS SWFSC La Jolla CA, for the NOAA NMFS SWFSC Santa Cruz CA, for the National Park Service, for the Scripps Institution of Oceanography, and for Hopkins Marine Station of Stanford University.

METHODS:

1. Sample for pelagic juvenile rockfish:
In general, 5-7 midwater trawls, were conducted each night between 2100-0500 Pacific Standard Time at stations along the mid-water trawling transects within the survey area, between San Diego and Delgada. The trawl stations remained 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 the 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 with a 5-minute duration. The fishing at target headrope depth begins when the designated amount of warp is out, with winches braked. 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, market squid, Humboldt squid stomachs and heads, selected juvenile groundfish, and juvenile salmon were frozen for laboratory analyses.

CTD casts using the 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 excluded during daytime and nighttime operations in the interests of the time needed to complete planned mid-water trawls. A Seabird Electronics SEACAT 19+ CTD was 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 taken, on average, three times every 24 hours, for chlorophyll and nutrient analysis. Water samples were collected during the upcast, with the Niskin Bottles, which were attached to the Seabird carousel.

2. Characterize prominent oceanographic features between San Diego and Delgada:

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 ue4m.exe 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. Map the distribution and abundance of krill along the continental shelf and shelf break:

A Simrad EK500 echo sounder was used to acoustically characterize the distribution and abundance of macro-zooplankton and micro-nekton, meroplankton and zooplankton. The echo sounder was 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. Daytime EK500 transects, and daytime transits, with good EK500 acoustic-recording surface weather conditions, were carried out during the course of the survey. Daytime hoop net deployments near acoustic signatures were used to verify species of krill and to collect live specimens.

4. Conduct side-by-side paired vessels trawls with the PWCC F/V EXCALIBUR:

Several nights were spent conducting 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 trawled at the same station within ¼ mile of each other and started and ended trawling at the same time. Similar trawl nets were used on each of the research vessels and target headrope depths were matched. This was a cooperative effort between the NOAA NMFS SWFSC Fisheries Ecology Division, the NOAA NMFS Northwest Fisheries Science Center, and the PWCC.

5. Collect pelagic juvenile rockfish for RNA:DNA analysis:

Subsamples of juvenile 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 RNA:DNA ratio analysis by Kevin Stierhoff, postdoctoral associate of the NOAA NMFS SWFSC Fisheries Ecology Division.

6. Collection of seawater for microchemical analysis 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 and 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.

7. Seabird and marine mammal observations:

Ornithologists from Point Reyes Bird Observatory (PRBO) Conservation Science were aboard during Legs 1, and 2. Seabirds were enumerated and identified in an arc from the bow to 90° amidships. All seabirds, which passed through this area in flight or observed sitting or foraging, were counted. Marine mammals were observed to the horizon. Distance and angle from the ship to each individual mammal or group of mammals were estimated. Data were entered as observations were made into a Husky Fex21 palmtop computer using the FLK program (courtesy George Hunt). Ornithologists from H. T. Harvey & Associates Ecological Consultants were aboard during Leg 3. The ornithologists estimated the distribution and abundance of seabirds and marine mammals while underway. The ornithologists used standardized population recording techniques to survey the marine birds and marine mammals. 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.

8. Collection of adult rockfish and Humboldt squid:

Hook and line fishing with rod /reel for adult rockfish species was conducted during daylight hours at different nearshore locations, in the southern California bight, to collect genetic samples of adult rockfish of the subgenus *Sebastes* (includes *S. chlorostictus*, *S. constellatus*, *S. ensifer*, *S. eos*, *S. helvomaculatus*, *S. lentiginosus*, *S. rosaceus*, *S. rosenblatti*, *S. simulator*, and *S. umbrosus*). Length, gender, and reproductive condition of gonads, were recorded for all fish captured. Otoliths, ovaries, and fin clips for genetic analysis were removed from select specimens. A fingernail size tissue sample was removed from the anal or caudal fin and saved on blotter paper and stored in sample envelopes. In addition, selected whole fish specimens were frozen and brought back to the NOAA NMFS SWFSC Fisheries Ecology Division for ID confirmation. As a secondary goal, tissue samples were also saved from rockfish species collected in which the adult IDs were not confirmed. Locations of the fishing activity were determined by location of the Ship, available time, and operational constraints.

Hook and line fishing with rod/reel/jig was conducted opportunistically for Humboldt squid whenever the squid were caught in the midwater trawl or seen near the surface, chasing schooling pelagic prey. Dip nets and gaffs were used to bring the squid aboard. Once the squid were aboard, the mantle lengths were measured and the stomachs and heads removed and frozen. Selected whole specimens were also saved and frozen.

PIGGYBACK PROJECTS:

1. Seawater samples collections at discrete depths for nutrient analysis in cooperation with San Francisco State University – Romberg Center:

Seawater samples were collected for nutrient analyses from the Farallones and Point Reyes areas. Niskin bottles attached to the CTD Carousel were tripped during CTD casts in order to collect the seawater samples at discrete depths, normally 100m (Previously you spelled out meters and now you are just using m. Be consistent.), chlorophyll maximum depth, and 5m. At select stations near Point Reyes and the Farallones, seawater was also collected at depths greater than 100m, usually 10 m off the bottom or 520m, whichever was shallower. Seawater samples were frozen in scintillating vials and delivered frozen to San Francisco State University-Romberg Center.

2. Market Squid Collections:

Dorsal mantle lengths were measured for up to 50 market squid caught, per trawl. Dorsal mantle lengths were taken for the University of California, Santa Cruz, and for the NMFS SWFSC Fisheries Resources Division, La Jolla CA. In addition, up to 30 squid larger than 60 mm were preserved (frozen) from each trawl for University of California, Santa Cruz for stomach contents analysis.

3. Opportunistically catch and save various fish and cephalopod specimens for the NMFS SWFSC, La Jolla CA, for the NOAA NMFS SWFSC, Santa Cruz CA, for the National Park Service, for the Scripps Institution of Oceanography, and for Hopkins Marine Station of Stanford University:

Whole specimens of selected species of fish and cephalopods from trawl catches were saved and frozen for subsequent dissemination and laboratory analyses after completion of the survey.

RESULTS:

1. Juvenile Rockfish Survey:

A total of 162 successful nighttime midwater trawls were completed, at 77 different stations along the California coast, during the 4 Legs of the survey. Table 1 lists the total numbers of juvenile rockfish caught since 1986. Table 2 lists the catches of juvenile rockfish and Pacific whiting from 2004 (DS-04-03), 2005 (DS-05-04), and 2006 (DS-06-03) comparing catches north and south of Point Conception.

Low catch rates of pre-recruit rockfish were experienced off central and northern California in 2006. It would appear that 2006 was unfavorable for rockfish reproductive success off California north of Point Conception. The 2005 survey also showed unfavorable rockfish reproductive success in the central and northern California regions. The catch rates for pre-recruit rockfish south of Point Conception were comparable to what was experienced during the 2004 survey, except for the relatively large number of YOY *Sebastes* caught during the 2006 survey. The overall catch for pre-recruit rockfish south of Point Conception during 2006 was much lower than the catch south of Point Conception in 2005, mostly due to the significant decrease in catches of shortbelly rockfish and half-banded rockfish.

Catches of Pacific whiting during the 2006 survey mimicked the 2004 survey in that catches were higher north of Point Conception than south of the Point. This is opposite of what was caught during the 2005 survey in which catches of Pacific whiting were higher south of Point Conception than north of the Point.

2. Physical Oceanographic Data Collections:

296 successful CTD casts were made during the survey. Surface weather conditions were variable throughout the survey. Periods of upwelling favorable conditions with strong equatorward winds were present during Legs 1 and 4 and were separated by calm wind conditions during much of Legs 2 and 3. Surface chlorophyll data was successfully collected along the Ship's track throughout the survey and all of the CTD casts successfully collected chlorophyll data at deployed depths. Phytoplankton showed well-mixed surface layers over the continental shelf during Legs 1 and 4 due to strong, persistent, northerly winds. Primary production of phytoplankton was much more variable in late May and early June with patchiness over the continental shelf during the calm wind conditions during Legs 2 and 3. The Seabird thermosalinometer successfully collected surface temperature and salinity data along the ship's track throughout the survey. The Ship's ADCP also collected subsurface current data successfully along the Ship's track throughout the survey.

3. Map the Distribution and Abundance of Krill Along the Continental Shelf and Shelf Break:

Acoustic data from the Simrad EK500 were collected continuously throughout the survey. Acoustic data are being used for various studies cooperatively between the NOAA NMFS Fisheries Ecology Division and the University of California, Santa Cruz, which include acoustic target identification/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.

Table 1. Number of YOY rockfish (*Sebastes spp.*) collected at stations by mid-water trawls during surveys (1986-2006)

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

Table 2. Pelagic juvenile rockfish (*Sebastes spp.*) and Pacific whiting (*Merluccius productus*) catches south and north of Point Conception during the annual rockfish surveys of 2004, 2005, and 2006

SPECIES	SOUTH-04	SOUTH-05	SOUTH-06	NORTH-04	NORTH-05	NORTH-06
AURORA ROCKFISH	2	1	1			
SPLITNOSE ROCKFISH	2	1	1			
GREENSTRIPED ROCKFISH	36	25	43			
SQUARESPOT ROCKFISH	74	932	178	7		
SHORTBELLY ROCKFISH	100	6388	142	1135	22	78
COWCOD	4	7	2	1		
BLACKGILL ROCKFISH	63	18	71			
SPECKLED ROCKFISH	1					
BOCACCIO	14	96	6	22		
BANK ROCKFISH	4	10	1	1		
STRIPETAILED ROCKFISH	1	3		212	3	1
HALFBANDED ROCKFISH	2	1410	3	4		
PYGMY ROCKFISH	66	82	17	17	24	4
SHARPCHIN ROCKFISH	2				1	
ROSEFISH GROUP	433	491	1050	3	1	
COPPER ROCKFISH COMPLEX	4	7	1	4		
BROWN ROCKFISH		2		27		
DARKBLOTCHED ROCKFISH				19		
WIDOW ROCKFISH				1248		
YELLOWTAIL ROCKFISH				838		3
CHILIPEPPER ROCKFISH		9		212	2	1
BLACK ROCKFISH				294		
BLUE ROCKFISH				470		
CANARY ROCKFISH				314	2	
OLIVE ROCKFISH				7	1	
CALICO ROCKFISH		4				
Total Catch	808	9486	1516	4835	56	87

SPECIES	SOUTH-04	SOUTH-05	SOUTH-06	NORTH-04	NORTH-05	NORTH-06
PACIFIC WHITING	636	13062	234	46919	91	2013

4. Paired trawls with the PWCC F/V EXCALIBUR:

15 paired trawls over 3 nights at 3 different transects were successfully completed. The first night of paired trawls occurred at the beginning of Leg 2 on May 21 along the Monterey Bay Outside transect, with 6 total trawls completed. The second night of paired trawling occurred on May 29 along the Point Reyes transect, with 5 total trawls completed. The third night of paired trawling occurred on May 31 along the Fort Ross transect, with 4 total trawls completed.

5. Collect pelagic juvenile rockfish for RNA:DNA analysis:

Muscle tissue was collected from 133 juvenile shortbelly rockfish for RNA:DNA analysis. RNA:DNA ratios serve as a proxy for recent growth, and can therefore be used to examine temporal and spatial patterns of growth relative to prevailing oceanographic conditions (e.g. upwelling intensity, primary productivity, temperature). Unfortunately, the past two years were particularly poor recruitment years for shortbelly rockfish in our study area. These samples are being stored at -80C until more samples can be accumulated for analysis.

6. Collection of seawater for microchemical analysis:

A GO-FLO bottle was deployed by hand from the port rail to collect 305 water samples for microchemical analysis. In particular, this objective sought to describe differences in microchemical signatures (e.g. Ba, Sr, Mg, Mn, Cd, and Li) from various water masses stretching from just north of Point Reyes to Point Sur in the south, with the ultimate goal of matching water chemistry to otolith chemistry of juvenile shortbelly rockfishes. Preliminary analyses indicate that one can discriminate between five distinct water masses (based on oceanographic conditions, such as upwelling intensity) with about 70% confidence. These results suggest that one should be able to also detect such differences in otolith chemistry of juvenile shortbelly rockfish. Similarities between otolith chemistry and water chemistry could then be used to examine potential transport pathways, transport times, and to explain temporal and spatial differences in growth rate (based on otolith increment analysis and RNA:DNA ratios) of pelagic juvenile shortbelly rockfish.

7. Seabird and Marine Mammal Observations:

PRBO Conservation Science conducted observations of marine birds and mammals from the flying bridge during all daylight hours, from 7-15 May and 19-25 May 2006 (Surveying did not occur 16-18 May as the Ship returned to port in San Diego for maintenance). Sophie Webb and Thomas Van Pelt using standard techniques conducted observations. Observations of the most numerous species for the period are summarized in Table 3 and Table 4. Total numbers of both seabirds (14,022) and mammals (2,670) were higher than counts from 2005 (12,909 and 937 respectively). The 2006 survey encountered the highest totals of California Sea Lion and Northern Right Whale Dolphin since PRBO began surveys on the RRS cruise. Most of the sea lions were observed near Santa Barbara Channel on 5/20/06 as the Jordan steamed north after repairs in San Diego. Counts of Brown Pelican and Xantus's Murrelet were also high relative to previous surveys.

Table 3. Observations of seabirds on legs 1 & 2 (7-15 May & 19-25 May)

TOP 20 SEABIRD SPECIES	TOTAL OBSERVED	% OF TOTAL SEABIRDS
Sooty Shearwater	8,107	57.82%
Common Murre	1,546	11.03%
Western Gull	1,074	7.66%
Cassin's Auklet	573	4.09%
Red-Necked Phalarope	489	3.49%
Brandt's Cormorant	488	3.48%
Pink-Footed Shearwater	415	2.96%
Black-Footed Albatross	308	2.20%
California Gull	200	1.43%
Red Phalarope	180	1.28%
Brown Pelican	152	1.08%
Pacific Loon	129	0.92%
Northern Fulmar	83	0.59%
Xantus's Murrelet	60	0.43%
Least Tern	33	0.24%
Rhinoceros Auklet	32	0.23%
Black Storm-Petrel	28	0.20%
Bonaparte's Gull	24	0.17%
Sabine's Gull	16	0.11%
Unidentified Phalarope	10	0.07%
Total Seabirds Observed*	14,022	

* Total represents sum of all seabird species observed (including other species not listed here)

Table 4. Observations of marine mammals on legs 1-3 (7-15 May and 19-25 May)

TOP 5 MAMMAL SPECIES	TOTAL OBSERVED	% OF TOTAL MAMMALS
California Sea Lion	1,173	43.93%
Northern Right Whale Dolphin	578	21.65%
California Sea Lion	350	13.11%
Risso's Dolphin	155	5.81%
Common Dolphin Species	146	5.47%
Total Mammals Observed*	2,670	

* Total represents sum of all mammal species observed (including other species not listed here)

Over the course of 8 days (Leg 4), David Ainley and Ian Gaffney of H.T. Harvey and Associates Inc. conducted surveys of marine birds and mammals from the flying bridge of the Ship. All birds and pinnipeds were tallied of those that came within 300 m, and all cetaceans within 800 m, of the side of the Ship. This cruise was the 20th survey for the H.T. Harvey and Associates Inc. seabird/marine mammal project. The two observers participated from 30 May until 9 June, and covered the Gulf of the Farallones as well as waters a bit to the north and south. During this period the 2 observers surveyed whenever the ship was underway during daylight, and covered a course of 719.6 nm. Within the 300 m strip census zone (800 m for cetaceans), 5,473 seabirds

(24 species), 25 pinnipeds (3 species) and 461 cetaceans (7 species) were encountered. Marine birds and mammals were concentrated in upwelling frontal areas off Davenport CA and inshore, between Point Reyes and Point Arena. Common murre and sooty shearwaters dominated the avifauna. Humpback whales and Pacific white-sided dolphins dominated the mammals. Except for those two areas of concentration, top trophic predators were sparse everywhere else.

8. Collection of adult rockfish and Humboldt squid:

Four afternoons were spent hook and line fishing for adult rockfish around the Channel Islands. The objective of the work was to collect samples for genetic analysis as well as to supplement our ongoing groundfish ecology program. Of particular interest were samples from the *Sebastes* group and whole vermilion rockfish. A total of 348 rockfish from 15 species were captured. Of those, 65 were vermilion rockfish, which were returned whole to the NOAA NMFS SWFSC Fisheries Ecology Division's laboratory. Subsequent genetic analysis indicated that we had not captured the second species of vermilion rockfish. In addition we caught 172 fish from five species of the *Sebastes* group.

For the second year in a row, Humboldt squid were caught during trawling operations within the central California region's standard stations. The surveys of 2005 and 2006 are the only ones having these squid show up in the trawl net. 30 squid were caught in 9 midwater trawls over the course of 8 different nights of trawling operations. Over 80 Humboldt squid were also caught opportunistically with jigs on rod/reel gear just after dawn near the stations where squid showed up in the trawl net. Mantle lengths were measured, stomachs, and heads of the squid were collected from all specimens caught and frozen for post cruise processing and analysis. Several whole squid specimens were also frozen for subsequent laboratory analyses.

PIGGYBACK PROJECTS:

1. Seawater samples at discrete depths for nutrient analysis in cooperation with San Francisco State University – Romberg Center:

Several hundred seawater samples were collected, frozen, and delivered to San Francisco State University for nutrient analyses. More samples were taken near the Gulf of the Farallones and Point Reyes than at any other transects, although water samples were collected consistently throughout the survey whenever daytime CTD casts were made. San Francisco State University – Romberg Tiburon Center scientists were aboard the Ship during Leg 2 to perform seawater incubations and collect additional seawater samples during daylight hours.

2. Market Squid Collections:

A total of 835 Market Squid were caught during the survey. Table 5 lists the total catch numbers for market squid during the surveys since 1987, which was the first year that market squid were identified and enumerated. The number of market squid caught in the midwater trawls was extremely low compared to previous surveys. In comparison to last year, a third as many market squid were caught. This year was the second lowest year for market squid, with only the El Nino year of 1998 being lower. Frozen specimens were delivered to University of California, Santa Cruz after the survey.

Table 5. Total number of market squid caught during surveys (1987-2006)

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

3. Opportunistically catch and save various and cephalopod specimens and finfish for several Divisions of the NMFS SWFSC, for the University of California, Berkeley, Stanford and for the Scripps Institution of Oceanography:

For Mark Lowry of NOAA NMFS SWFSC Protected Resources Division, the survey collected and delivered about 100 *Gonatus* squid, ~20-30 pelagic octopus, and over 100 samples of various species of myctophids, blacksmelt and other finfish (Pacific whiting, northern anchovy [*Engraulis mordax*], etc). They are to be used as reference specimens for identifying prey items for California sea lions and other predators, and for constructing otolith length/fish length and squid beak/squid mantle length regressions.

The survey also opportunistically collected adult Pacific sardine (*Sardinops sagax*) for Roger Hewitt of NOAA NMFS SWFSC Fisheries Resources Division.

Samples of various species (e.g. euphausiids, northern anchovy, Pacific whiting, myctophids, etc.) were collected for Allison Moody of University of California, Berkeley working with the National Park Service Point Reyes National Seashore for working up stable isotope values to help in inferring seabird diets. Samples were mainly collected from Point Reyes to Monterey Bay.

For Lou Zeidberg of Hopkins Marine Station, Stanford University, the survey collected ~ 1 dozen each, of northern anchovy, northern lampfish (*Stenobranchius leucopsarus*) and Pacific whiting samples for stable isotope (trophic level) analysis.

Larval northern anchovies and Pacific sardines were collected for Motomitsu Takahashi of Scripps Institution of Oceanography. 1194 larval northern anchovies were frozen in seawater from 15 trawls, while 83 larval Pacific sardine were preserved from 9 trawls.

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, 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.

SCIENTIFIC PERSONNEL:

Leg 1 (May 5 - May 18)

Ken Baltz, Oceanographer, NMFS, Santa Cruz, CA (Cruise Leader)
Keith Sakuma, Fish Biologist, NMFS, Santa Cruz, CA (Chief Scientist)
Don Pearson, Fish Biologist, NMFS, Santa Cruz, CA
Steve Ralston, Fish Biologist, NMFS, Santa Cruz, CA
Brian Wells, Post-Doc, NMFS, Santa Cruz, CA
Kevin Stierhoff, Post-Doc, UCSC and NMFS, Santa Cruz, CA
Asila Ghoul, Krill Biologist, University of California, Santa Cruz, Santa Cruz, CA
Thomas Van Pelt, PRBO Conservation Science, Stinson Beach, CA
Sophie Webb, PRBO Conservation Science, Stinson Beach, CA
Allison Moody, Marine Technician, UC Berkeley-NPS-PRBO, Berkeley, CA

Leg 2 (May 18 - May 26)

Ken Baltz, Oceanographer, NMFS, Santa Cruz, CA (Cruise Leader)
Keith Sakuma, Fish Biologist, NMFS, Santa Cruz, CA (Chief Scientist)
Don Pearson, Fish Biologist, NMFS, Santa Cruz, CA
Eric Bjorkstedt, Fish Biologist, NMFS, Santa Cruz, CA
Christine Peterson, Post-Doc, NMFS, Santa Cruz, CA
Kevin Stierhoff, Post-Doc, UCSC and NMFS, Santa Cruz, CA
Baldo Marinovic, Krill Biologist, University of California, Santa Cruz, Santa Cruz, CA
Amy Kleckner, San Francisco State Univ., Romberg Center, Tiburon, CA
Thomas Van Pelt, PRBO Conservation Science, Stinson Beach, CA
Sophie Webb, PRBO Conservation Science, Stinson Beach, CA

Leg 3 (May 29 - June 9)

Ken Baltz, Oceanographer, NMFS, Santa Cruz, CA (Cruise Leader)
Keith Sakuma, Fish Biologist, NMFS, Santa Cruz, CA (Chief Scientist)
Don Pearson, Fish Biologist, NMFS, Santa Cruz, CA
John Field, Fish Biologist, NMFS, Santa Cruz, CA
Joy Featherstone, Krill Biologist, University of California, Santa Cruz, Santa Cruz, CA
Brian Wells, Post-Doc, NMFS, Santa Cruz, CA
Lisa Wertz, Moss Landing Marine Lab - CSU, Moss Landing, CA
David Ainley, Ornithologist, H. T. Harvey & Associates
Ian Gaffney, Ornithologist, H. T. Harvey & Associates

Leg 4 (June 9 - June 18)

Ken Baltz, Oceanographer, NMFS, Santa Cruz, CA (Cruise Leader)
Keith Sakuma, Fish Biologist, NMFS, Santa Cruz, CA (Chief Scientist)
Edward Dick, Fish Biologist, NMFS, Santa Cruz, CA
Heidi Fish, Fish Biologist, NMFS, Santa Cruz, CA
Jason Mulsow, Krill Biologist, University of California, Santa Cruz, Santa Cruz, CA
Ashok Sadrozinski, Humboldt State University, Arcata, CA
Brian Wells, Post-Doc, NMFS, Santa Cruz, CA
Scot Lucas, Marine Biologist, CDF&G, Monterey, CA

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

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° 45.8'	50	25	461
CTD	39° 08'	123° 45.8'	50	40	461

DAY: CTD - DELGADA SOUTH

<i>OPS</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Depth(m)</i>	<i>Wire Out(m)</i>	<i>Station</i>
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