Ecosystem-based Monitoring and Research in Support of the Marine Life Protection Act and Marine Life Management Act – Remotely Operated Vehicle Deepwater Benthic Fish and Habitat Statewide Sampling

FINAL REPORT

Coastal Impact Assistance Program Grant # F12AF00444

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INTRODUCTION

Deep-water ocean habitats contain a diversity of species that are important commercially and recreationally. While these areas have been fished for decades, little is known about these habitats and their associated communities compared to shallower areas. The growing use of underwater visual survey tools including remotely operated vehicles (ROVs) aims to close this knowledge gap and provide valuable data that informs species and ecosystem management.

The California Department of Fish and Wildlife (CDFW) began developing ROV-based deep-water assessments in 1997 after obtaining a ROV with funds from California Sea Grant and CDFW. Since then, CDFW has formed partnerships focused on expanding its ROV survey capabilities collecting data for both marine protected area (MPA) assessment and fisheries management. Surveys completed under this grant were led and supervised by staff from the CDFW's Statewide Marine Protect Areas Management Project. Additional funding to complete the statewide surveys was provided in the form of staff time and an additional allocation of $325,000 to contracted technical services from MARE.

CDFW and Marine Applied Research & Exploration (MARE)

For this study, CDFW contracted with Marine Applied Research & Exploration, with whom there exists a long-standing scope of collaboration. MARE is a 501(c)(3) nonprofit organization that develops and operates cost-effective and innovative deep-water robotic technology and data analysis expertise to inform ocean management. Under the guidance of CDFW lead scientist, MARE executed the at-sea ROV studies with equipment they own and operate. Additionally they performed data management, taxonomic scoring of imagery and reported result summaries. This report is based on data summaries and findings as reported to CDFW.

Report Purpose

This report summarizes the methods employed and data collected during a three-year study (January 2014 – December 2016) that completed a statewide survey using a ROV. The resulting data products collected fulfill the terms of the CIAP grant and have been incorporated into CDFW's archive of ROV survey databases and imagery library. The data will also be incorporated into a central web based data repository being developed as part of a comprehensive information management system for MPAs by the California Natural Resources Agency. Through this portal, the CIAP ROV data will be searchable and accessible along with many other MPA monitoring datasets. In-depth analyses are underway for various MPA and fishery management information needs and will be used in additional reports and publications by CDFW and it's partners.

Project Goals

1. **MPA Assessment**: Obtain information necessary to evaluate the effectiveness of MPAs in helping to rebuild stock abundances and increase biodiversity.
2. **Fisheries Management**: Obtain crucial data needed for natural resource protection and the development of adaptive ecosystem-based management.
3. **Project Infrastructure**: Build out and support CDFW's core ROV program providing operational and equipment costs needed to sustain a statewide sampling.

Project Objectives

1. Conduct baseline surveys within MPA regions.
2. Collect archival video and photo records and associated data from completed ROV surveys.
3. Create a geo-referenced database of ROV transects and observations from completed ROV surveys.
4. Provide quantitative information necessary to evaluate the condition of nearshore marine life and current fisheries management.

Milestones and Deliverables

	Milestones and Deliverables as Listed in the Approved Project Narrative
See footnote	~~**Task I:** Service and upgrade CDFWs ROV and related survey equipment.~~
See footnote	~~**Task I:** Install necessary equipment on CDFW research vessel Garibaldi.~~
See footnote	~~**Task I:** Retrofit CDFW electronics control van for use on ROV support vessels.~~
X	**Task I:** Establish subcontracts/subgrants for the above and at-sea survey support.
X	**Task II:** North Central California Coast region ROV surveys.
X	**Task II:** Southern California Coast region ROV surveys.
X	**Task II:** Northern California Coast region ROV surveys.
X*	**Task II:** Central California Coast region ROV surveys.
X	**Task II:** Archived underwater video and photographs from completed ROV surveys.
X	**Task II:** Georeferenced database of ROV transects and observations from completed ROV surveys.
X	**Task II:** Final report of all ROV surveys performed.

***An amendment to the CIAP grant was requested and approved to redirect funds allocated to Task 1 to augment Task 2 surveys. A second contract was solicited via RFP in May 2016 for surveys performed in the fall of 2016 on the central coast of California between Monterey Bay and Point Conception. MARE won the award and conducted surveys in the fall of 2016.**

METHODS

Site and Survey Line Selection

Survey sites were selected in the south, central, north central, and north coast MPA regions of California, as defined during the MLPA Initiative (California Department of Fish and Wildlife 2008). We collected baseline data on rocky habitats from sites within select MPAs and associated reference areas outside the MPAs. Within each MPA region, sites were chosen to survey as many MPAs as possible and also to visit MPAs that had not been surveyed by the baseline MPA monitoring program in each region. Sites were also chosen in as many prominent rocky reef areas as possible including many rocky reefs that have never before been surveyed using visual methods. Individual maps of sites from each survey cruise can be found in the appendix.

Survey lines within sites were selected based on the available rocky habitat and distributed across the entire depth range of a rocky reef where possible. The number of survey lines planned at each site was determined by the estimated cover of rocky habitat. Areas with high degrees of rock cover were allocated approximately 4-6, 500 meter transect lines while areas with sparse or patchy rock cover were allocated 7-10 transect lines to adequately capture sufficient rocky habitat for analysis. The final locations of the survey lines were chosen by selecting the desired number of planned lines and then using a systematic random approach, distributing them evenly across the site starting at a randomly selected starting point. They were then placed across the width of the site parallel to the prevailing isobaths.

Data Collection Methods

ROV System and Configuration

ROV Underwater Maneuvering

*T*he ROV used in this study was a Deep Ocean Engineering Vector M4, named *ROV Beagle*, owned and operated by MARE. The ROV was equipped with a three-axis autopilot including a rate gyro-damped compass and altimeter. Together, these allowed the pilot to maintain a constant heading (± 1 degree) and constant altitude (± 0.3 meter) above the seafloor with minimal pilot corrections. In addition, a forward thruster speed "cruise" control was used to help the pilot maintain a consistent forward velocity between 0.25 and 0.5 m/sec.

Up-close of ROV components. Photo credit: MARE

ROV Positioning and Transect Swath Measurement

An ORE Offshore Trackpoint III® ultra-short baseline acoustic positioning system with ORE Offshore Motion Reference Unit (MRU) pitch and roll sensor was used to reference the ROV position relative to the ship's Wide Area Augmentation System Global Positioning System (WAAS GPS). The ship's heading was determined using a KVH magnetic compass. The Trackpoint III®

positioning system calculated the geographic position of the ROV relative to the ship at approximately two-second intervals. The ship-relative position was corrected to real world position and recorded in meters as X and Y coordinates using the World Geodetic System (WGS 1984) Universal Transverse Mercator (UTM) coordinate system using HYPACK® 6.2 hydrographic survey and navigation software. Measurements of ROV heading, depth, altitude, water temperature, camera tilt and ranging sonar distance both forward and downward to the substrate, were averaged over a one-second period and recorded along with the position data.

Two Tritech® 500 kHz ranging sonars, which measure distance across a range of 0.1–10 meters using a 6° conical transducer, were used as the primary method for measuring transect width for both the forward and downward facing video. The ranging sonars were fixed below and parallel to the camera between two forward-facing red lasers spaced 100 millimeters apart. Each transducer was pointed at the center of view in each camera and was used to calculate the distance to middle of screen, which was subsequently converted to width using the known optical viewing angle of each cameras field of view. Readings from these sonars were averaged five times per second and recorded into the sensor data file at a one-second interval. Measurements of transect width using a ranging sonar are accurate to ± 0.1 m (Karpov et al. 2006). Transect width is combined with distance traveled by the ROV to calculate area swept by the video cameras thereby providing transect swath for determining density and area covered of observations.

ROV Imagery Capture Configuration

The ROV was equipped with four standard resolution (640 by 480) color cameras: two locally recorded stereo cameras for highly accurate measurements of size and two primary data collection cameras; one facing forward approximately 30° below the horizon and the other pointing directly downwards. The two-camera system provided a continuous, slightly overlapping view from above the horizon to directly below the ROV. Video for both cameras was captured on SONY® DSR 45 digital video tape recorders and Pioneer DVR510 digital video disc recorders. In addition to capturing biological and habitat observations, the forward video was overlaid with an on screen display of text characters representing real time sensor data (time, depth, temperature, range, altitude, forward camera angle and heading). The ROV was also equipped with a high definition (HD) video and 5.6 mega pixel digital still camera. The HD and still cameras were mounted forward facing and were locally recorded on a hard drive housed in the ROV. At the end of each survey day, this imagery was downloaded and saved to a portable hard drive.

ROV Imagery and Data Timestamping

A continuous time feed was necessary to relate all data and imagery collected during ROV dives. Time was extracted once per second from the ships GPS data stream and was used to provide a basis for relating ROV position, sensor data and video observations (Veisze and Karpov 2002). A Horita® GPS3 and WG-50 were used to generate on screen overlay display of GPS time, as well as output Society of Motion Picture and Television Engineers (SMPTE) linear timecode (LTC) for capture on video recorder audio tracks synchronized to each video frame at an interval of 1/30th of a second. This stored SMPTE timecode can then be accessed from the audio track during subsequent video scoring of any observation. This method was improved by customizing HYPACK® navigational software to link all data collected in the field to the GPS time. ROV tracked position and sensor data were recorded directly by HYPACK® as a time-linked text file. A redundant one-second timecode file of sensor data was also collected in the field using a custom built on-screen display and operating system software with timecode extracted from the navigation computer system's internal clock which was synchronized to GPS time.

ROV Data Management

All data collected by the ROV, along with subsequent observations extracted during post-processing of the video, was linked in a Microsoft Access® database using GPS time. Database management software, developed by MARE, was used to expand all data records to one second of Greenwich Mean Time (GMT) time. During video post-processing, a Horita® Time Code Wedge (model number TCW50) was used in conjunction with a customized computer keyboard to extract and record SMPTE timecode stored on the video audio track, to one second resolution, of observations into a customized Microsoft Access® database entry form.

Support Platform and ROV Sampling Operations

During Cruise A, B, and D, ROV operations were conducted off the F/V Donna Kathleen, a 19 meter fishing vessel owned and operated by Tim Maricich. During Cruise C and E, ROV operations were conducted off the R/V Miss Linda, a 23 meter research vessel owned and operated by Captain Robert Pedro. Surveys were conducted between the hours of 08:00 and 17:00 PST to avoid the low light conditions of dawn and dusk that might affect finfish abundance, measurements and underwater visibility.

The ROV was flown off the F/V Donna Kathleen's starboard side and the R/V Miss Linda's port side using a "live boat" technique that employed a 317.5 kg (700 lb) clump weight. Using this method, all but 45 meters of the ROV umbilical was isolated from current-induced drag by coupling it with the clump weight cable and suspending the clump weight several meters off the seafloor. The 45 meter tether allowed the ROV pilot sufficient maneuverability to maintain a constant speed (0.5 to 0.75 meters per second) and a straight course down the planned survey line. In addition, the ROV pilot and ship's helm used real-time video displays of the location of the ship and the ROV, relative to the planned survey line, to navigate along the 500 meter line. The ship's captain used the displays to follow and maintain the position of the ship within 35 m of the ROV.

At each site, the ROV was flown as close as possible along the pre-planned survey lines. In most cases, the ROV pilot maintained forward direction within ± 10 meters of the planned line. The ROV pilot used the ranging sonar readings to sustain a consistent transect width by maintaining the distance from the camera to the substrate (at the screen horizontal mid-point) between 1.5 and 3 meters.

Post-Processing Methods

ROV Positional Data

Acoustic tracking systems generate numerous erroneous positional fixes due to underwater acoustic noise and vessel movement. For this reason positional data was post-processed to remove outliers and averaged to better approximate the actual path of the ROV. Positional information was filtered for outliers and smoothed using a 21 position running mean (Karpov et al. 2006). Planar length of positions tracked was calculated for each second and combined with width to calculate area surveyed per second. These one second lengths were then added together to determine area swept for a given length of transect. Various lengths of transects were able to be utilized depending on the objective of summarization or analysis of observations.

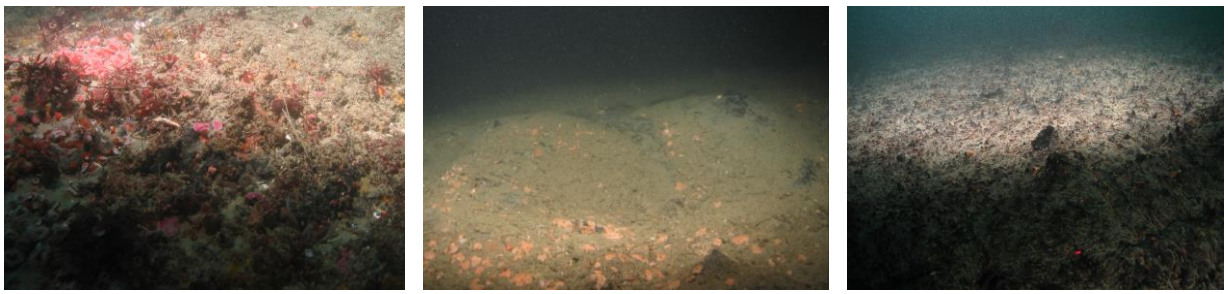
Gaps in the positional data that occurred due to deviations from quantitative protocols, such as pulls (ROV pulled back by ship induced tension on the umbilical), stops (ROV stops to let the ship catch up) or loss of

target altitude caused by traveling over the back side of high relief structures (visual loss of 4 meter target distance for more than 6 seconds which typically occurs on the downward slope of high relief habitat) were removed from the data to be used to generate quantitative transects along each survey line. The remaining usable portions of each survey line were then divided into two different transect types; fish density transects and invertebrate density transects. Details on each transect type are described later in the post-processing methods.

Substrate and Habitat

A protocol to characterize substrate observed in video along survey lines was developed to be compatible to a hierarchical classification system developed by Green et al. (1999). The video record was reviewed and substrate types were classified independently as rock, boulder, cobble, gravel, sand or mud. Rock was defined as any igneous, metamorphic or sedimentary substrate; boulder as rounded rock material that is between 0.25 and 3.0 meter in diameter and clearly detached from the base substrate; cobble as broken or rounded rock material that is between 6 and 25 centimeter in diameter and clearly detached; gravel as any granular material with a diameter between 0.5 and 6 centimeter; sand as any granular material less than 0.5 cetimeter (may include organic debris such as shell or bone, gravel or pebble); and mud as fine material whose granularity is not discernible via the ROV imagery.

In addition to the basic substrate categories used throughout all sites, three new categories of asphalt- tar and granular material, were added to help describe the unique, natural petroleum seep habitats found near Point Conception during Cruise A. Old asphalt was defined as any tar material that appeared to be fully mixed with other granular materials to the point where very little black tar was visible. Fresh asphalt was defined as tar that had granular material mixed in, but had much of the black tar coloration. Active asphalt was defined as tar that appeared to be actively spreading or rising from the sea floor.



Old Asphalt, Fresh Asphalt, Active Asphalt

To determine substrate percent cover during review of the video, a transparency film overlay with diminishing perspective guidelines approximating a parallel swath was placed over the video monitor screen. Each of the substrate types are identified by the processor independently and were recorded as discrete segments of the transect by noting where it was present with a beginning and ending timecode. Thus, the segments of substrate types may overlap each other along the survey line, creating areas of mixed substrate combinations (e.g. rock/sand, sand/cobble) along the transect. A substrate segment was considered continuous until a break of two meters or greater occurred along the survey line or the substrate dropped below 20% of the total combined substrates for a distance of at least three meters.

After the review process, the substrates were combined to create three independent habitat types: **hard** (rock and/or boulder), **mixed** (rock and/or boulder with any combination of cobble, gravel, sand and/or mud), or **soft** (any combination of cobble, gravel, sand, and/or mud).

Finfish Transect Selection

Fish density transects used the entire horizontal field of the forward camera's mid-screen and were calculated using a two-step approach. First, the usable portions of each survey line were divided into 25 m² segments (subunits). Each subunit's total percent hard and/or mixed habitat was then calculated and those with percentages below 50% hard or mixed were removed. Next, the remaining subunits were concatenated into 100 m² transects (four sequential usable 25 m² subunits) for use in density calculations. One spacer subunit was discarded between each transect to minimize bias of contiguous transects (spatial autocorrelation). Using this method of post-stratification generates hard substrate transects without the loss of rock/sand interface habitat which may be important to some species. All subunits and final transects were created using a labeling scheme that preserves the original data, thus future data analysis can stratify using other parameters or transect sizes.

Finfish Enumeration

We classified finfish to the lowest taxonomic level possible through video post-processing. Finfish that could not be classified to the species level were grouped into a complex of species, or recorded as unidentified. All finfish species and groupings were selected for classification after a preliminary review of video prior to the formal enumeration processing. Several fish species were enumerated as a complex only due to visual characteristics and sizes that are difficult to discern from video (e.g. olive rockfish/*Sebastes serranoides* and yellowtail rockfish/*Sebastes flavidus* were grouped together into the "olive/yellowtail rockfish complex").

A screen overlay representing a diminishing perspective was used during fish review to approximate the three dimensional transect extending away from viewing screen. The overlay served as a guide for determining if a fish was in or out of the ROV transect. Finfish enumeration was limited to a maximum distance of four meters. Using the sonar range value depicted on the screen as a gauge, the processor determined if a fish was within four meters as it entered the viewing area. Fish that entered the viewing area were only counted if more than half the fish crossed the overlay guidelines.

In order to accurately correlate the location of the fish with habitat, timecode entry was made when the fish crossed the mid-screen line. For finfish that were within four meters, but swam away before they crossed the mid-screen line, timecode entry was made when the location where the finfish had been observed reached the mid-screen point. All data entries were recorded in a Microsoft Access® database linked with the time.

Fish size (total length) was estimated by the video observer with the use of two parallel lasers placed 10 cm apart aimed to hit the seafloor in the center of the video viewing screen of the forward facing camera. Fish sizes were estimated to the nearest cm and when possible tagged for future stereo sizing. Criteria for stereo sizing included fish orientation (almost perpendicular) and distance (within 2 meters) to the cameras.

Invertebrate Transect Selection

Invertebrate transects used only the field of view at the bottom of the viewing monitor, which was calculated using paired lasers as 45% of the mid screen width. Each transect was calculated by dividing the usable portions of each survey line into 30 m^2 transects. The total percent hard and/or mixed habitat was then calculated. No transects were removed from the summaries based on habitat criteria.

Invertebrate Enumeration & Patch Coverage

We classified macro-invertebrates to the lowest taxonomic level possible during video post-processing. All invertebrate species and groupings were based on review of video prior to enumeration. All identifications to species level were based on visual attributes and should be considered the best possible identification based on appearance only.

Only macro-invertebrates with body forms and colors that were uniformly identifiable on video were selected to be enumerated (Gotshall 2005). Invertebrate species that form large colonial mats or cover large areas, were not enumerated as individuals, but rather identified as patches with discrete start and stop points along the transect and given a coverage codes to quantify the total coverage within the viewing area of the patch. Patches were coded for percent cover using four groupings: 1) less than 25% cover, 2) between 25% and 50% cover, 3) between 50% and 75% cover, and 4) greater than 75% cover. Six species groupings were quantified using these methods: unidentified brachiopod species, mat-forming brittle star species, club-tipped anemone (*Corynactus californica*), market squid eggs, unidentified zoanthid species, and feather stars (class Crinoidea).

A screen overlay was also used during invertebrate review to approximate the transect width, calculated by the ranging sonar, at the bottom of the screen. The diminishing perspective overlay lines served as a guide for determining if an invertebrate was in or out of the ROV transect. The overlay used for invertebrate enumeration was the same as the overlay used in habitat classification, allowing for direct correlation of habitat to each invertebrate observation. In order to accurately correlate the location of the invertebrate with the habitat, timecode entry was made when the invertebrate crossed the bottom of the screen line. All data entries were recorded in a Microsoft Access® database linked with the timecode. Invertebrates that entered the viewing area were only counted if more than half the animal crossed the overlay guidelines at the bottom of the screen.

RESULTS

Cruise Summaries

Data was gathered from ROV surveys conducted during five separate research cruises between 2014 and 2016. A total of 138 sites and 361 kilometer in the south, central, north central, and north coast MPA regions of California were surveyed. Surveyed sites were located on soft and hard bottom habitats at depths ranging between 9 to 440 meters. The majority of survey effort occurred between 20 and 100 meters depth. Summaries totals can be seen for each cruise in table 1 while detailed accounts of each cruise can be found in each cruise summary found in the appendix.

	Cruise Time Period	Total Number of survey sites	Total no. of survey lines completed	Total Km surveyed	Min Depth Range (m)	Avg. Depth Range (m)	Max Depth Range (m)
Cruise A (south coast)	1/13/2014 thru 1/23/2014	20	99	52	15	56	113
Cruise B (south coast)	6/11/2014 thru 6/25/2014	32	155	76	18	64	295
Cruise C (north coast)	9/14/2014 thru 10/10/2014	28	115	60	14	52	113
Cruise D (north central)	8/23/2015 thru 9/12/2015	25	146	76	9	40	102
Cruise E (central coast)	9/16/2016 thru 10/14/2016	33	183	97	12	82	440
	Totals:	**138**	**698**	**361**	**min: 9**	**avg: 60**	**max: 440**

Table 1. Survey totals and depth ranges for ROV research cruises.

Tolo Bank, Cruise D.

Substrate & Habitat Summaries

Video review for substrate revealed a common range of substrate types for each cruise. The classification system used (see Methods section) during post processing allowed for the description of every observed substrate except for natural petroleum seeps (asphalt) witnessed during Cruise A at the sites near Point Conception. Though survey site selection focused on sites identified with "rocky habitat", the degree of substrate presence varied by region. Surveys conducted in the south coast region (Cruise A & B) had especially low proportions of rock substrate while surveys conducted in the central, north central, and north coast regions all displayed substantially higher rock substrate frequency.

Average habitat composition of each cruise is presented in Figure 1. General habitat structure was calculated directly from substrate observations thus results similar to substrate totals are observed between regions. Low observations of rock and/or boulders in the south coast (Cruise A & B) equated to low overall averages of hard and/or mixed habitat while higher averages of rock and/or boulder in the central, north central, and north coast regions equated to higher averages of hard and/or mixed habitat.

	Substate Average (%)				
	Rock	Boulder	Cobble	Sand	Mud
Cruise A (South Coast)	17	2	6	36	49
Cruise B (South Coast)	33	4	9	39	48
Cruise C (North Coast)	66	3	7	21	29
Cruise D (North Central)	76	3	5	10	30
Cruise E (Central)	67	3	8	27	26
Averages:	**52**	**3**	**7**	**27**	**36**

Table 2. Substrate averages by cruise. Averages for each substrate component by cruise are based on the ratio of the survey line that has a given substrate compared to the total line and are not relative percentages to other categories (i.e. segments of substrate types may overlap each other along the survey line, creating areas of mixed substrate combinations (e.g. rock/sand, sand/cobble) along the transect.

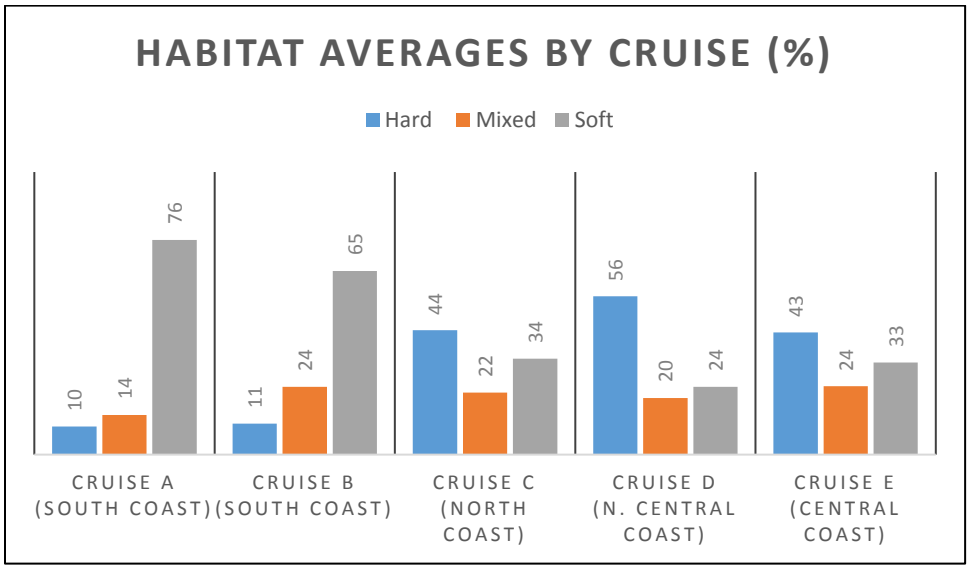


Figure 1 Percent habitat type (hard, mixed, and soft) by cruise

The unique natural petroleum seeps (old, active, and fresh asphalt) observed during Cruise A (Point Conception sites) were considered separately during habitat calculations. Of the total asphalt observed, old asphalt was the most commonly identified, representing 94% of the total observed asphalt and appeared to contain a high amount of hard granular rock and shell materials (based on high definition still photos). During habitat calculations (hard, mixed, soft), old asphalt was considered a hard substrate, as many sessile invertebrates and algal species commonly found on hard substrates were observed on it. Active and fresh asphalt were not included as hard substrate in habitat calculations. Further details on asphalt observations can be found in the Cruise A tables in the appendix.

Total Species Summaries

The number of transects available for post-processing varied by site and were dependent on the number of survey lines planned and the amount of available rocky habitat at each site. A total of 2,910 post-stratified fish transects (100 m^2) and 16,890 invertebrate transects (30 m^2) were generated from the 698 survey lines sampled. Post-processing of these transects revealed 797,343 fish from over 101 taxa and 694,609 invertebrates from over 108 taxa. Total counts for fish and invertebrates from each cruise, including averages per km are displayed in Table 3 & 4, respectively.

Collectively, Cruise B sites had the highest counts of finfish and invertebrates, contributing 51% and 52% respectively to the totals counted from all sites combined. During Cruise B, one site from one study area (SBK2, South Bank, Santa Monica Bay) accounted for 13% of the total fish observations across all cruises with 107,522 fish counted. Cruise A had the lowest fish counts overall, contributing 2% to the total fish counts, while Cruise D had the lowest number of invertebrates accounting for 11% of the total invertebrates. See the appendix for fish and invertebrate count totals by individual cruise and sites.

	Total no. of survey lines completed	No. of Transect cts 100m (Fish)	Fish counted	No. of Fish Taxa (Approx.)	Fish per km	% of total fish
Cruise A (south coast)	99	141	18,812	41	300	2
Cruise B (south coast)	155	384	403,459	51	4,768	51
Cruise C (north coast)	115	552	34,203	39	472	4
Cruise D (north central)	146	810	20,717	42	270	3
Cruise E (central coast)	183	1,023	320,152	44	1,749	40
Totals:	**698**	**2,910**	**797,343**	**101***		

Table 3. Summaries from each cruise for number of fish transects, total fish count, number of observed taxa. *Total number of taxa is a calculation of each taxon observed from all cruises.

	Total no. of survey lines completed	No. of Transect cts 30m (inverts)	Inverts counted	No. of Invert (Approx.)	Inverts per km	% of total inverts
Cruise A (south coast)	99	1,818	93,737	48	1,513	13
Cruise B (south coast)	155	3,302	357,999	59	4,480	52
Cruise C (north coast)	115	2,188	81,532	62	1,427	12
Cruise D (north central)	146	5,236	73,105	53	859	11
Cruise E (central coast)	183	4,346	88,236	71	482	13
Totals:	**698**	**16,890**	**694,609**	**108***		

Table 4.Summaries from each cruise for number of invertebrate transects, total invertebrate count, number of observed taxa. *Total number of taxa is a calculation of each taxon observed from all cruises.

Farallon Islands, Cruise D.

DERIVED PRODUCTS AND FUTURE ANALYSIS

While results from this study focus on basic data summaries and are presented without detailed analysis, a number of products have already been and/or are being derived from this work and include the following:

CDFW Blog

A number of videos and photographs collected during ROV surveys are highlighted in a series of articles found in "Exploring California's MPAs" which is part of the CDFW Marine Management News blog.

Remotely Operated Vehicle Provides a Deep Water Window into California's MPAs
Point St. George Reef Offshore State Marine Conservation Area
Southeast Farallon State Marine Reserve
Sea Lion Gulch State Marine Reserve
Point Conception State Marine Reserve
Año Nuevo State Marine Reserve
Portuguese Ledge State Marine Conservation Area

Public Outreach Materials

Photos and videos have been shared with partner agencies and organizations for use in their public outreach efforts.

Scientific Collecting Permit Analysis

Data from CIAP ROV surveys has been utilized to inform CDFW's decision process for approving extractive scientific collection permits of marine species in and around MPAs.

Central and Northern California Ocean Observing System (CeNCOOS) Map Interface

The usability and impact of the data collected during these surveys will be magnified with a web based interactive map interface being developed in collaboration with the CeNCOOS and Axiom Data Science and funded by the California Ocean Protection Council. The initial pilot project will link locations of the CIAP ROV transects with video and still photos in an interactive web interface.

Postdoctoral Fellowship

In February of 2017 CDFW entered into collaboration with University of California Davis's California Marine Science Institute (CMSI) to hire three postdoctoral fellows who are working closely with CDFW and CMSI mentors to address MPA management questions. One of these fellows was assigned to develop analytical techniques to further the usefulness of the CIAP ROV surveys. Dr. Nicholas Perkins from the University of Tasmania was hired for this position and is working on spatial modeling techniques and biogeographic analyses of the CIAP data set. This 18-month fellowship will help CDFW and Ocean Protection Council (OPC) create a rigorous deepwater monitoring program for California's MPA network.

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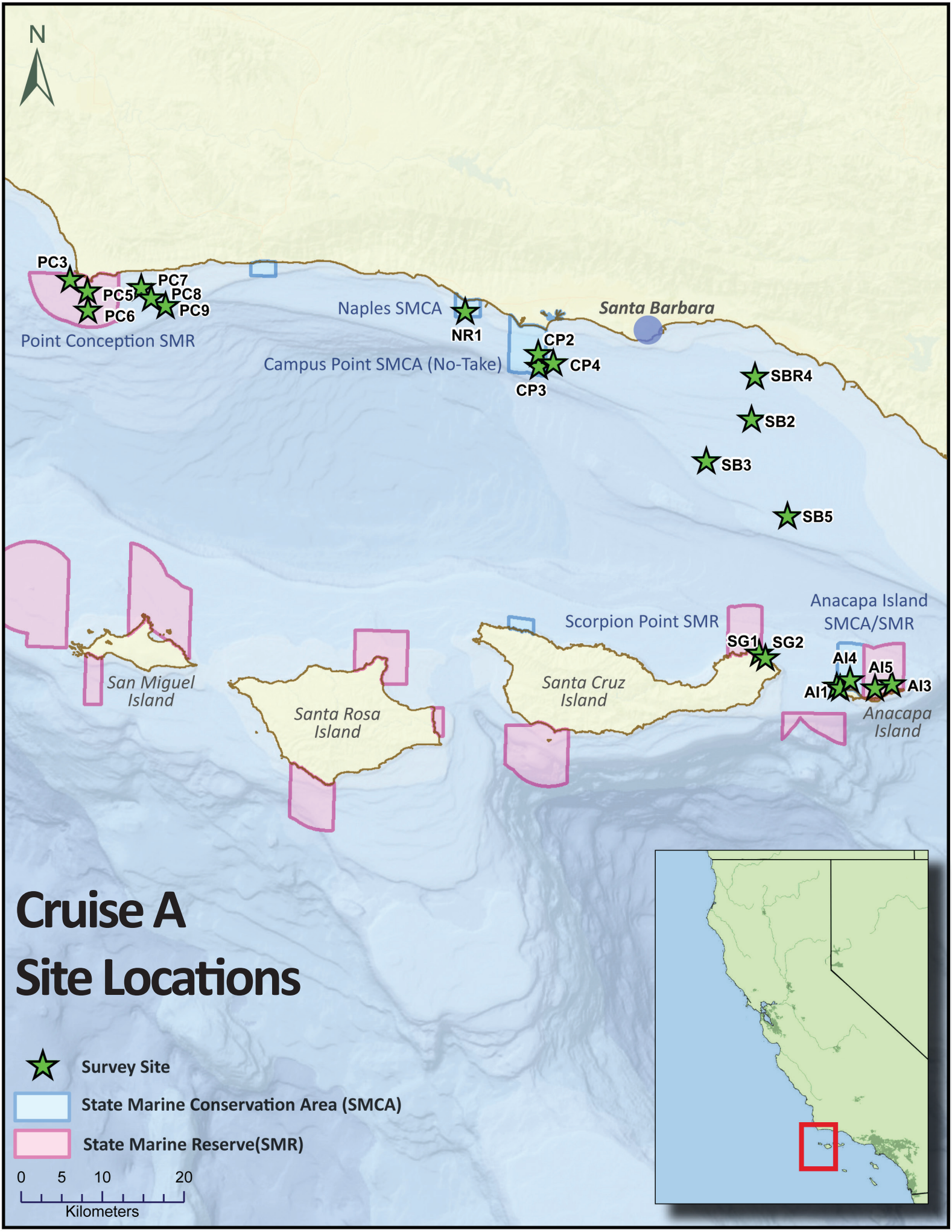

N
PC3
PC7
PC5
PC8
PC9
PC6
Point Conception SMR
Naples SMCA
NR1
Santa Barbara
CP2
Campus Point SMCA (No-Take)
CP4
CP3
SBR4
SB2
SB3
SB5
Anacapa Island
SMCA/SMR
Scorpion Point SMR
SG1
SG2
AI4
AI5
AI1
AI3
San Miguel
Island
Santa Rosa
Island
Santa Cruz
Island
Anacapa
Island
Cruise A
Site Locations
Survey Site
State Marine Conservation Area (SMCA)
State Marine Reserve(SMR)
0 5 10 20
Kilometers

Cruise A: Cruise Summary

Study Area	Site	No. of Survey Lines	Total km	Hard and/or Mixed Habitat		No. of Transects 100m2 (Fish)	No. of Transects 30 m2 (Invert)	Min Depth (m)	Max Depth (m)
				Km	Area (ha)				
Anacapa Island									
	AI1	8	4.3	1.8	0.39	19	157	14.7	54.6
	AI3	7	3.6	1.6	0.40	22	161	24.2	73.4
	AI4	6	3.1	0.2	0.04	2	113	65.2	82.1
	AI5	10	5.3	1.1	0.23	13	225	15.3	79.6
Campus Point & Naples Reef									
	CP2	6	3.0	0.1	0.01	0	90	60.4	67.0
	CP3	6	3.0	0.1	0.02	0	97	75.3	85.1
	CP4	7	3.1	0.2	0.03	0	112	67.3	80.3
	NR1	4	2.0	0.0	0.00	0	54	19.7	43.4
Point Conception									
	PC3	4	2.0	0.8	0.13	9	71	22.1	43.8
	PC5	4	2.0	1.1	0.22	15	77	32.4	66.8
	PC6	4	2.0	0.3	0.05	3	76	82.8	90.5
	PC7	5	2.5	2.5	0.37	28	84	19.0	35.7
	PC8	5	2.5	0.6	0.11	7	96	24.2	55.5
	PC9	2	0.7	0.4	0.08	5	27	37.8	56.2
Santa Barbara									
	SB2	4	2.0	0.0	0.00	0	54	67.8	72.7
	SB3	4	2.0	0.0	0.00	0	72	107.9	113.4
	SB5	4	2.1	0.0	0.00	0	63	93.9	98.2
	SBR4	6	3.2	1.9	0.28	18	92	30.7	37.5
Scorpion Point									
	SG1	1	1.3	0.1	0.01	0	42	17.5	63.7
	SG2	2	1.8	0.0	0.00	0	55	15.3	44.7
Totals:		**99**	**51.5**	**12.7**	**2.37**	**141**	**1,818**	**min: 14.7**	**max: 113.4**

Cruise A: Substrate & Habitat Summary
(Including Asphalt Summary)

Study Area	Site	Percent by substrate					Percent by habitat		
		Rock	Boulder	Cobble	Sand	Mud	Hard	Mix	Soft
Anacapa Island									
	AI1	35	1	3	75	0	19	19	61
	AI3	43	1	5	77	0	21	23	56
	AI4	6	0	0	0	98	1	5	93
	AI5	21	0	4	22	64	12	9	79
Campus Point & Naples Reef									
	CP2	1	0	10	0	98	0	1	98
	CP3	3	0	3	0	98	1	2	96
	CP4	3	0	2	0	97	0	4	95
	NR1	0	0	0	100	0	0	0	100
Point Conception									
	PC3	2	0	0	88	0	0	42	58
	PC5	0	0	0	41	45	0	54	46
	PC6	13	1	3	0	98	2	12	86
	PC7	96	0	27	2	0	66	34	0
	PC8	23	0	32	40	40	0	23	76
	PC9	55	1	16	50	0	39	17	43
Santa Barbara									
	SB2	0	0	0	0	99	0	0	99
	SB3	0	0	0	0	100	0	0	100
	SB5	0	0	0	0	100	0	0	100
	SBR4	42	35	14	26	33	29	30	41
Scorpion Point									
	SG1	3	1	0	100	0	0	4	95
	SG2	0	0	1	100	0	0	0	100
Averages:		17	2	6	36	49	10	14	76

Study Area	Site	Percent asphalt by category		
		Active	Fresh	Old Asphalt
Point Conception				
	PC3	0	2	39
	PC5	0.3	4	51
	PC6	0	0	0
	PC7	0.2	0	5
	PC8	0	0	0
	PC9	0	0	0
Average:		**0.1**	**1**	**16**

Cruise A: Fish & Invertebrate Summary

Study Area	Site	Total km	Total Fish	Total Inverts		Fish per km	Inverts per km
Anacapa Island							
	AI1	4.3	2,184	3,295		508	766
	AI3	3.6	3,018	23,864		837	6,616
	AI4	3.1	2,675	18,610		874	6,080
	AI5	5.3	6,417	16,274		1,200	3,044
Campus Point and Naples Reef							
	CP2	3.0	221	2,141		74	712
	CP3	3.0	528	590		175	196
	CP4	3.1	1,319	525		419	167
	NR1	2.0	65	7,165		33	3,615
Point Conception							
	PC3	2.0	28	242		14	122
	PC5	2.0	159	443		80	222
	PC6	2.0	238	623		119	311
	PC7	2.5	154	1,572		63	642
	PC8	2.5	601	14,318		238	5,682
	PC9	0.7	862	516		1,204	721
Santa Barbara							
	SB2	2.0	40	33		20	16
	SB3	2.0	76	286		38	143
	SB5	2.1	100	941		49	457
	SBR4	3.2	138	2,149		43	677
Scorpion Point							
	SG1	1.3	15	65		11	50
	SG2	1.8	13	46		7	26
	Totals:	51.5	18,851	93,698	**Average:**	300	1,513

Cruise A: Fish Counts

Common Name	Scientific Name	Total Count	Coarse Size (cm)			Depth Range (m)		
			Avg	Max	Min	Avg	Max	Min
unidentified small rockfish	*Sebastes sp.*	6,853	10	18	8	66	80	15
halfbanded rockfish	*Sebastes semicinctus*	3,893	11	20	8	26	59	15
blacksmith	*Chromis punctipinnis*	3,253	20	25	13	73	111	29
unidentified fish	Pisces	1,278	18	60	6	58	113	16
unidentified flatfish	*Pleuronectiformes* order	1,083	16	39	10	72	111	26
vermilion rockfish	*Sebastes miniatus*	364	31	45	12	57	88	28
blue rockfish	*Sebastes mystinus*	204	20	35	10	46	85	15
lingcod	*Ophiodon elongatus*	173	35	62	19	49	88	16
unidentified rockfish	*Sebastes sp.*	172	21	40	10	55	87	22
combfish complex	*Zaniolepis frenata/latipinnis*	167	15	25	10	77	113	26
lingcod/CA lizardfish complex	*O. elongatus* or *S. lucioceps*	167	24	50	13	63	112	21
pink surfperch	*Zalembius rosaceus*	134	13	19	10	74	109	36
California sheephead	*Semicossyphus pulcher*	123	41	65	12	29	59	15
calico rockfish	*Sebastes dalli*	120	12	22	10	58	85	30
copper rockfish	*Sebastes caurinus*	113	31	50	15	60	89	26
unidentified surfperch	*Embiotocidae* family	87	14	25	10	63	97	16
Sebastomus rockfish complex	*Sebastomus* Subgenus	84	21	39	11	66	96	45
eelpout complex	*Zoarcidae* family	75	17	25	12	92	113	43
pile perch	*Rhacochilus vacca*	64	23	30	12	46	83	21
painted greenling	*Oxylebius pictus*	50	15	24	10	45	86	15
kelp rockfish	*Sebastes atrovirens*	45	29	40	20	35	87	16
yellowtail/olive complex	*Sebastes flavidus/serranoides*	43	33	45	23	60	87	33
ocean whitefish	*Caulolatilus princeps*	25	54	70	30	27	46	21
yellowtail	*Seriola lalandi*	25	120	120	120	32	32	32
California lizardfish	*Synodus lucioceps*	24	25	35	15	66	110	26
senorita	*Oxyjulis californica*	23	21	25	15	40	57	17
gopher rockfish	*Sebastes carnatus*	22	27	35	20	43	52	15
bocaccio	*Sebastes paucispinis*	21	37	48	28	66	87	44
flag rockfish	*Sebastes rubrivinctus*	20	21	35	14	70	85	49
kelp bass	*Paralabrax clathratus*	17	24	35	18	18	22	16
kelp greenling	*Hexagrammos decagrammus*	15	28	35	20	60	88	30
copper/gopher complex	*Sebastes caurinus/carnatus*	10	31	35	25	49	68	44
opaleye	*Girella nigricans*	10	30	35	25	22	44	16
YOY (young of year) rockfish	*Sebastes sp.*	8	15	15	15	63	63	63
treefish	*Sebastes serriceps*	7	30	35	25	47	59	32
brown rockfish	*Sebastes auriculatus*	5	29	31	25	53	66	35
California scorpionfish	*Scorpaena guttata*	5	25	30	22	68	83	57
swell shark	*Cephaloscyllium ventriosum*	4	27	28	25	70	70	70
wolf eel	*Anarrhichthys ocellatus*	4	19	20	18	71	83	47
California halibut	*Paralichthys californicus*	3	65	70	60	44	71	30
redbanded rockfish	*Sebastes babcocki*	3	16	20	14	83	83	83

Common Name	Scientific Name	Total Count	Coarse Size (cm)			Depth Range (m)		
			Avg	Max	Min	Avg	Max	Min
unidentified sculpin	*Cottidae* family	3	50	75	36	61	84	45
bat ray	*Myliobatis californica*	2	85	90	80	77	81	73
canary/vermillion complex	*Sebastes pinniger/miniatus*	2	35	35	34	42	51	34
barred sand bass	*Paralabrax nebulifer*	1	65	65	65	34	34	34
big skate	*Raja binoculata*	1	46	46	46	46	46	46
cabezon	*Scorpaenichthys marmoratus*	1	35	35	35	25	25	25
giant sea bass	*Stereolepis gigas*	1	250	250	250	45	45	45
halfmoon	*Medialuna californiensis*	1	33	33	33	28	28	28
horn shark	*Heterodontus francisci*	1	55	55	55	27	27	27
rock greenling	*Hexagrammos lagocephalus*	1	38	38	38	26	26	26
round ray complex		1	30	30	30	77	77	77
unidentified skate	*Rajidae* family	1	20	20	20	71	71	71
	Total:	**18,812**						

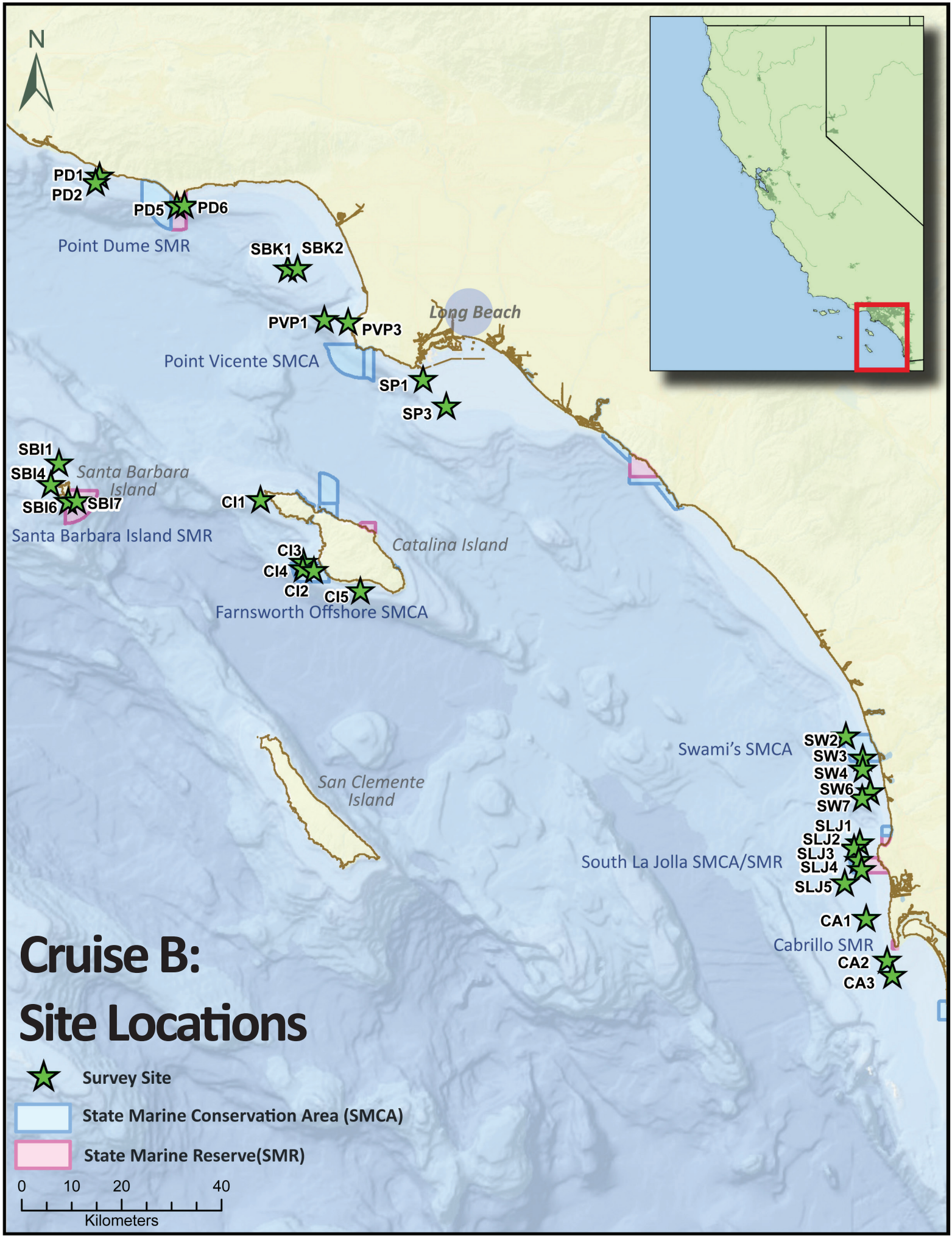
Cruise A: Fish Counts

Cruise A: Invertebrate Counts

Common Name	Scientific Name (to closest Taxon)	Total Count	Avg	Max	Min
white urchin	*Lytechinus anamesus*	51,204	82	113	35
sea whip	*Halipteris californica*	26,328	68	113	20
bat star	*Asterina miniata*	4,446	37	88	15
purple gorgonian	*Eugorgia rubens*	2,014	69	113	16
california sea cucumber	*Parastichopus californicus*	2,006	44	97	15
red gorgonian	*Lophogorgia chilensis*	989	38	88	15
red sea star	*Mediaster aequalis*	746	52	86	19
orange puffball sponge	*Tethya aurantia*	681	39	87	15
orange gorgonian	*Adelogorgia phyllosclera*	539	74	80	50
unidentified nipple sponge	----------	523	54	88	29
whelk complex	*Kelletia spp.*	381	46	110	16
white-plumed anemone	*Metridium farcimen*	335	83	113	21
warty sea cucumber	*Parastichopus parvimensis*	333	25	65	15
sand star	*Luidia foliolata*	312	86	113	20
unidentified zoanthid	----------	302	43	77	15
white sea pen	*Stylatula elongata*	295	70	113	20
sand-rose anemone	*Urticina columbiana*	257	44	110	21
crowned urchin	*Centrostephanus coronatus*	250	24	44	15
leather star	*Dermasterias imbricata*	248	27	58	19
california spiny lobster	*Panulirus interruptus*	245	29	77	16
Cancer complex	*Cancer sp.*	119	49	95	18
orange sea pen	*Ptilosarcus gurneyi*	111	48	97	27
sea pen complex	*Virgularia spp.*	105	65	83	37
unidentified lobed sponge or tunicate	----------	90	42	86	31
unrecognized sea star	----------	90	34	95	19
marshmallow sponge	----------	87	63	79	36
red octopus	*Octopus rubescens*	84	77	110	22
unidentified gorgonian	----------	70	33	78	15
unidentified tube dwelling anemone	----------	53	43	109	15
Henricia complex	*Henricia sp.*	47	48	87	30
unidentified octopus	----------	43	66	97	22
unidentified sand prawn	----------	42	109	113	72
Market squid	*Loligo opalescens*	39	15	18	10
Pleurobranchaea complex	*Pleurobranchaea sp.*	37	67	113	20
unidentified anemone	----------	36	54	111	20
giant spined star	*Pisaster giganteus*	34	25	47	15
feather star	*Florometra serratissima*	31	67	95	33
red sea urchin	*Strongylocentrotus franciscanus*	21	21	35	15
fish-eating anemone	*Urticina piscivora*	19	23	35	16
sheep crab	*Loxorhynchus grandis*	14	47	74	16
unidentified branched sponge or tunicate	----------	14	59	84	35
unidentified vase sponge/tunicate	----------	13	63	84	28
gray puffball sponge	*Craniella arb*	12	42	78	20
unidentified invertebrate	----------	12	31	63	26
giant keyhole limpet	*Megathura crenulata*	9	18	30	16
cushion star	*Pteraster tesselatus*	8	53	86	22
unidentified boot sponge	----------	8	67	75	60
california golden gorgonian	*Muricea californica*	7	18	22	15

Common Name	Scientific Name (to closest Taxon)	Total Count	Avg	Max	Min
long-legged sunflower star	*Rathbunaster californicus*	7	95	96	94
purple sea urchin	*Strongylocentrotus purpuratus*	5	15	15	15
unidentified brittle star	----------	5	71	71	71
unidentified jelly	----------	5	27	34	17
white-spotted rose anemone	*Urticina lofotensis*	5	21	22	20
cookie star	*Ceramaster patagonicus*	4	50	52	49
short spined sea star	*Pisaster brevispinus*	4	24	34	20
fish-eating star	*Stylasterias forreri*	3	90	95	80
rainbow star	*Orthasterias koehleri*	3	39	55	27
stalked tunicate	*Styela montereyensis*	3	20	20	20
boot sponge	*Rhabdocalyptus dawsoni*	1	60	60	60
brown gorgonian	*Muricea fruticosa*	1	29	29	29
giant Pacific octopus	*Enteroctopus dofleini*	1	34	34	34
southern kelp crab	*Taliepus nuttallii*	1	22	22	22
		Total: 93,737			

Cruise A: Invertebrate Counts


N
PD1
PD2
PD5
PD6
Point Dume SMR
SBK1
SBK2
PVP1
PVP3
Point Vicente SMCA
Long Beach
SP1
SP3
SBI1
SBI4
SBI6
SBI7
Santa Barbara Island
Santa Barbara Island SMR
CI1
CI3
CI4
CI2
CI5
Catalina Island
Farnsworth Offshore SMCA
San Clemente Island
SW2
SW3
SW4
SW6
SW7
Swami's SMCA
SLJ1
SLJ2
SLJ3
SLJ4
SLJ5
South La Jolla SMCA/SMR
CA1
Cabrillo SMR
CA2
CA3
Cruise B:
Site Locations
Survey Site
State Marine Conservation Area (SMCA)
State Marine Reserve(SMR)
0
10
20
40
Kilometers

Cruise B: Cruise Summary

Study Area	Site	No. of Survey Lines	Total km	Hard and/or Mixed Habitat		No. of Transects 100m^2 (Fish)	No. of Transects 100m^2 (Invert)	Min Depth (m)	Max Depth (m)
				Km	Area (ha)				
San Diego									
	CA1	4	2.0	0.7	0.14	12	86	65.4	71.7
	CA2	3	1.5	0.7	0.15	11	64	29.2	46.4
	CA3	4	1.9	1.1	0.23	19	87	32.5	46.1
	SLJ1	6	3.0	1.4	0.24	19	115	47	72.3
	SLJ2	4	2.0	0.6	0.13	7	85	59.4	88.6
	SLJ3	5	2.5	0.5	0.11	8	102	40.3	74.2
	SLJ4	5	2.2	0.7	0.14	10	86	28.9	63.1
	SLJ5	4	2.0	0.9	0.15	12	74	77.8	88.5
	SW2	5	2.5	0.8	0.14	10	97	83.9	112.9
	SW3	6	3.0	0.3	0.05	2	128	49.6	75.8
	SW4	5	2.5	0.6	0.13	8	115	58.7	140.1
	SW6	5	2.0	0.6	0.16	9	95	43.6	61
	SW7	5	2.5	0.6	0.14	7	109	86.8	104
Catalina Island									
	CI1	5	2.6	1.1	0.26	15	102	55.1	95.9
	CI2	6	3.6	1.1	0.28	8	148	26.2	94.6
	CI3	6	3.1	1.1	0.28	14	125	26.1	94.7
	CI4	4	2.1	0.5	0.11	6	100	61.8	73.5
	CI5	4	2.0	0.2	0.04	3	93	55.4	86
Santa Barbara Island									
	SBI1	5	2.5	1.9	0.46	30	114	80.9	103.4
	SBI4	5	2.3	1.0	0.22	14	101	41.5	87.6
	SBI6	4	2.0	0.6	0.15	9	87	39.2	86.2
	SBI7	5	2.5	1.1	0.34	15	106	58.8	86.8
San Pedro									
	SP1	5	2.5	1.4	0.32	23	113	24.3	32.5
	SP3	5	2.4	0.5	0.11	8	120	32.2	37.6
South Bank									
	SBK1	5	2.4	0.9	0.25	16	117	53.7	72.3
	SBK2	7	3.5	1.6	0.33	22	164	53.9	67.2
Palos Verdes									
	PVP1	5	2.5	1.5	0.32	23	116	68.5	84.5
	PVP3	5	2.3	1.8	0.44	35	122	17.5	41.7
Point Dume									
	PD1	3	1.2	0.3	0.05	4	54	19	29.9
	PD2	6	3.0	0.3	0.05	4	124	39.2	64
	PD5	5	2.3	0.6	0.09	1	76	19.8	294.7
	PD6	4	1.9	0.0	0.00	0	77	24.1	46.8
	Totals:	**155**	**76.3**	**27.2**	**6.03**	**384**	**3,302**	**min: 19**	**max: 294.7**

Cruise B: Substrate & Habitat Summary

Study Area	Site	Percent by Substrate					Percent by Habitat		
		Rock	Boulder	Cobble	Sand	Mud	Hard	Mix	Soft
San Diego									
	CA1	34	6	22	0	98	2	35	63
	CA2	44	6	10	86	0	13	31	56
	CA3	45	25	32	83	0	10	49	42
	SLJ1	46	5	5	24	77	7	40	53
	SLJ2	29	0	1	4	80	16	14	71
	SLJ3	20	2	6	12	86	5	17	79
	SLJ4	32	4	6	16	72	13	20	67
	SLJ5	45	8	10	0	87	8	38	55
	SW2	24	11	25	1	90	2	28	70
	SW3	8	3	5	0	98	1	8	90
	SW4	24	1	0	0	100	0	24	76
	SW6	31	2	0	23	73	4	27	69
	SW7	22	3	13	0	89	6	18	76
Catalina Island									
	CI1	43	5	0	73	1	26	18	56
	CI2	30	1	0	26	63	13	17	70
	CI3	35	2	10	54	29	17	19	64
	CI4	23	0	3	0	93	6	16	77
	CI5	10	0	0	0	97	3	7	90
Santa Barbara Island									
	SBI1	62	26	54	43	0	29	47	24
	SBI4	44	0	1	73	0	27	17	56
	SBI6	29	0	0	83	0	17	12	71
	SBI7	39	5	13	85	0	15	28	57
San Pedro									
	SP1	57	1	11	87	0	13	44	43
	SP3	21	0	11	89	0	9	12	79
South Bank									
	SBK1	37	5	6	74	7	15	24	61
	SBK2	41	5	6	68	8	18	27	55
Palos Verdes									
	PVP1	60	5	11	1	80	16	44	40
	PVP3	81	0	0	72	0	28	52	19
Point Dume									
	PD1	23	0	2	85	0	15	9	77
	PD2	9	0	2	0	93	5	4	90
	PD5	24	0	0	70	25	7	17	76
	PD6	0	0	0	0	100	0	0	100
	Averages:	**33**	**4**	**8**	**39**	**48**	**11**	**24**	**65**

Cruise B: Fish & Invertebrate Summary

Study Area	Site	Total km	Total No. of Fish	Total No. of Inverts		No. Fish per km	No. Inverts per km
San Diego							
	CA1	2.0	1,126	5,783		573	2,943
	CA2	1.5	4,652	737		3,090	490
	CA3	1.9	5,020	5,724		2,622	2,989
	SLJ1	3.0	17,396	17,823		5,727	5,867
	SLJ2	2.0	11,738	14,337		5,746	7,018
	SLJ3	2.5	2,316	11,544		917	4,571
	SLJ4	2.2	2,845	10,090		1,279	4,535
	SLJ5	2.0	994	6,280		490	3,098
	SW2	2.5	7,799	44,256		3,090	17,535
	SW3	3.0	14,177	4,377		4,762	1,470
	SW4	2.5	1,872	5,539		748	2,214
	SW6	2.0	9,883	13,499		4,962	6,778
	SW7	2.5	7,975	29,572		3,142	11,651
Catalina Island							
	CI1	2.6	19,821	21,275		7,682	8,245
	CI2	3.6	22,991	21,148		6,366	5,856
	CI3	3.1	19,195	18,301		6,244	5,953
	CI4	2.1	8,009	3,592		3,896	1,747
	CI5	2.0	16,856	2,769		8,430	1,385
Santa Barbara Island							
	SBI1	2.5	16,609	5,629		6,561	2,224
	SBI4	2.3	5,470	4,010		2,428	1,780
	SBI6	2.0	16,698	4,194		8,304	2,086
	SBI7	2.5	10,228	1,389		4,098	556
San Pedro							
	SP1	2.5	3,875	23,816		1,550	9,527
	SP3	2.4	9,968	19,216		4,123	7,948
South Bank							
	SBK1	2.4	7,398	20,399		3,088	8,515
	SBK2	3.5	107,522	7,731		30,760	2,212
Palos Verdes							
	PVP1	2.5	11,606	18,479		4,611	7,342
	PVP3	2.3	34,006	1,316		15,062	583
Point Dume							
	PD1	1.2	701	1,378		573	1,127
	PD2	3.0	4,153	10,142		1,395	3,406
	PD5	2.3	429	2,550		191	1,133
	PD6	1.9	133	1,102		69	574
	Totals:	**76.3**	**403,461**	**357,997**	**Average**	**4,768**	**4,480**

Cruise B: Fish Counts

Common Name	Scientific Name	Total Count	Coarse Size (cm)			Depth Range (m)		
			Avg	Max	Min	Avg	Max	Min
YOY (young of year) rockfish	*Sebastes sp.*	180,540	6	200	3	67	101	24
halfbanded rockfish	*Sebastes semicinctus*	147,533	10	35	2	73	180	27
unidentified small rockfish	*Sebastes sp.*	30,536	12	220	5	67	102	28
shortbelly rockfish	*Sebastes jordani*	14,346	90	2,000	7	52	84	29
California scorpionfish	*Scorpaena guttata*	9,037	20	30	12	68	89	28
squarespot rockfish	*Sebastes hopkinsi*	3,628	15	30	10	73	95	41
unidentified fish	unidentified fish	2,391	13	60	5	66	266	19
blacksmith	*Chromis punctipinnis*	2,145	16	25	10	34	87	19
squarespot/widow complex	*Sebastes hopkinsi/entomelas*	1,529	15	30	10	68	97	41
lingcod/ca lizardfish complex	*O. elongatus* or *S. lucioceps*	1,337	12	42	2	61	244	21
speckled rockfish	*Sebastes ovalis*	1,247	19	35	10	78	91	59
Sebastomus rockfish complex	*Sebastomus* Subgenus	1,227	15	35	4	77	292	33
unidentified rockfish	*Sebastes sp.*	940	16	50	7	70	288	20
California lizardfish	*Synodus lucioceps*	791	11	30	8	58	97	23
blue rockfish	*Sebastes mystinus*	722	19	35	10	48	83	20
vermilion rockfish	*Sebastes miniatus*	589	26	55	8	58	98	25
unidentified flatfish	unidentified flatfish	562	14	40	4	74	286	21
pink surfperch	*Zalembius rosaceus*	529	11	15	8	69	103	22
combfish complex	*Zaniolepis* spp.	489	11	19	10	76	203	26
widow rockfish	*Sebastes entomelas*	482	14	25	7	72	98	35
senorita	*Oxyjulis californica*	470	16	70	5	39	66	20
unidentified surfperch	*Embiotocidae* family	458	13	30	6	56	96	20
slender snipefish	*Macrorhamphosus gracilis*	400	10	10	10	78	78	78
calico rockfish	*Sebastes dalli*	226	12	20	8	47	98	24
bocaccio	*Sebastes paucispinis*	215	37	60	10	78	96	34
lingcod	*Ophiodon elongatus*	201	41	75	10	67	96	26
California sheephead	*Semicossyphus pulcher*	160	32	65	8	54	93	20
flag rockfish	*Sebastes rubrivinctus*	144	17	30	8	77	102	41
yellowtail/olive complex	*Sebastes flavidus/serranoides*	113	30	50	1	55	97	21
pygmy rockfish	*Sebastes wilsoni*	90	10	12	10	78	81	74
copper rockfish	*Sebastes caurinus*	71	29	45	13	63	97	23
painted greenling	*Oxylebius pictus*	49	12	16	10	43	81	26
stripedfin ronquil	*Rathbunella hypoplecta*	35	12	20	10	67	92	41
pile perch	*Rhacochilus vacca*	32	20	35	10	52	82	28
eelpout complex	*Zoarcidae* family	25	11	16	5	79	140	41
greenstriped rockfish	*Sebastes elongatus*	20	16	22	10	99	170	73
greenspotted rockfish	*Sebastes chlorostictus*	17	22	32	13	88	98	79
unidentified scorpionfish	*Scorpaenidae* family	17	28	35	18	50	73	39
treefish	*Sebastes serriceps*	17	21	30	10	57	89	33
cowcod	*Sebastes levis*	12	32	50	20	82	96	27
unidentified sculpin	*Cottidae* family	9	11	12	10	70	71	69
wolf eel	*Anarrhichthys ocellatus*	9	81	120	40	65	90	37
copper/gopher complex	*Sebastes caurinus/carnatus*	8	20	27	14	57	70	32
gopher rockfish	*Sebastes carnatus*	7	21	30	14	52	83	20
threadfin bass	*Pronotogrammus multifasciatus*	7	19	20	15	70	75	69
ocean whitefish	*Caulolatilus princeps*	6	42	60	25	55	72	34
spotted ratfish	*Hydrolagus colliei*	6	43	65	20	79	91	64
kelp greenling	*Hexagrammos decagrammus*	4	25	35	20	51	57	48
Pacific angel shark	*Squatina californica*	4	55	73	42	70	93	44

Common Name	Scientific Name	Total Count	Coarse Size (cm)			Depth Range (m)		
			Avg	Max	Min	Avg	Max	Min
California halibut	*Paralichthys californicus*	3	53	65	35	38	58	20
canary rockfish	*Sebastes pinniger*	3	30	40	10	92	97	89
kelp bass	*Paralabrax clathratus*	3	30	30	30	30	30	30
barred sand bass	*Paralabrax nebulifer*	2	33	33	32	48	54	42
brown rockfish	*Sebastes auriculatus*	2	13	15	10	38	51	24
kelp rockfish	*Sebastes atrovirens*	2	24	25	23	42	42	41
unidentified skate	*Rajidae* family	2	29	33	25	79	84	74
unidentified poacher	*Agonidae* family	2	12	12	12	189	192	187
yellowtail rockfish	*Sebastes flavidus*	2	20	22	18	164	235	93
black surfperch	*Embiotoca jacksoni*	1	30	30	30	32	32	32
Pacific electric ray	*Torpedo californica*	1	55	55	55	41	41	41
rubberlip surfperch	*Rhacochilus toxotes*	1	25	25	25	43	43	43
starry rockfish	*Sebastes constellatus*	1	25	25	25	82	82	82
starry skate	*Raja stellulata*	1	20	20	20	46	46	46
swell shark	*Cephaloscyllium ventriosum*	1	45	45	45	69	69	69
	Total:	**403,459**						

Cruise B: Fish Counts

Cruise B: Invertebrate Counts

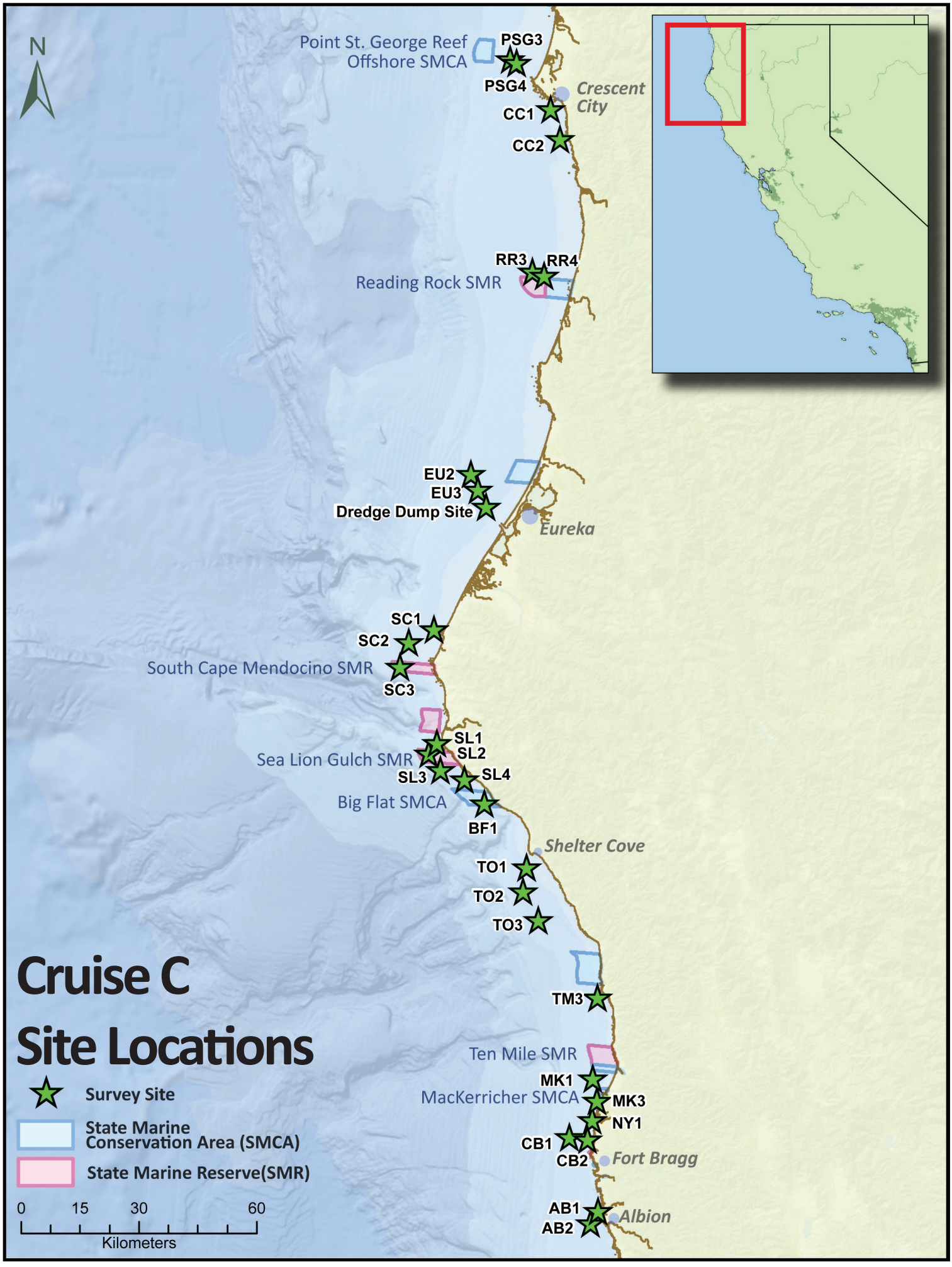
CommonName	Scientific Name (to closest Taxon)	Total Count	Avg	Max	Min
white urchin	*Lytechinus anamesus*	277,725	71	113	26
orange gorgonian	*Adelogorgia phyllosclera*	38,684	69	106	19
purple gorgonian	*Eugorgia rubens*	7,951	66	102	20
red gorgonian	*Lophogorgia chilensis*	4,533	51	99	19
california sea cucumber	*Parastichopus californicus*	3,259	71	271	27
spiny sand star	*Astropecten armatus*	2,783	30	97	20
unidentified boot sponge	----------	2,442	84	106	28
sea whip	*Halipteris californica*	2,278	67	110	21
bat star	*Asterina miniata*	2,225	46	93	20
unidentified vase sponge	----------	2,064	87	101	35
unidentified brachiopod	----------	1,983	97	280	81
white branched sea cucumber	*Cucumaria piperata*	1,463	81	157	64
red sea star	*Mediaster aequalis*	1,417	63	157	19
white sea pen	*Stylatula elongata*	1,276	54	139	20
feather star/sea lily (crinoid) complex	*Crinoidea* class	771	97	269	38
henricia complex	Henricia sp.	750	64	103	25
unidentified zoanthid	----------	721	74	93	23
unidentified gorgonian	----------	601	59	96	19
unidentified hard or soft coral	----------	564	86	99	28
unidentified branched sponge	----------	538	64	93	27
sea pen complex	*Virgularia spp.*	507	68	95	28
unidentified lobed sponge or tunicate	----------	445	74	99	27
orange puffball sponge	*Tethya aurantia*	375	47	99	19
unidentified large tubeworm	----------	348	84	102	39
cookie star	*Ceramaster patagonicus*	327	78	168	41
whelk complex	*Kelletia spp.*	280	55	100	23
squat lobster	*Munida quadrispina*	208	254	295	158
unidentified yellow gorgonian	----------	168	66	88	28
sand star	*Luidia foliolata*	142	78	171	30
unidentified brittle or basket star	----------	121	72	80	57
gray puffball sponge	*Craniella arb*	105	54	90	32
crowned urchin	*Centrostephanus coronatus*	91	36	79	25
unidentified nipple sponge	----------	76	51	89	26
red sea urchin	*Strongylocentrotus franciscanus*	69	35	40	30
sand-rose anemone	*Urticina columbiana*	66	47	89	27
rainbow star	*Orthasterias koehleri*	64	78	92	41
brown gorgonian	*Muricea fruticosa*	62	75	87	28
orange sea pen	*Ptilosarcus gurneyi*	53	77	96	25
tiny six armed sea star complex	*Leptasterias sp.*	47	78	84	60
leather star	*Dermasterias imbricata*	46	46	79	26
california golden gorgonian	*Muricea californica*	44	74	86	27
C*ancer* complex	*Cancer sp.*	42	29	59	20
unidentified sea star	----------	40	56	93	27

Cruise B: Invertebrate Counts

CommonName	Scientific Name (to closest Taxon)	Total Count	Avg	Max	Min
warty sea cucumber	*Parastichopus parvimensis*	36	43	62	26
diamondback tritonia	*Tritonia festiva*	25	39	79	24
siphonophore	*Dromalia alexandri*	23	244	290	37
red octopus	*Octopus rubescens*	21	54	93	26
fish-eating anemone	*Urticina piscivora*	13	36	47	34
spot prawn	*Pandalus platyceros*	12	169	207	86
unidentified large yellow sponge	----------	11	89	90	85
unidentified branched bryozoan	----------	10	64	69	59
long-legged sunflower star	*Rathbunaster californicus*	8	88	98	83
unidentified tube dwelling anemone	----------	8	80	92	56
rock scallop	*Crassedoma giganteum*	7	43	46	37
unidentified octopus	----------	7	77	123	51
slipper sea cucumber	*Psolus chitonoides*	6	69	109	57
california hydrocoral	*Stylaster californicus*	5	42	44	40
mantis shrimp	*Hemisquilla ensigera*	4	62	65	60
short spined sea star	*Pisaster brevispinus*	4	41	82	23
sunflower star	*Pycnopodia helianthoides*	4	76	87	62
crested sea star	*Lophaster furcilliger*	3	116	169	67
giant spined star	*Pisaster giganteus*	3	35	42	28
spiny red star	*Hippasteria spinosa*	3	204	290	144
spiny sea star	*Poraniopsis inflata*	3	171	238	52
california king crab	*Paralithodes californiensis*	2	252	275	229
california sea hare	*Aplysia californica*	2	24	24	24
dirty marshmallow	----------	2	61	61	60
encrusting hydrocoral	*Stylantheca porphyra*	2	61	65	58
fish-eating star	*Stylasterias forreri*	2	180	182	177
giant keyhole limpet	*Megathura crenulata*	2	59	85	34
giant pacific octopus	*Enteroctopus dofleini*	2	87	94	80
market squid	*Loligo opalescens*	2	20	20	20
unidentified branched sea cucumber	----------	2	46	61	31
unidentified nudibranch	----------	2	162	266	58
brown box crab	*Lopholithodes foraminatus*	1	140	140	140
cushion star	*Pteraster tesselatus*	1	72	72	72
frilled anemone	*Metridium senile*	1	95	95	95
sheep crab	*Loxorhynchus grandis*	1	33	33	33
southern staghorn bryozoan	*Diaperoecia californica*	1	39	39	39
unidentified anemone	----------	1	57	57	57
unidentified jelly	----------	1	54	54	54
unidentified lobed or laced bryozoan	----------	1	39	39	39
unrecognized sea star	----------	1	71	71	71
		Total: 357,999			

Cruise B: Invertebrate Patch Coverage

Study Area	Site	Total Area (m2)	Common Name	Total Area w/ Invert (m^2)	% of Total Area w/ Invert	% Cover Code
San Diego						
	CA2	2,987	Brittle Star Complex	1,119.3	0.4	1.0
	SLJ2	3,953	Brittle Star Complex	930.2	0.2	1.0
			Club-tipped anemone	61.4	0.0	1.0
	SLJ3	4,323	Brittle Star Complex	894.2	0.2	1.0
	SLJ4	3,575	Brittle Star Complex	339.7	0.1	1.0
	SLJ5	3,118	Brittle Star Complex	81.1	0.0	1.0
	SW3	5,439	Brittle Star Complex	740.7	0.1	1.0
	SW4	4,854	Brittle Star Complex	705.8	0.1	1.0
	SW6	5,017	Brittle Star Complex	31.8	0.0	1.0
	SW7	4,867	Brittle Star Complex	457.6	0.1	1.0
Catalina Island						
	CI1	5,617	Brittle Star Complex	18.3	0.0	1.0
	CI3	7,491	California hydrocoral	161.1	0.0	1.5
	CI4	5,138	Brittle Star Complex	2,121.7	0.4	1.0
	CI5	4,719	Brittle Star Complex	4,460.6	0.9	1.0
Santa Barbara Island						
	SBI1	6,068	Brittle Star Complex	2,087.4	0.3	1.0
			Crinoidea	2,322.2	0.4	1.6
	SBI7	7,932	Brittle Star Complex	2.7	0.0	1.0
San Pedro						
	SP3	5,132	Brittle Star Complex	116.9	0.0	2.8
South Bank						
	SBK1	5,935	Brittle Star Complex	1,785.9	0.3	1.1
			Club-tipped anemone	26.9	0.0	1.7
	SBK2	7,209	Brittle Star Complex	2,687.7	0.4	1.0
Palos Verdes						
	PVP1	5,281	Brittle Star Complex	3,406.9	0.6	1.0
	PVP3	5,559	Club-tipped anemone	1.6	0.0	1.0
Point Dume						
	PD1	2,302	Brittle Star Complex	390.8	0.2	1.0
			Club-tipped anemone	14.7	0.0	1.0
	PD2	5,344	Brittle Star Complex	1,895.7	0.4	1.0
			Club-tipped anemone	19.8	0.0	2.6


N
Point St. George Reef
Offshore SMCA
PSG3
PSG4
Crescent
City
CC1
CC2
RR3
RR4
Reading Rock SMR
EU2
EU3
Dredge Dump Site
Eureka
SC1
SC2
South Cape Mendocino SMR
SC3
SL1
SL2
Sea Lion Gulch SMR
SL3
SL4
Big Flat SMCA
BF1
Shelter Cove
TO1
TO2
TO3
TM3
Ten Mile SMR
MK1
MacKerricher SMCA
MK3
NY1
CB1
CB2
Fort Bragg
AB1
AB2
Albion
Cruise C
Site Locations
Survey Site
State Marine
Conservation Area (SMCA)
State Marine Reserve(SMR)
0
15
30
60
Kilometers

Cruise C: Cruise Summary

Study Area	Site	No. of Survey Lines	Total Km	Hard and/or Mixed		No. of Transects $100m^2$ (Fish)	No. of Transects $30m^2$ (Invert)	Min Depth (m)	Max Depth (m)
				Km	Area (ha)				
Point St. George									
	PSG3	4	2.0	1.8	0.29	22	75	26.3	37.8
	PSG4	4	2.0	2.0	0.34	25	77	27.9	33.7
Crescent City									
	CC1	1	0.5	0.1	0.01	0	5	29.0	32.7
	CC2	3	1.5	0.7	0.09	5	26	13.7	35.9
Reading Rock									
	RR3	4	2.1	1.0	0.13	9	37	42.0	74.2
	RR4	4	2.1	1.8	0.34	26	79	18.2	45.4
Eureka Dump Site									
	ED1	1	0.7	0.0	0.00	0	24	38.2	40.5
Eureka									
	EU2	2	1.0	0.0	0.00	0	26	94.7	99.9
	EU3	1	1.2	0.0	0.00	0	34	69.5	74.0
South Cape Mendocino									
	SC1	4	2.1	1.1	0.19	13	70	26.2	42.0
	SC2	4	2.0	1.9	0.38	27	83	30.5	40.4
	SC3	6	3.1	2.8	0.53	37	122	42.2	70.8
Sea Lion Gulch									
	SL1	3	1.7	1.5	0.30	20	61	14.1	38.2
	SL2	6	3.2	2.7	0.72	38	130	62.7	93.5
	SL3	4	2.1	0.9	0.17	11	71	55.0	92.4
	SL4	2	1.0	1.0	0.16	12	38	23.9	30.7
Tolo Bank									
	TO1	6	3.0	2.7	0.59	40	132	22.9	43.0
	TO2	6	3.0	2.2	0.51	36	140	41.7	83.1
	TO3	6	3.1	2.2	0.50	36	131	55.9	105.4
Big Flat									
	BF1	3	1.6	0.7	0.10	8	49	42.5	67.7
Ten Mile									
	TM3	6	3.0	2.1	0.47	31	120	17.5	73.8
MacKerricher									
	MK1	6	2.8	1.6	0.35	25	112	59.0	94.7
	MK3	6	3.0	2.4	0.51	31	126	13.7	41.8
Noyo									
	NY1	3	1.7	1.3	0.26	19	64	22.8	53.3
Cablillo									
	CB1	4	2.0	0.8	0.16	11	75	86.2	113.3
	CB2	6	3.1	2.1	0.41	29	112	20.8	76.7
Albion									
	AB1	6	2.8	1.8	0.33	23	95	16.2	66.7
	AB2	4	2.0	1.2	0.22	18	74	76.5	99.6
Totals:		**115**	**59.5**	**40.4**	**8.05**	**552**	**2188**	**min: 16.2**	**max: 113.3**

Cruise C: Substrate & Habitat Summary

Study Area	Site	Percent by Substrate					Percent by Habitat		
		Rock	Boulder	Cobble	Sand	Mud	Hard	Mix	Soft
Point St. George									
	PSG3	89	2	6	14	1	82	7	11
	PSG4	100	5	8	4	2	87	13	0
Crescent City									
	CC1	36	0	0	0	80	20	15	64
	CC2	66	0	0	34	8	58	7	34
Reading Rock									
	RR3	68	0	2	0	61	37	30	32
	RR4	94	8	37	8	0	57	37	6
Eureka Dump Site									
	ED1	0	0	0	100	0	0	0	100
Eureka									
	EU2	0	0	0	0	100	0	0	100
	EU3	0	0	0	0	100	0	0	100
South Cape Mendocino									
	SC1	59	6	4	52	32	20	39	41
	SC2	96	4	12	3	9	78	18	4
	SC3	90	0	0	9	62	34	56	10
Sea Lion Gulch									
	SL1	98	2	0	36	1	63	35	2
	SL2	86	6	4	20	12	65	21	14
	SL3	45	8	2	71	0	27	18	55
	SL4	91	29	84	6	0	16	78	7
Tolo Bank									
	TO1	91	4	9	21	0	71	20	9
	TO2	75	9	9	28	17	49	26	25
	TO3	73	2	1	10	43	47	26	27
Big Flat									
	BF1	44	1	8	36	35	28	17	56
Ten Mile									
	TM3	71	0	1	26	17	57	14	29
MacKerricher									
	MK1	59	1	1	1	56	42	17	41
	MK3	82	0	0	30	0	70	12	18
Noyo									
	NY1	82	0	0	25	4	71	11	18
Cablillo									
	CB1	41	1	1	0	96	4	37	59
	CB2	75	1	2	21	13	64	10	25
Albion									
	AB1	70	1	0	38	2	59	11	30
	AB2	60	0	0	0	70	30	30	40
Average:		**66**	**3**	**7**	**21**	**29**	**44**	**22**	**34**

Cruise C: Fish & Invertebrate Summary

Study Area	Site	Total km	Total No. of Fish	Total No. of Inverts		No. of Fish per km	No. of Inverts per km
Point St. George							
	PSG3	2.0	364	1,274		181	635
	PSG4	2.0	380	1,480		190	738
Crescent City							
	CC1	0.5	146	2,822		285	5,504
	CC2	1.5	250	2,336		164	1,535
Reading Rock							
	RR3	2.1	649	1,841		303	860
	RR4	2.1	220	4,343		107	2,110
Eureka Dump Site							
	ED1	0.7	14	173		20	247
Eureka							
	EU2	1.0	51	161		51	162
	EU3	1.2	83	266		70	223
South Cape Mendocino							
	SC1	2.1	306	3,113		149	1,513
	SC2	2.0	571	4,774		283	2,370
	SC3	3.1	684	4,305		221	1,393
Sea Lion Gulch							
	SL1	1.7	1,387	1,982		807	1,154
	SL2	3.2	2,846	6,360		898	2,006
	SL3	2.1	962	4,134		457	1,962
	SL4	1.0	247	2,574		239	2,493
Tolo Bank							
	TO1	3.0	3,778	4,175		1,241	1,372
	TO2	3.0	3,298	7,442		1,092	2,465
	TO3	3.1	2,326	4,526		744	1,448
Big Flat							
	BF1	1.6	310	2,495		198	1,592
Ten Mile							
	TM3	3.0	2,612	3,596		863	1,188
MacKerricher							
	MK1	2.8	1,728	3,383		622	1,218
	MK3	3.0	1,919	2,770		643	928
Noyo							
	NY1	1.7	816	1,870		480	1,100
Cabrillo							
	CB1	2.0	473	1,371		236	684
	CB2	3.1	6,135	3,182		1,999	1,037
Albion							
	AB1	2.8	1,142	2,541		408	908
	AB2	2.0	506	2,243		250	1,109
	Totals:	**59.5**	**34,203**	**81,532**	**Average:**	**472**	**1,427**

Cruise C: Fish Counts

Common Name	Scientific Name	Total Count	Coarse Size (cm)			Depth Range (m)		
			Avg	Max	Min	Avg	Max	Min
YOY (young of year) rockfish	*Sebastes sp.*	22,486	7	9	5	52	105	16
unidentified rockfish	*Sebastes sp.*	2,261	16	65	10	56	111	16
blue rockfish	*Sebastes mystinus*	2,142	25	60	8	39	92	17
unidentified small, schooling rockfish (10-15 cm)	*Sebastes sp.*	1,464	12	20	9	49	94	20
yellowtail/olive complex	*Sebastes flavidus/serranoides*	1,126	41	61	15	71	105	19
Sebastomus rockfish complex	*Sebastomus Subgenus*	744	23	65	10	71	113	28
canary rockfish	*Sebastes pinniger*	646	29	60	8	54	103	17
lingcod	*Ophiodon elongatus*	595	57	130	20	46	107	18
kelp greenling	*Hexagrammos decagrammus*	566	39	60	20	43	100	17
unidentified flatfish	*Pleuronectiformes* order	474	17	45	5	74	111	30
unidentified fish	*Pisces*	399	20	40	8	50	103	24
black rockfish	*Sebastes melanops*	331	43	62	10	31	87	18
widow rockfish	*Sebastes entomelas*	219	26	43	7	65	90	37
quillback rockfish	*Sebastes maliger*	126	39	53	16	54	96	26
vermilion rockfish	*Sebastes miniatus*	106	49	66	32	49	91	18
yelloweye rockfish	*Sebastes ruberrimus*	76	40	70	12	68	103	29
greenstriped rockfish	*Sebastes elongatus*	63	21	35	13	101	112	88
copper rockfish	*Sebastes caurinus*	49	41	53	30	50	88	26
greenspotted rockfish	*Sebastes chlorostictus*	37	31	42	15	90	105	41
halfbanded rockfish	*Sebastes semicinctus*	37	12	16	7	78	100	48
unidentified schooling pelagic fish	Pisces	35	12	12	12	28	28	28
China rockfish	*Sebastes nebulosus*	31	38	54	29	39	68	25
pygmy rockfish	*Sebastes wilsoni*	29	14	20	11	92	104	69
shortbelly rockfish	*Sebastes jordani*	25	10	10	10	45	45	45
rosy rockfish	*Sebastes rosaceus*	17	27	33	20	69	89	45
spotted ratfish	*Hydrolagus colliei*	16	52	60	40	79	85	55
unidentified surfperch	*Embiotocidae* family	14	15	20	12	64	94	23
cabezon	*Scorpaenichthys marmoratus*	13	57	75	33	28	39	16
longnose skate	*Raja rhina*	10	66	85	42	90	109	62
black/blue complex	*Sebastes melanops/mystinus*	9	17	20	13	31	36	19
squarespot/widow complex	*Sebastes hopkinsi/entomelas*	8	15	19	10	67	80	53
bocaccio	*Sebastes paucispinis*	5	63	65	62	76	83	70
canary/vermillion complex	*Sebastes pinniger/miniatus*	5	48	50	45	70	91	45
painted greenling	*Oxylebius pictus*	5	16	20	14	31	36	18
Pacific hagfish	*Eptatretus stoutii*	4	57	77	45	74	90	65
calico rockfish	*Sebastes dalli*	3	15	17	12	58	73	30
gopher rockfish	*Sebastes carnatus*	3	32	33	30	35	45	23
starry skate	*Raja stellulata*	3	57	65	50	53	72	38
unidentified sculpin	*Cottidae* family	3	16	20	14	70	72	67
wolf eel	*Anarrhichthys ocellatus*	3	132	150	115	42	83	17
big skate	*Raja binoculata*	2	68	70	65	81	81	81
brown rockfish	*Sebastes auriculatus*	2	47	48	46	38	40	36
flag rockfish	*Sebastes rubrivinctus*	2	22	28	15	65	94	35
pink surfperch	*Zalembius rosaceus*	2	18	18	17	97	97	97
bat ray	*Myliobatis californica*	1	38	38	38	71	71	71
ocean sunfish	*Mola mola*	1	55	55	55	50	50	50
pile perch	*Rhacochilus vacca*	1	30	30	30	26	26	26
speckled rockfish	*Sebastes ovalis*	1	35	35	35	80	80	80
starry rockfish	*Sebastes constellatus*	1	37	37	37	79	79	79
striped surfperch	*Embiotoca lateralis*	1	30	30	30	26	26	26
tiger rockfish	*Sebastes nigrocinctus*	1	30	30	30	43	43	43
	Total:	**34,203**						

Cruise C: Invertebrate Counts

Common Name	Scientific Name (to closest Taxon)	Total Count	Avg	Max	Min
white-plumed anemone	*Metridium farcimen*	14,485	54	107	16
california sea cucumber	*Parastichopus californicus*	14,094	56	113	18
short red gorgonian	*Swiftia spauldingi*	7,958	56	101	28
unidentified branched sponge	----------	6,322	70	100	26
red sea urchin	*Strongylocentrotus franciscanus*	5,625	31	92	16
california hydrocoral	*Stylaster californicus*	5,452	49	92	23
red sea star	*Mediaster aequalis*	5,406	67	113	19
unidentified branched bryozoan	----------	2,887	37	65	31
slipper sea cucumber	*Psolus chitonoides*	2,850	44	104	27
dungeness crab	*Cancer magister*	2,719	35	73	30
Henricia complex	*Henricia sp.*	2,047	43	104	19
unidentified lobed sponge or tunicate	----------	1,618	40	81	22
short spined sea star	*Pisaster brevispinus*	1,030	31	65	18
unidentified lobed or laced bryozoan	----------	838	39	88	28
basket star	*Gorgonocephalus eucnemis*	780	71	113	28
red octopus	*Octopus rubescens*	771	83	111	27
orange puffball sponge	*Tethya aurantia*	770	43	84	18
fish-eating anemone	*Urticina piscivora*	648	47	106	17
gray puffball sponge	*Craniella arb*	410	33	65	22
leather star	*Dermasterias imbricata*	395	42	105	19
sand-rose anemone	*Urticina columbiana*	291	64	99	19
unidentified octopus	----------	270	85	104	30
cookie star	*Ceramaster patagonicus*	239	73	96	55
white branched sea cucumber	*Cucumaria piperata*	225	43	70	35
fragile pink urchin	*Strongylocentrotus fragilis*	219	87	113	35
unidentified sea star	----------	205	49	105	21
sea whip	*Halipteris californica*	203	85	100	31
unidentified orange lobed sponge	----------	194	38	77	31
unidentified nipple sponge	----------	181	40	62	22
orange sea pen	*Ptilosarcus gurneyi*	179	41	86	39
trumpet sponge	*Stylissa stipitata*	172	45	76	27
fish-eating star	*Stylasterias forreri*	162	75	109	28
white sea pen	*Stylatula elongata*	156	79	102	62
unidentified jelly	----------	143	62	105	21
thorny/spiny star	*P. inflata* or *H. spinosa*	133	69	103	28
cushion star	*Pteraster tesselatus*	118	45	106	28
unidentified stalked boot sponge	----------	107	57	92	42
unidentified tube dwelling anemone	----------	97	55	86	28
orange sea cucumber	*Cucumaria miniata*	95	33	61	24
stimpson's sun star	*Solaster stimpsoni*	93	32	67	25
rainbow star	*Orthasterias koehleri*	75	46	101	25
frilled anemone	*Metridium senile*	73	48	93	25
unidentified anemone	----------	68	66	104	25
painted anemone	*Urticina crassicornis*	67	52	113	30
red/purple urchin complex	*S. franciscanus/purpuratus*	51	25	27	22
thorny sea star	*Poraniopsis inflata*	46	61	94	24
Dawson's sun star	*Solaster dawsoni*	45	45	103	29
unidentified nudibranch	----------	42	36	65	24
market squid	*Loligo opalescens*	36	65	94	36
unidentified solitary brittle star	----------	32	52	58	50
sand star	*Luidia foliolata*	29	83	102	66
clown nudibranch	*Triopha catalinae*	28	38	52	31

Cruise C: Invertebrate Counts

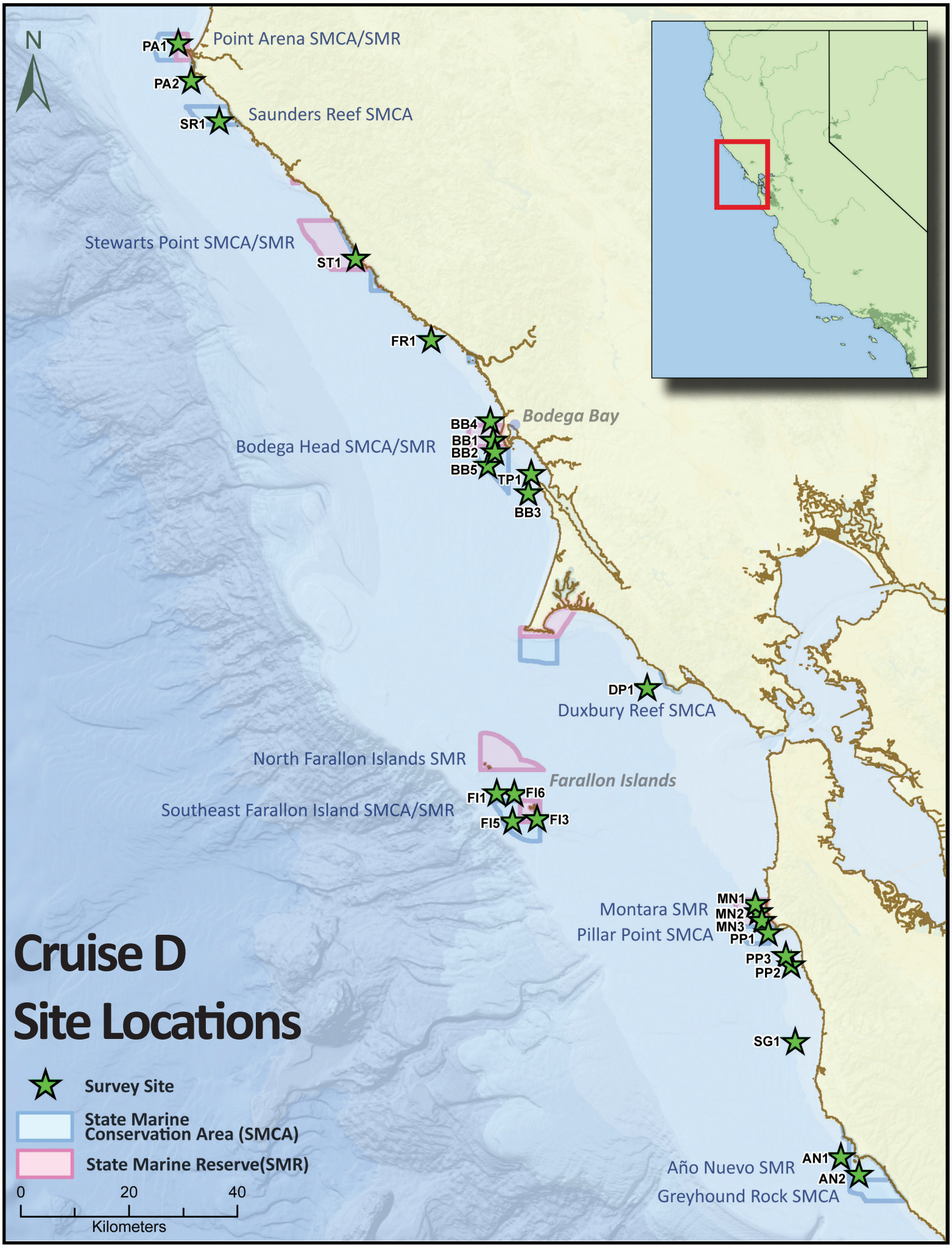
Common Name	Scientific Name (to closest Taxon)	Total Count	Avg	Max	Min
bat star	*Asterina miniata*	24	31	77	24
freckled pale sea lemon	*Peltodoris lentignosa*	23	40	80	29
puget sound king crab	*Lopholithodes mandtii*	23	59	85	29
unidentified tubeworm	----------	20	48	71	30
sea pen complex	*Virgularia spp.*	18	75	91	48
white-spotted rose anemone	*Urticina lofotensis*	17	33	74	24
sunflower star complex	*R. californicus* or *P. helianthoides*	16	80	98	27
rock scallop	*Crassedoma giganteum*	15	30	39	24
unidentified boot sponge	----------	15	71	84	31
giant pacific octopus	*Enteroctopus dofleini*	14	74	104	36
spiny red star	*Hippasteria spinosa*	14	51	90	38
white spine sea cucumber	*Parastichopus leukothele*	13	98	108	68
northern staghorn bryozoan	*Heteropora pacifica*	11	49	66	29
red rock crab	*Cancer productus*	11	52	64	41
unidentified gorgonian	----------	11	41	70	30
stalked tunicate	*Styela montereyensis*	10	29	35	20
Pleurobranchaea californica	*Pleurobranchaea californica*	9	96	105	73
purple sea urchin	*Strongylocentrotus purpuratus*	8	33	40	27
spanish shawl nudibranch	*Flabellina iodinea*	8	32	34	31
vase sponge complex	Vase sponges	8	62	86	46
orange-peel nudibranch	*Tochuina tetraquetra*	7	37	73	22
unidentified salp	----------	6	47	74	30
unidentified sand dwelling anemone	----------	6	71	82	64
whelk complex	*Kelletia spp.*	6	40	71	30
noble sea lemon	*Peltodoris nobilis (Anisodoris nobilis)*	5	32	46	19
sunflower star	*Pycnopodia helianthoides*	4	66	101	33
swimming anemone	*Stomphia didemon*	4	79	94	65
unidentified crab	----------	4	52	64	38
unidentified scallop	----------	4	42	73	19
unrecognized invertebrate	----------	4	50	83	30
long-legged sunflower star	*Rathbunaster californicus*	3	70	76	65
stubby rose anemone	*Urticina coriacea* or *Tealia coriacea*	3	46	47	46
Solaster complex	*Solaster spp.*	2	32	33	32
unidentified large yellow sponge	----------	2	30	30	29
decorator crab	*Loxorhynchus crispatus*	1	62	62	62
giant spined star	*Pisaster giganteus*	1	23	23	23
trumpet sponge complex	*S. stipitata* or similar	1	29	29	29
unidentified branched sea cucumber	----------	1	69	69	69
unidentified white lobed sponge	----------	1	69	69	69
		Total: 81,532			

Cruise C:Invertebrate Patch Coverage

Study Area	Site	Total Area Surveyed (m^2)	Common Name	Total Area w/ Invert (m^2)	% of Total Area w/ Invert	Average % Cover Code
Point St. George						
	PSG3	2,398	unidentified zoanthid	6	0.3	2.0
Crescent City						
	CC2	1,611	club-tipped anemone	19	1.2	1.9
			market squid eggs	2	0.1	1.0
Reading Rock						
	RR3	2,247	club-tipped anemone	93	4.2	1.3
	RR4	2,713	club-tipped anemone	96	3.5	1.6
South Cape Mendocino						
	SC1	2,488	club-tipped anemone	27	1.1	2.2
	SC2	2,801	brittle star complex	1,762	62.9	1.0
	SC3	4,218	brittle star complex	1,891	44.8	1.4
			crinoidea	113	2.7	1.0
Sea Lion Gulch						
	SL1	2,184	club-tipped anemone	387	17.7	1.6
			unidentified zoanthid	116	5.3	1.4
	SL2	5,979	crinoidea	1,274	21.3	1.3
	SL3	2,305	brittle star complex	24	1.1	2.0
			crinoidea	65	2.8	1.1
	SL4	1,165	club-tipped anemone	1	0.1	1.0
Tolo Bank						
	TO2	4,841	brachiopods	1	0.0	1.0
			brittle star complex	260	5.4	1.4
			club-tipped anemone	7	0.1	3.0
			crinoidea	1,014	20.9	1.4
	TO3	4,604	club-tipped anemone	187	4.1	1.5
	TO3		crinoidea	1,926	41.8	1.6
Big Flat						
	BF1	1,533	club-tipped anemone	1	0.1	1.0
			crinoidea	11	0.7	1.0
			market squid eggs	6	0	1.0
Ten Mile						
	TM3	4,532	brittle star complex	80	2	1.5
			crinoidea	25	0.6	1.0

Cruise C: Invertebrate Patch Coverage

Study Area	Site	Total Area Surveyed (m^2)	Common Name	Total Area w/ Invert (m^2)	% of Total Area w/ Invert	Average % Cover Code
MacKerricher						
	MK1	4,026	club-tipped anemone	58	1.4	1.2
			crinoidea	986	24.5	1.8
			market squid eggs	35	0.9	2.3
	MK3	4,603	club-tipped anemone	4	0.1	1.0
Noyo						
	NY1	2,595	club-tipped anemone	4	0.1	1.0
			unidentified zoanthid	15	0.6	1.9
Cabrillo						
	CB1	2,472	crinoidea	1,664	67.3	1.9
	CB2	4,203	brittle star complex	152	3.6	2.6
			club-tipped anemone	69	1.6	1.7
			crinoidea	13	0.3	1.1
			unidentified zoanthid	28	0.7	2.7
Albion						
	AB1	3,665	brittle star complex	75	2.0	1.8
			club-tipped anemone	93	2.5	1.6
			unidentified zoanthid	95	2.6	3.2
	AB2	2,409	club-tipped anemone	35	1.5	1.9
			crinoidea	629	26.1	1.5


N
PA1
Point Arena SMCA/SMR
PA2
SR1
Saunders Reef SMCA
Stewarts Point SMCA/SMR
ST1
FR1
Bodega Bay
BB4
BB1
BB2
BB5
Bodega Head SMCA/SMR
TP1
BB3
DP1
Duxbury Reef SMCA
North Farallon Islands SMR
Farallon Islands
FI1
FI6
Southeast Farallon Island SMCA/SMR
FI5
FI3
MN1
MN2
MN3
Montara SMR
Pillar Point SMCA
PP1
PP3
PP2
SG1
AN1
AN2
Año Nuevo SMR
Greyhound Rock SMCA
Cruise D
Site Locations
Survey Site
State Marine Conservation Area (SMCA)
State Marine Reserve(SMR)
0
20
40
Kilometers

Cruise D: Cruise Summary

Study Area	Site	No. of Survey Lines	Total Km	Hard and/or Mixed Habitat		No. of Transects 100m^2 (Fish)	No. of Transects 30m^2 (Invert)	Min Depth (m)	Max Depth (m)
				Km	Area (ha)				
Point Arena									
	PA1	8	4.2	3.1	0.69	37	261	18	65.9
	PA2	9	4.5	3.5	0.68	45	316	18.7	67.4
Saunders Reef									
	SR1	8	4.1	3.2	0.56	42	274	24.2	72.1
Stewarts Point									
	ST1	3	1.6	1.1	0.22	13	97	22.3	48.5
Fort Ross									
	FR1	1	0.5	0.3	0.06	3	24	42.8	50.1
Bodega Bay									
	BB1	10	5.2	4.1	0.73	54	327	17	62.5
	BB2	10	5.2	4.4	0.88	61	348	22.2	61.1
	BB3	10	5.1	4.3	0.87	63	365	22.4	65.6
	BB4	7	3.6	2.7	0.47	35	231	12.8	58.3
	BB5	8	4.3	3.5	0.57	44	266	51.2	83.1
Tomales Point									
	TP1	3	1.5	1.4	0.25	17	93	17.1	29.1
Duxbury Point									
	DP1	3	1.5	1	0.17	13	96	25.7	37.1
Farallon Islands									
	FI1	8	4.1	3.4	0.82	52	318	12.9	62.1
	FI3	8	4.1	3.3	0.75	55	329	9	64.2
	FI5	6	3.3	1.8	0.42	31	257	72.4	102.2
	FI6	5	2.7	2.2	0.46	33	203	70.5	84.8
Montara									
	MN1	4	2.1	1.6	0.35	20	148	9.5	35.1
	MN2	4	2.1	1.1	0.21	15	154	25.3	39.9
	MN3	4	2.1	1.9	0.39	27	142	18.7	29.1
Pillar Point									
	PP1	4	2.1	1.8	0.35	23	137	18.1	32.5
	PP2	4	2	1.5	0.32	24	152	19.7	29.2
	PP3	4	2.1	1.5	0.34	24	164	19	27.1
San Gregorio									
	SG1	6	3.1	2.3	0.5	34	243	23.3	42.8
Año Nuevo									
	AN1	4	2.1	1.4	0.25	18	128	27.3	43.2
	AN2	5	2.6	2.1	0.4	27	163	22.6	48.5
Totals:		**146**	**75.8**	**58.5**	**11.71**	**810**	**5,236**	**min: 9**	**max: 102.2**

Cruise D: Substrate & Habitat Summary

Study Area	Site	Percent by Substrate					Percent by Habitat		
		Rock	Boulder	Cobble	Sand	Mud	Hard	Mix	Soft
Point Arena									
	PA1	72	0	1	8	24	67	5	28
	PA2	75	3	4	8	23	66	10	25
Saunders Reef									
	SR1	77	1	4	9	40	48	29	23
Stewarts Point									
	ST1	70	0	2	0	41	58	12	30
Fort Ross									
	FR1	69	0	0	0	53	47	21	32
Bodega Bay									
	BB1	79	0	2	9	22	67	12	21
	BB2	84	3	9	4	23	66	18	16
	BB3	84	6	18	5	17	60	24	16
	BB4	76	2	0	6	34	60	16	24
	BB5	82	16	4	0	35	61	20	18
Tomales Point									
	TP1	93	0	0	9	8	83	10	7
Duxbury Point									
	DP1	66	2	0	0	62	38	28	34
Farallon Islands									
	FI1	81	8	6	32	0	66	17	17
	FI3	82	1	8	43	0	53	29	18
	FI5	54	5	0	9	57	34	22	44
	FI6	82	0	17	0	31	53	29	18
Montara									
	MN1	74	1	5	10	24	63	11	26
	MN2	50	0	9	0	69	30	20	50
	MN3	94	1	6	14	6	76	18	6
Pillar Point									
	PP1	85	1	1	1	25	73	12	15
	PP2	73	18	7	4	33	57	19	25
	PP3	73	1	4	44	0	52	20	27
San Gregorio									
	SG1	74	10	19	19	35	34	40	26
Año Nuevo									
	AN1	68	0	3	0	54	44	24	32
	AN2	81	1	3	7	36	54	26	20
Averages:		**76**	**3**	**5**	**10**	**30**	**56**	**20**	**24**

Cruise D: Fish & Invertebrate Summary

Study Area	Site	No. Lines	Total Km	Totol No. of Fish	Totol No. of Inverts		No. of Fish per km	No. of Inverts per km
Point Arena								
	PA1	8	4	773	4,869		184	1,159
	PA2	9	5	1,896	5,856		421	1,301
Saunders Reef								
	SR1	8	4	579	2,640		141	644
Stewarts Point								
	ST1	3	2	455	467		284	292
Fort Ross								
	FR1	1	1	36	395		72	790
Bodega Bay								
	BB1	10	5	410	2,931		79	564
	BB2	10	5	871	5,359		168	1,031
	BB3	10	5	1,274	3,841		250	753
	BB4	7	4	535	2,345		149	651
	BB5	8	4	456	1,929		106	449
Tomales Point								
	TP1	3	2	49	520		33	347
Duxbury Point								
	DP1	3	2	107	577		71	385
Farallon Islands								
	FI1	8	4	1,990	12,537		485	3,058
	FI3	8	4	1,392	9,920		340	2,420
	FI5	6	3	1,572	2,249		476	682
	FI6	5	3	2,270	1,287		841	477
Montara								
	MN1	4	2	1,097	1,868		522	890
	MN2	4	2	902	1,522		430	725
	MN3	4	2	341	863		162	411
Pillar Point								
	PP1	4	2	449	1,029		214	490
	PP2	4	2	454	818		227	409
	PP3	4	2	553	1,251		263	596
San Gregorio								
	SG1	6	3	1,222	4,655		394	1,502
Año Nuevo								
	AN1	4	2	479	1,675		228	798
	AN2	5	3	557	1,703		214	655
	Totals:	**146**	**76**	**20,717**	**73,106**	**Averages:**	**270**	**859**

Cruise D: Fish Counts

Common Name	Scientific Name	Total Count	Coarse Size (cm)			Depth Range (m)		
			Avg	Max	Min	Avg	Max	Min
YOY (young of year) rockfish	*Sebastes sp.*	8,507	8	9	4	48	92	12
blue rockfish	*Sebastes mystinus*	2,415	21	39	5	31	74	10
unidentified rockfish	*Sebastes sp.*	1,249	15	40	10	51	101	15
canary rockfish	*Sebastes pinniger*	1,162	25	43	9	50	101	21
olive/yellowtail complex	*Sebastes serranoides/flavidus*	979	28	52	8	56	101	10
kelp greenling	*Hexagrammos decagrammus*	969	32	45	15	38	86	10
unidentified small, schooling rockfish (10-15 cm)	*Sebastes sp.*	902	12	15	10	58	91	25
lingcod	*Ophiodon elongatus*	711	46	80	12	42	102	14
Sebastomus rockfish complex	*Sebastomus* Subgenus	552	18	39	10	70	102	30
halfbanded rockfish	*Sebastes semicinctus*	393	12	15	7	65	92	30
pygmy rockfish	*Sebastes wilsoni*	321	11	15	8	87	101	75
brown rockfish	*Sebastes auriculatus*	218	30	42	15	51	81	20
striped surfperch	*Embiotoca lateralis*	204	22	31	12	23	41	10
unidentified flatfish	*Pleuronectiformes* order	194	15	50	5	63	102	27
pile perch	*Rhacochilus vacca*	192	25	40	13	24	50	11
vermilion rockfish	*Sebastes miniatus*	189	32	50	9	38	83	14
unidentified fish	Pisces	174	16	35	6	50	102	18
painted greenling	*Oxylebius pictus*	162	13	22	7	32	91	11
unidentified surfperch	*Embiotocidae* family	145	20	37	10	32	92	11
quillback rockfish	*Sebastes maliger*	125	30	42	17	46	83	24
black rockfish	*Sebastes melanops*	124	34	43	20	24	43	13
squarespot/widow complex	*Sebastes hopkinsi/entomelas*	87	13	22	9	64	83	38
gopher rockfish	*Sebastes carnatus*	81	27	39	19	31	68	14
greenspotted rockfish	*Sebastes chlorostictus*	73	22	35	12	96	102	81
china rockfish	*Sebastes nebulosus*	70	29	37	21	33	61	16
copper rockfish	*Sebastes caurinus*	68	33	45	17	48	92	23
unidentified small benthic fish	Pisces	58	14	20	8	46	101	20
shortbelly rockfish	*Sebastes jordani*	54	9	11	8	54	61	50
black/blue complex	*Sebastes melanops/mystinus*	49	24	34	12	29	55	26
widow rockfish	*Sebastes entomelas*	35	18	23	8	66	88	49
greenstriped rockfish	*Sebastes elongatus*	32	21	30	12	99	102	86
rosy rockfish	*Sebastes rosaceus*	32	19	26	13	80	101	39
pink surfperch	*Zalembius rosaceus*	31	15	21	10	62	92	25
wolf eel	*Anarrhichthys ocellatus*	22	82	105	60	33	51	19
canary/vermillion complex	*Sebastes pinniger/miniatus*	20	31	40	22	47	74	30
yelloweye rockfish	*Sebastes ruberrimus*	18	26	50	12	72	102	31
spotted ratfish	*Hydrolagus colliei*	13	38	50	26	77	90	55
copper/gopher complex	*Sebastes caurinus/carnatus*	10	31	34	25	36	45	26
eelpout complex	*Zoarcidae* family	10	13	25	10	42	58	38
starry rockfish	*Sebastes constellatus*	9	23	30	17	75	85	58
cabezon	*Scorpaenichthys marmoratus*	8	47	56	34	37	65	16
combfish complex	*Zaniolepis frenata/latipinnis*	8	12	17	10	70	81	42
flag rockfish	*Sebastes rubrivinctus*	6	24	25	22	85	91	74
starry skate	*Raja stellulata*	5	46	55	40	62	68	53
unidentified croaker	*Sciaenidae* family	5	24	28	20	62	62	61
unidentified sculpin	*Cottidae* family	5	15	20	10	60	78	36
stripedfin ronquil	*Rathbunella hypoplecta*	4	14	15	12	66	82	57
white surfperch	*Phanerodon furcatus*	4	20	20	20	25	25	25
Pacific hagfish	*Eptatretus stoutii*	3	42	50	36	57	92	39
squarespot rockfish	*Sebastes hopkinsi*	3	18	22	13	69	82	63

Common Name	Scientific Name	Total Count	Coarse Size (cm)			Depth Range (m)		
			Avg	Max	Min	Avg	Max	Min
unidentified poacher	*Agonidae* family	3	16	21	12	91	100	82
tiger rockfish	*Sebastes nigrocinctus*	2	30	33	27	67	74	60
bocaccio	*Sebastes paucispinis*	1	34	34	34	75	75	75
calico rockfish	*Sebastes dalli*	1	13	13	13	42	42	42
California halibut	*Paralichthys californicus*	1	70	70	70	42	42	42
English sole	*Parophrys vetulus*	1	25	25	25	100	100	100
speckled rockfish	*Sebastes ovalis*	1	37	37	37	81	81	81
	Total:	**20,717**						

Cruise D: Fish Counts

Cruise D: Invertebrate Counts

Common Name	Scientific Name (to closest Taxon)	Total Count	Avg	Max	Min
california sea cucumber	*Parastichopus californicus*	14,826	47	92	16
white-plumed anemone	*Metridium farcimen*	8,682	47	102	15
red sea urchin	*Strongylocentrotus franciscanus*	8,135	24	56	9
purple sea urchin	*Strongylocentrotus purpuratus*	6,178	18	35	9
bat star	*Asterina miniata*	5,916	30	102	9
short red gorgonian	*Swiftia spauldingi*	5,764	49	92	22
unidentified branched bryozoan	----------	2,646	41	73	20
california hydrocoral	*Stylaster californicus*	2,563	35	72	23
fish-eating anemone	*Urticina piscivora*	2,550	33	101	14
white sea pen	*Stylatula elongata*	2,212	55	91	23
slipper sea cucumber	*Psolus chitonoides*	1,699	36	83	21
white branched sea cucumber	*Cucumaria piperata*	1,409	40	85	24
white-spotted rose anemone	*Urticina lofotensis*	1,291	22	52	11
Henricia complex	*Henricia sp.*	1,241	38	102	13
red sea star	*Mediaster aequalis*	1,218	56	101	16
unidentified lobed sponge or tunicate	----------	1,135	37	81	18
orange puffball sponge	*Tethya aurantia*	910	37	73	13
leather star	*Dermasterias imbricata*	889	35	87	10
sand-rose anemone	*Urticina columbiana*	673	41	87	17
orange sea cucumber	*Cucumaria miniata*	622	31	86	16
short spined sea star	*Pisaster brevispinus*	383	31	87	15
gray puffball sponge	*Craniella arb*	288	28	62	13
unrecognized anemone #1	----------	266	43	89	22
unidentified sea star	----------	168	36	89	10
decorator crab	*Loxorhynchus crispatus*	138	29	60	19
acorn barnacle	*Balanus nubilus*	115	38	61	20
cookie star	*Ceramaster patagonicus*	115	72	92	23
unidentified anemone	----------	101	44	72	23
sand star	*Luidia foliolata*	98	65	92	35
unidentified tube dwelling anemone	----------	91	43	90	28
unidentified nipple sponge	----------	88	32	78	18
sea whip	*Halipteris californica*	66	64	85	42
unidentified branched sponge	----------	45	46	64	21
giant spined star	*Pisaster giganteus*	42	17	24	12
basket star	*Gorgonocephalus eucnemis*	38	61	101	45
brown box crab	*Lopholithodes foraminatus*	36	101	101	101
bat star/red star complex	*A. miniata or M. aequalis*	33	43	63	9
unidentified nudibranch	----------	33	44	80	19
dungeness crab	*Cancer magister*	30	46	87	22
C*ancer* complex	*Cancer sp.*	28	37	80	20
unidentified large tubeworm	----------	25	66	90	38
market squid	*Loligo opalescens*	21	60	67	44
red octopus	*Octopus rubescens*	21	51	73	26
cushion star	*Pteraster tesselatus*	20	52	84	13
red rock crab	*Cancer productus*	20	39	61	21
unidentified boot sponge	----------	19	63	76	57
unrecognized anemone #2	----------	17	43	67	24
orange sea pen	*Ptilosarcus gurneyi*	16	59	67	45
thorny sea star	*Poraniopsis inflata*	16	58	62	55
unidentified vase sponge	----------	16	59	61	56

Cruise D: Invertebrate Counts

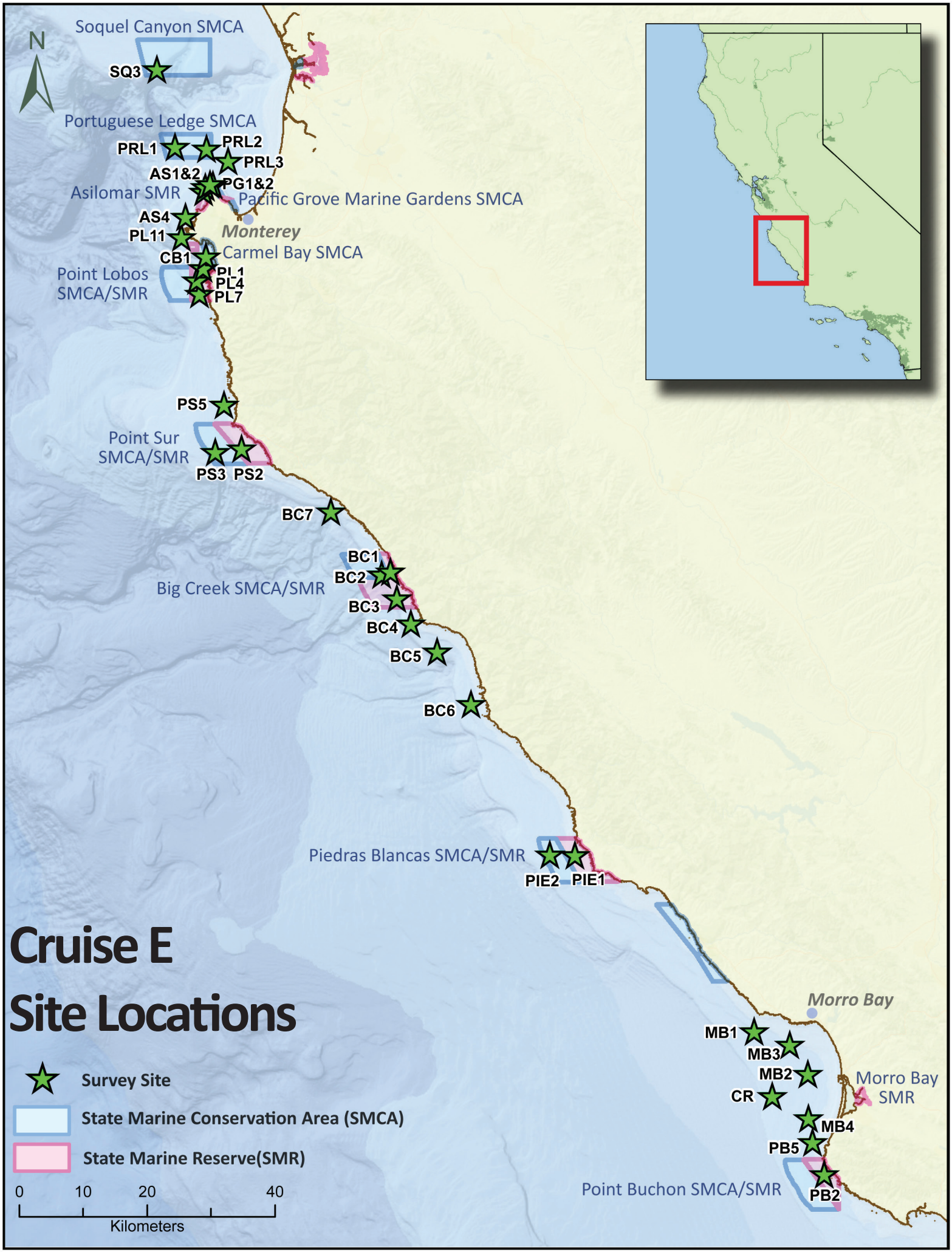
Common Name	Scientific Name (to closest Taxon)	Total Count	Avg	Max	Min
frilled anemone	*Metridium senile*	14	57	102	36
Puget Sound king crab	*Lopholithodes mandtii*	12	46	63	29
rock scallop	*Crassedoma giganteum*	12	44	56	33
Pleurobranchaea californica	*Pleurobranchaea californica*	11	73	101	61
fish-eating star	*Stylasterias forreri*	10	45	86	19
unidentified crab	----------	9	36	62	26
sea pen complex	*Virgularia sp.*	8	30	35	26
rainbow star	*Orthasterias koehleri*	7	45	58	31
spiny/thorny star	*P. inflata or H. spinosa*	7	69	92	36
unidentified sand dwelling anemone	----------	7	49	61	36
giant pacific octopus	*Enteroctopus dofleini*	6	62	102	29
ochre star	*Pisaster ochraceus*	5	20	26	14
Pisaster complex	*Pisaster sp.*	4	17	19	11
unidentified branched sea cucumber	----------	4	38	41	30
unrecognized sea star	----------	4	64	92	10
orange-peel nudibranch	*Tochuina tetraquetra*	3	26	29	23
spiny red star	*Hippasteria spinosa*	3	48	57	31
swimming anemone	*Stomphia didemon*	3	83	84	81
unidentified sea jelly	----------	3	44	87	10
unidentified stalked boot sponge	----------	3	56	60	51
unrecognized invertebrate	----------	3	84	84	84
white spine sea cucumber	*Parastichopus leukothele*	3	90	92	86
sand star/spiny sand star complex	*L. foliolata or A. armatus*	2	44	46	42
unidentified gorgonian	----------	2	64	64	64
unidentified sea scallop	----------	2	57	57	57
fragile pink urchin	*Strongylocentrotus fragilis*	1	71	71	71
painted anemone	*Urticina crassicornis*	1	84	84	84
sheep crab	*Loxorhynchus grandis*	1	29	29	29
Solaster complex	*S. dawsoni or S. endeca or S. stimpsoni*	1	20	20	20
swimming nudibranch	*Dendronotus iris*	1	50	50	50
unidentified zoanthid	----------	1	56	56	56
	Total:	**73,105**			

Cruise D: Invertebrate Patch Coverage

Study Area	Site	Total Area of all Surveyed Lines (m^2)	Common Name	Total Area w/ Invert (m^2)	% of Total Area w/ Invert	% Cover Code
Point Arena						
	PA1	8,790	brittle star complex	934	10.6	2.6
			club-tipped anemone	12	0.1	1.9
			unidentified zoanthid	29	0.3	2.1
	PA2	8,927	brittle star complex	1,274	14.3	1.8
			club-tipped anemone	190	2.1	1.1
			unidentified zoanthid	19	0.2	1.0
Saunders Reef						
	SR1	7,345	brittle star complex	1,924	26.2	1.8
			club-tipped anemone	43	0.6	1.5
Stewarts Point						
	ST1	2,993	club-tipped anemone	25	0.8	1.5
			unidentified zoanthid	48	1.6	2.1
Bodega Bay						
	BB2	10,124	brittle star complex	24	0.2	1.7
			club-tipped anemone	2	0.0	1.0
	BB3	10,043	club-tipped anemone	83	0.8	2.4
			unidentified zoanthid	12	0.1	1.6
	BB4	6,078	crinoidea	5	0.1	1.0
			unidentified zoanthid	3	0.1	2.0
	BB5	6,946	club-tipped anemone	135	1.9	1.6
Duxbury Point						
	DP1	2,517	brittle star complex	474	18.8	2.0
Farallon Islands						
	FI1	9,829	brittle star complex	139	1.4	1.3
			club-tipped anemone	266	2.7	1.1
	FI3	9,429	brittle star complex	1,057	11.2	1.2
			club-tipped anemone	267	2.8	1.7
	FI5	7,121	brittle star complex	842	11.8	1.4
			crinoidea	3,595	50.5	1.5
	FI6	5,623	brittle star complex	430	7.6	1.0
			club-tipped anemone	32	0.6	2.0
			crinoidea	321	5.7	1.3
Montara						
	MN1	4,819	club-tipped anemone	98	2.0	2.0
			unidentified zoanthid	144	3.0	1.8
	MN2	4,167	brittle star complex	353	8.5	2.6
			club-tipped anemone	180	4.3	1.6
			unidentified zoanthid	191	4.6	1.9
	MN3	4,135	brittle star complex	51	1.2	2.3
			club-tipped anemone	155	3.7	1.5
			unidentified zoanthid	2	0.0	4.0

Cruise D: Invertebrate Patch Coverage

Study Area	Site	Total Area of all Surveyed Lines (m^2)	Common Name	Total Area w/ Invert (m^2)	% of Total Area w/ Invert	% Cover Code
Pillar Point						
	PP1	4,196	brittle star complex	544	13.0	2.0
			club-tipped anemone	20	0.5	1.0
	PP2	4,127	unidentified zoanthid	64	1.6	1.1
	PP3	4,641	club-tipped anemone	11	0.2	1.4
			unidentified zoanthid	20	0.4	1.6
San Gregorio						
	SG1	6,760	brittle star complex	141	2.1	2.1
			club-tipped anemone	12	0.2	1.0
Año Nuevo						
	AN1	3,379	club-tipped anemone	72	2.1	2.7
			unidentified zoanthid	229	6.8	1.3
	AN2	4,825	club-tipped anemone	46	1.0	1.7
			unidentified zoanthid	18	0.4	1.6


N
Soquel Canyon SMCA
SQ3
Portuguese Ledge SMCA
PRL1
PRL2
PRL3
AS1&2
PG1&2
Asilomar SMR
Pacific Grove Marine Gardens SMCA
AS4
Monterey
PL11
Carmel Bay SMCA
CB1
Point Lobos
SMCA/SMR
PL1
PL4
PL7
PS5
Point Sur
SMCA/SMR
PS3
PS2
BC7
BC1
BC2
Big Creek SMCA/SMR
BC3
BC4
BC5
BC6
Piedras Blancas SMCA/SMR
PIE2
PIE1
Morro Bay
MB1
MB3
MB2
Morro Bay
SMR
CR
MB4
PB5
Point Buchon SMCA/SMR
PB2
Cruise E
Site Locations
Survey Site
State Marine Conservation Area (SMCA)
State Marine Reserve(SMR)
0
10
20
40
Kilometers

Cruise E: Cruise Summary

Study Area	Site	No. of Survey Lines	Total Km	Hard and/or Mixed Habitat Km	Hard and/or Mixed Habitat Area (ha)	No. of Transects 100m^2 (Fish)	No. of Transects 30m^2 (Invert)	Min Depth (m)	Max Depth (m)
Soquel Canyon									
	SQ3	3	2.3	0.9	0.18	14	94	100.7	347.0
Portuguese Ledge									
	PRL1	3	2.7	1.6	0.36	22	106	153.6	398.6
	PRL2	6	3.3	1.9	0.46	32	151	76.5	99.3
	PRL3	6	3.1	0.6	0.18	11	152	76.6	86.2
Pacific Grove									
	PG1	4	2.0	1.8	0.42	29	88	20.7	39.2
	PG2	4	2.0	1.9	0.33	24	89	26.9	38.8
Asilomar									
	AS1	4	2.0	1.7	0.47	20	78	11.6	47.1
	AS2	4	2.0	1.6	0.45	26	93	16.1	31.5
	AS4	7	3.7	3.3	0.81	49	159	24.0	50.8
Carmel Bay									
	CB1	8	4.2	3.3	0.85	52	200	15.4	72.5
Point Lobos									
	PL1	4	2.1	1.4	0.33	23	88	18.8	71.4
	PL4	8	4.2	2.5	0.70	38	184	26.3	115.5
	PL7	4	2.2	1.3	0.29	17	92	21.0	94.1
	PL11	8	4.3	3.2	0.81	46	181	13.5	133.2
Point Sur									
	PS2	7	3.5	3.2	0.75	50	164	21.8	59.0
	PS3	8	4.3	2.9	0.65	47	200	48.5	72.2
	PS5	8	3.9	3.6	0.95	54	180	25.6	57.6
Big Creek									
	BC1	4	1.8	0.5	0.15	9	84	16.5	38.4
	BC2	1	1.2	0.6	0.14	11	57	52.9	325.7
	BC3	1	1.3	0.3	0.07	5	53	76.9	386.0
	BC4	8	4.1	3.1	0.89	45	213	23.4	86.0
	BC5	6	3.2	1.7	0.39	28	152	65.5	96.4
	BC6	6	3.2	2.7	0.66	41	142	30.0	58.8
	BC7	3	1.1	0.1	0.02	1	44	257.9	439.5
Piedras Blancas									
	PIE1	4	2.1	2.1	0.48	33	89	20.0	34.7
	PIE2	4	2.1	1.9	0.51	34	98	48.1	75.4
Morro Bay									
	MB1	8	4.7	2.5	0.61	41	209	37.9	86.5
	MB2	8	4.0	1.8	0.46	32	165	50.6	70.8
	MB3	7	3.5	2.6	0.56	40	165	21.8	56.7
	MB4	7	3.6	2.3	0.44	35	146	46.4	70.1
Churck Rock									
	CR	5	2.3	2.1	0.45	32	111	66.8	100.2
Point Buchon									
	PB2	7	3.5	2.6	0.56	40	147	13.5	49.8
	PB5	8	4.0	2.9	0.57	42	172	19.3	64.5
Totals:		**183.0**	**97.4**	**66.4**	**15.96**	**1023**	**4346**	**min: 11.6**	**max: 439.5**

Cruise E: Substrate & Habitat Summary

Study Area	Site	Percent by Substrate					Percent by Habitat		
		Rock	Boulder	Cobble	Sand	Mud	Hard	Mixed	Soft
Soquel Canyon									
	SQ3	40	0	0	0	99	1	39	60
Portuguese Ledge									
	PRL1	63	0	0	0	94	6	57	37
	PRL2	56	4	1	4	56	41	16	43
	PRL3	21	1	0	0	83	17	3	79
Pacific Grove									
	PG1	89	10	0	38	0	62	28	10
	PG2	94	12	10	37	0	55	39	5
Asilomar									
	AS1	85	3	0	48	0	52	33	15
	AS2	80	2	1	35	0	64	17	19
	AS4	88	1	16	27	0	66	23	11
Carmel Bay									
	CB1	75	9	3	39	0	59	20	21
Point Lobos									
	PL1	70	3	5	42	1	55	17	28
	PL4	60	5	13	56	0	38	23	38
	PL7	65	0	2	36	3	60	6	35
	PL11	73	6	13	40	0	51	25	25
Point Sur									
	PS2	93	0	12	31	0	63	30	7
	PS3	63	14	60	48	0	24	44	31
	PS5	91	5	16	25	0	66	26	8
Big Creek									
	BC1	26	0	0	79	0	21	5	74
	BC2	52	0	0	0	72	28	24	48
	BC3	25	0	0	0	88	12	14	75
	BC4	75	5	1	51	0	49	27	25
	BC5	53	6	14	8	54	28	26	47
	BC6	87	2	3	28	0	70	17	13
	BC7	8	0	0	0	100	0	7	92
Piedras Blancas									
	PIE1	98	0	0	34	0	65	33	2
	PIE2	92	6	18	11	9	68	24	8
Morro Bay									
	MB1	56	0	4	27	39	33	23	44
	MB2	47	0	13	0	62	32	15	53
	MB3	74	5	14	53	11	32	42	26
	MB4	66	0	4	0	58	40	26	34
Churck Rock									
	CR	90	0	26	8	17	63	27	10
Point Buchon									
	PB2	74	0	4	53	0	45	28	26
	PB5	74	0	4	17	21	61	14	26
Average:		**67**	**3**	**8**	**27**	**26**	**43**	**24**	**33**

Cruise E: Fish & Invertebrate Summary

Study Area	Site	Total Lines	Total km	Total Fish	Total Inverts		Fish per km	Inverts per km
Soquel Canyon								
	SQ3	3	2.3	1,330	2,475		574	1,067
Portugese Ledge								
	PRL1	3	2.7	1,127	11,893		415	4,375
	PRL2	6	3.3	15,417	5,157		4,641	1,552
	PRL3	6	3.1	2,322	4,022		739	1,280
Pacific Grove								
	PG1	4	2.0	5,190	1,469		2,637	746
	PG2	4	2.0	4,557	1,531		2,319	779
Asilomar								
	AS1	4	2.0	3,245	1,356		1,624	678
	AS2	4	2.0	302	2,505		149	1,235
	AS4	7	3.7	15,463	2,813		4,195	763
Carmel Bay								
	CB1	8	4.2	10,608	3,257		2,527	776
Point Lobos								
	PL1	4	2.1	10,817	3,233		5,167	1,544
	PL4	8	4.2	40,653	4,532		9,724	1,084
	PL7	4	2.2	13,600	3,335		6,308	1,547
	PL11	8	4.3	29,143	7,778		6,772	1,807
Point Sur								
	PS2	7	3.5	6,245	1,752		1,808	507
	PS3	8	4.3	67,333	1,508		15,768	353
	PS5	8	3.9	10,040	1,430		2,550	363
Big Creek								
	BC1	4	1.8	360	539		195	292
	BC2	1	1.2	351	9,596		283	7,733
	BC3	1	1.3	3,260	1,464		2,592	1,164
	BC4	8	4.1	9,502	1,970		2,310	479
	BC5	6	3.2	8,805	2,149		2,779	678
	BC6	6	3.2	6,281	941		1,984	297
	BC7	3	1.1	382	509		335	446
Piedras Blancas								
	PIE1	4	2.1	1,096	220		513	103
	PIE2	4	2.1	4,720	1,104		2,286	535
Morrow Bay								
	MB1	8	4.7	3,997	1,128		859	242
	MB2	8	4.0	2,791	1,891		706	478
	MB3	7	3.5	1,681	2,122		486	613
	MB4	7	3.6	2,029	670		570	188
Church Rock								
	CR	5	2.3	34,089	791		14,593	339
Point Buchon								
	PB2	7	3.5	2,264	1,446		643	411
	PB5	8	4.0	1,152	1,651		287	411
	Totals:	**183**	**97**	**320152**	**88237**	**Averages:**	**3,010**	**1,057**

Cruise E: Fish Counts

Common Name	Scientific Name	Total Count	Coarse Size (cm)			Depth Range (m)		
			Avg	Max	Min	Avg	Max	Min
YOY (young of year) rockfish	*Sebastes sp.*	257,739	7	9	4	55	353	18
unidentified small, schooling rockfish (10-15 cm)	*Sebastes sp.*	10,928	11	18	10	68	134	15
blue rockfish	*Sebastes mystinus*	9,649	21	50	5	41	238	14
Unrecognized fish	Pisces	8,126	11	16	9	76	93	65
shortbelly rockfish	*Sebastes jordani*	4,731	9	12	6	62	97	37
halfbanded rockfish	*Sebastes semicinctus*	4,475	10	15	5	74	140	25
squarespot/widow complex	*Sebastes hopkinsi/entomelas*	3,834	12	32	8	76	172	35
squarespot rockfish	*Sebastes hopkinsi*	3,018	14	36	8	77	141	22
unidentified rockfish	*Sebastes sp.*	3,018	15	44	10	131	439	14
Sebastomus rockfish complex	*Sebastomus* Subgenus	2,240	17	36	6	98	422	30
olive/yellowtail complex	*Sebastes serranoides/flavidus*	1,791	34	50	7	54	112	12
lingcod	*Ophiodon elongatus*	1,225	58	115	12	71	349	20
vermilion rockfish	*Sebastes miniatus*	1,010	41	56	11	61	212	19
rosy rockfish	*Sebastes rosaceus*	746	18	33	10	73	281	31
senorita	*Oxyjulis californica*	575	13	22	9	34	79	20
unidentified flatfish	*Pleuronectiformes* order	573	15	36	6	144	435	26
unidentified small benthic fish	Pisces	536	12	35	5	94	381	31
gopher rockfish	*Sebastes carnatus*	378	26	40	11	41	63	16
painted greenling	*Oxylebius pictus*	364	12	24	7	49	86	18
brown cat shark	*Apristurus brunneus*	325	29	35	20	355	386	315
pile perch	*Rhacochilus vacca*	321	25	40	11	36	75	17
canary rockfish	*Sebastes pinniger*	296	34	58	10	70	212	24
splitnose rockfish	*Sebastes diploproa*	296	20	35	12	286	396	115
unidentified smelt	*Osmeriformes* order	259	11	18	7	84	99	55
shortspine thornyhead	*Sebastolobus alascanus*	212	16	23	9	329	433	243
unidentified fish	Pisces	196	14	40	7	97	433	17
copper rockfish	*Sebastes caurinus*	194	36	50	23	66	97	25
pygmy rockfish	*Sebastes wilsoni*	190	11	13	9	103	151	46
unidentified poacher	*Agonidae* family	185	17	27	10	260	418	91
kelp greenling	*Hexagrammos decagrammus*	173	35	55	23	45	90	22
pink surfperch	*Zalembius rosaceus*	173	12	23	7	74	155	39
unidentified surfperch	*Embiotocidae* family	167	17	35	7	38	95	14
calico rockfish	*Sebastes dalli*	166	12	18	8	56	84	28
Pacific hake	*Merluccius productus*	155	30	60	15	339	436	183
greenspotted rockfish	*Sebastes chlorostictus*	143	24	38	10	123	288	43
greenstriped rockfish	*Sebastes elongatus*	136	19	30	7	141	284	56
Pacific hagfish	*Eptatretus stoutii*	126	34	50	13	287	433	84
bocaccio	*Sebastes paucispinis*	100	46	64	20	124	263	50
stripetail rockfish	*Sebastes saxicola*	93	16	25	10	238	374	125
white surfperch	*Phanerodon furcatus*	92	16	30	11	42	67	30
yelloweye rockfish	*Sebastes ruberrimus*	90	37	62	5	88	232	42
ui eel pout	Zoarcidae, Blennidae, Pholididae or Stichaeidae	83	25	36	9	297	432	69
combfish complex	*Zaniolepis frenata/latipinnis*	80	14	20	9	74	175	48
aurora/splitnose rockfish complex	*Sebastes aurora/diploproa*	64	20	35	12	260	357	146
Dover sole	*Microstomus pacificus*	64	19	36	12	293	406	117
black rockfish	*Sebastes melanops*	63	29	40	9	25	35	19
flag rockfish	*Sebastes rubrivinctus*	60	25	36	7	91	323	56
thornyhead complex	*Sebastolobus altivelis/alascanus*	55	19	30	8	308	397	151
starry rockfish	*Sebastes constellatus*	54	27	43	14	80	169	41
blackgill rockfish	*Sebastes melanostomus*	53	29	60	13	343	433	272

Cruise E: Fish Counts

Common Name	Scientific Name	Total Count	Coarse Size (cm)			Depth Range (m)		
			Avg	Max	Min	Avg	Max	Min
unidentified schooling pelagic fish	Pisces	50	16	16	16	22	22	22
striped surfperch	*Embiotoca lateralis*	46	22	32	10	32	69	20
spotted ratfish	*Hydrolagus colliei*	44	46	56	25	115	271	33
rex sole	*Glyptocephalus zachirus*	39	22	33	10	297	422	160
wolf eel	*Anarrhichthys ocellatus*	35	114	140	80	72	133	28
brown rockfish	*Sebastes auriculatus*	27	37	46	26	60	84	43
canary/vermillion complex	*Sebastes pinniger/miniatus*	25	39	48	28	72	117	32
longnose skate	*Raja rhina*	21	45	75	30	332	391	273
China rockfish	*Sebastes nebulosus*	18	28	38	12	53	76	32
slender sole	*Lyopsetta exilis*	17	17	20	14	299	408	258
aurora rockfish	*Sebastes aurora*	16	23	30	15	301	367	193
bank rockfish	*Sebastes rufus*	15	27	40	20	309	350	272
California sheephead	*Semicossyphus pulcher*	15	54	65	44	41	58	25
unidentified sculpin	*Cottidae* family	15	16	22	10	222	375	37
widow rockfish	*Sebastes entomelas*	14	27	35	8	79	91	54
California lizardfish	*Synodus lucioceps*	10	14	20	11	68	86	53
pinkrose rockfish	*Sebastes simulator*	10	19	23	13	290	336	262
darkblotched rockfish	*Sebastes crameri*	9	29	35	24	320	353	281
red banded rockfish	*Sebastes babcocki*	9	27	52	11	291	386	229
rubberlip surfperch	*Rhacochilus toxotes*	9	37	40	34	50	51	50
cowcod	*Sebastes levis*	8	41	62	17	179	261	84
copper/gopher complex	*Sebastes caurinus* or *carnatus*	6	30	33	25	42	53	24
kelp rockfish	*Sebastes atrovirens*	6	31	36	21	21	29	17
quillback rockfish	*Sebastes maliger*	6	30	31	30	62	69	52
rosethorn rockfish	*Sebastes helvomaculatus*	6	16	23	13	225	344	127
treefish	*Sebastes serriceps*	5	24	32	20	37	57	23
cabezon	*Scorpaenichthys marmoratus*	4	36	45	24	47	58	35
unidentified sanddab	*Citharichthys sp.*	4	18	26	10	88	133	59
chilipepper rockfish	*Sebastes goodei*	3	25	33	16	263	266	258
greenblotched rockfish	*Sebastes rosenblatti*	3	27	33	21	202	240	133
ocean whitefish	*Caulolatilus princeps*	3	14	16	11	54	64	50
Pacific electric ray	*Torpedo californica*	3	45	62	22	185	349	35
petrale sole	*Eopsetta jordani*	3	34	35	32	218	386	133
sablefish	*Anoplopoma fimbria*	3	36	45	31	259	314	190
sunset rockfish	*Sebastes crocotulus*	3	38	38	38	118	118	118
big skate	*Raja binoculata*	2	70	95	45	50	50	50
California lizard fish/lingcod	*S. lucioceps* or *O. elongatus*	2	18	20	16	58	62	54
kelp surfperch	*Brachyistius frenatus*	2	10	10	10	26	26	26
rock sole	*Lepidopsetta bilineata*	2	36	36	35	79	83	75
speckled rockfish	*Sebastes ovalis*	2	37	40	34	77	78	76
starry skate	*Raja stellulata*	2	69	75	63	86	95	76
black surfperch	*Embiotoca jacksoni*	1	20	20	20	25	25	25
black/blue complex	*Sebastes melanops/mystinus*	1	37	37	37	20	20	20
Pacific lamprey	*Entosphenus tridentatus*	1	25	25	25	436	436	436
Pacific sand lance	*Ammodytes hexapterus*	1	10	10	10	130	130	130
shortraker rockfish	*Sebastes borealis*	1	63	63	63	383	383	383
sixgill shark	*Hexanchus griseus*	1	170	170	170	86	86	86
striped kelpfish	*Gibbonsia metzi*	1	15	15	15	264	264	264
stripedfin ronquil	*Rathbunella hypoplecta*	1	16	16	16	70	70	70
swordspine rockfish	*Sebastes ensifer*	1	18	18	18	155	155	155
unidentified grenadier	*Macrouridae* family	1	30	30	30	433	433	433
	Total:	**320,152**						

Cruise E: Invertebrate Counts

Common Name	Scientific Name (to closest Taxon)	Total Count	Avg	Max	Min
bat star	*Asterina miniata*	10,682	38	342	14
white urchin	*Lytechinus anamesus*	10,573	88	132	35
pelagic red crab	*Pleuroncodes planipes*	7,516	363	399	211
red sea star	*Mediaster aequalis*	7,052	78	377	20
unidentified lobed sponge or tunicate	----------	5,783	55	437	19
red gorgonian	*Lophogorgia chilensis*	4,800	53	317	27
california sea cucumber	*Parastichopus californicus*	4,211	67	229	21
white-plumed anemone	*Metridium farcimen*	4,095	78	370	21
red sea urchin	*Strongylocentrotus franciscanus*	3,632	26	83	14
fish eating anemone	*Urticina piscivora*	2,489	33	132	15
white sea pen	*Stylatula elongata*	2,486	80	266	32
unidentified nipple sponge	----------	2,118	41	84	21
unidentified gorgonian (dead)	----------	2,053	58	97	27
purple sea urchin	*Strongylocentrotus purpuratus*	1,804	21	29	14
unidentified branched bryozoan	----------	1,692	40	68	22
california hydrocoral	*Stylaster californicus*	1,565	37	81	15
fragile pink urchin	*Strongylocentrotus fragilis*	1,428	320	418	215
long-legged sunflower star	*Rathbunaster californicus*	1,236	294	398	108
unidentified branched sea cucumber	----------	1,230	326	439	121
spot prawn	*Pandalus platyceros*	1,102	262	386	77
henricia complex	*Henricia sp.*	1,071	80	388	19
unidentified sea pen	*Virgularia sp.*	886	219	323	54
unidentified branched sponge	----------	854	59	272	22
squat lobster	*Munida quadrispina*	777	240	382	147
orange puffball sponge	*Tethya aurantia*	718	50	92	15
sea whip	*Halipteris californica*	710	79	173	48
cookie star	*Ceramaster patagonicus*	584	80	317	23
fish eating star	*Stylasterias forreri*	571	241	370	75
sand-rose anemone	*Urticina columbiana*	523	41	104	15
unidentified boot sponge	----------	314	88	374	43
slipper sea cucumber	*Psolus chitonoides*	303	52	94	27
unidentified sedentary tunicate	----------	224	97	374	31
sand star	*Luidia foliolata*	217	113	348	27
sand star/spiny sand star complex	*L. foliolata* or *A. armatus*	194	85	133	36
red octopus	*Octopus rubescens*	191	116	260	50
white spine sea cucumber	*Parastichopus leukothele*	176	255	390	97
unidentified tube dwelling anemone	----------	175	141	257	54
unidentified sea star	----------	173	145	418	23
gray puffball sponge	*Craniella arb*	164	46	171	23
rainbow star	*Orthasterias koehleri*	163	39	71	21
unidentified anemone	----------	148	162	383	20
leather star	*Dermasterias imbricata*	116	39	116	22
marshmallow sponge	Unidentified cube sponge	105	39	92	23
giant spined star	*Pisaster giganteus*	94	28	62	15
short red gorgonian	*Swiftia spauldingi*	88	55	96	33
unidentified sand dwelling anemone	----------	84	174	369	29
unrecognized invertebrate	----------	76	117	177	33
white-spotted rose anemone	*Urticina lofotensis*	75	28	54	16
spiny/thorny star	*P. inflata or H. spinosa*	61	201	395	37
orange sea pen	*Ptilosarcus gurneyi*	54	74	140	33
unidentified sea jelly	----------	53	316	374	255
purple gorgonian	*Eugorgia rubens*	51	60	92	47

Cruise E: Invertebrate Counts

Common Name	Scientific Name (to closest Taxon)	Total Count	Avg	Max	Min
sunflower star complex	*R. californicus* or *P. helianthoides*	50	320	397	147
bat star/red star complex	*A. miniata* or *M. aequalis*	47	59	229	29
mushroom soft coral	*Anthomastus ritteri*	43	330	382	195
pleurobranchaea californica	*Pleurobranchaea californica*	43	188	397	84
glassy tunicate	*Ascidia paratropa*	38	50	67	31
thorny sea star	*Poraniopsis inflata*	36	231	358	45
basket star	*Gorgonocephalus eucnemis*	35	94	170	65
decorator crab	*Loxorhynchus crispatus*	32	58	94	22
elephant ear tunicate	*Polyclinum planum*	31	61	94	23
unrecognized anemone species #4	----------	28	227	296	123
swimming anemone	*Stomphia didemon*	26	241	333	87
unidentified tubeworm	----------	26	187	333	85
unidentified vase sponge	----------	26	82	170	41
cushion star	*Pteraster tesselatus*	22	85	317	30
gray moon sponge	*Spheciospongia confoederata*	22	311	386	228
rock scallop	*Crassedoma giganteum*	20	47	92	21
sheep crab	*Loxorhynchus grandis*	20	52	91	24
unrecognized sea star	----------	19	171	331	31
Cancer complex	*Cancer sp.*	12	89	229	31
unidentified gorgonian	----------	12	135	229	28
dungeness crab	*Cancer magister*	11	165	316	50
red/purple urchin complex	*S. franciscanus/purpuratus*	11	24	24	24
unidentified sand prawns	----------	11	242	273	210
red rock crab	*Cancer productus*	10	53	90	33
unidentified crab	----------	10	191	304	52
acorn barnacle	*Balanus nubilus*	6	32	37	25
orange gorgonian	*Adelogorgia phyllosclera*	6	65	81	43
benthic siphonophore	*Dromalia alexandri*	4	320	359	272
spiny red star	*Hippasteria spinosa*	4	300	359	245
deep sea cucumber	*Pannychia moseleyi*	3	431	433	429
orange sea cucumber	*Cucumaria miniata*	3	24	25	23
orange-peel nudibranch	*Tochuina tetraquetra*	3	131	275	53
pink tritonia	*Tritonia diomedea*	3	129	172	85
white branched sea cucumber	*Cucumaria piperata*	3	102	160	64
unidentified hard or soft coral	----------	2	268	268	268
unidentified nudibranch	----------	2	197	374	20
wrinkled sea star	*Pteraster militaris*	2	299	304	294
crowned urchin	*Centrostephanus coronatus*	1	32	32	32
diamondback tritonia	*Tritonia festiva*	1	38	38	38
noble sea lemon	*Peltodoris nobilis (Anisodoris nobilis*	1	46	46	46
ochre star	*Pisaster ochraceus*	1	14	14	14
painted anemone	*Urticina crassicornis*	1	34	34	34
short spined sea star	*Pisaster brevispinus*	1	33	33	33
spiny sand star	*Astropecten armatus*	1	54	54	54
stalked tunicate	*Styela montereyensis*	1	33	33	33
sun star complex	*Solaster sp.*	1	304	304	304
trumpet sponge	*Stylissa stipitata*	1	52	52	52
unidentified lobed or laced bryozoan	----------	1	59	59	59
unidentified octopus	----------	1	363	363	363
unidentified zoanthid	----------	1	28	28	28
whelk complex	*Kelletia spp.*	1	84	84	84
	Total:	**88,236**			

Cruise E: Invertebrate Patch Coverage

Study Area	Site	Total Area of all Surveyed Lines (m^2)	Common Name	Total Area w/ Invert (m^2)	% of Total Area w/ Invert	% Cover Code
Soquel Canyon						
	SQ3	2,943	feather stars	147	5	1.6
			unidentified brachiopoda	44	1	2.0
Portuguese Ledge						
	PRL1	3,841	feather stars	43	1	1.0
	PRL2	4,961	club-tipped anemones	28	1	1.6
			feather stars	405	8	1.1
	PRL3	4,857	club-tipped anemones	6	0	1.5
			feather stars	22	0	1.0
Pacific Grove						
	PG1	3,047	club-tipped anemones	20	1	2.3
			market squid eggs	2	0	2.0
Asilomar						
	AS1	4,216	club-tipped anemones	69	2	1.5
	AS2	3,645	club-tipped anemones	44	1	1.3
	AS4	6,154	club-tipped anemones	78	1	1.7
Carmel Bay						
	CB1	7,505	club-tipped anemones	15	0	2.0
			feather stars	2	0	1.0
Point Lobos						
	PL1	3,104	club-tipped anemones	33	1	1.4
	PL4	7,466	club-tipped anemones	273	4	1.7
			feather stars	14	0	1.5
			unidentified brittle stars	123	2	1.0
	PL7	3,378	club-tipped anemones	302	9	1.6
	PL11	6,919	club-tipped anemones	144	2	1.5
			feather stars	244	4	1.5
Point Sur						
	PS2	5,819	club-tipped anemones	100	2	1.3
	PS3	6,361	club-tipped anemones	26	0	2.5
	PS5	7,429	feather stars	28	0	1.0
			club-tipped anemones	62	1	1.6
Big Creek						
	BC1	2,714	club-tipped anemones	26	1	1.7
	BC2	1,779	feather stars	55	3	1.3
			unidentified brittle stars	201	11	1.0
	BC3	1,677	feather stars	65	4	1.0
			unidentified brittle stars	222	13	1.4
	BC4	7,591	club-tipped anemones	12	0	1.5
	BC5	5,091	feather stars	55	1	1.1
	BC6	5,325	club-tipped anemones	52	1	1.9
			unidentified zoanthid	2	0	3.0
Piedras Blancas						
	PIE1	2,918	club-tipped anemones	18	1	1.0
	PIE2	3,407	club-tipped anemones	25	1	1.0
Morro Bay						
	MB1	6,995	club-tipped anemones	33	0	1.6
			feather stars	470	7	1.3
	MB2	5,293	club-tipped anemones	13	0	1.0
	MB3	5,489	club-tipped anemones	7	0	1.0
			unidentified zoanthid	16	0	4.0
Churck Rock						
	CR	3,760	club-tipped anemones	454	12	1.7
			feather stars	150	4	1.4
			lophelia complex	25	1	1.3
			unidentified zoanthid	80	2	1.9
Point Buchon						
	PB2	4,906	club-tipped anemones	147	3	1.5
	PB5	5,502	club-tipped anemones	6	0	2.0