Southern California Bight
2008 Regional Marine Monitoring Survey
(Bight'08)

Rocky Reef Workplan

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BIGHT'08 ROCKY REEF COMMITTEE

Chair:	
Dan Pondella	Vantuna Research Group, Occidental College (VRG)
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Mike Lyons	Los Angeles Regional Water Quality Control Board (LARWQCB)
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Ken Schiff	Southern California Coastal Water Research Project (SCCWRP)
Brian Edwards	United State Geological Survey (USGS)
Mitch Purdue	US Navy

I. INTRODUCTION

The Southern California Bight (SCB) a transitional zone between the cool temperate (Oregonian) fauna fueled by the California Current to the north and the warm temperate (San Diegan) fauna from the south is a unique and increasingly critical stretch of the California coastline. With its eight channel islands, the linear coastline of the SCB is roughly equal to the rest of the state. Irrespective of the biogeographic intricacies, the physical constitution of the coastline along the mainland SCB is dominated by sandy beaches, with approximately 15% rocky-headlands, a stark contrast to the remainder of the state. The southern California islands, however, support a greater proportion of reefs to soft substrate communities. Due to accessibility and increasing stress by a growing population, these reefs are under a variety of anthropogenic stressors (e.g. turbidity, river plumes, sedimentation, overfishing, pollution etc.) and harmful algal blooms, which in many instances are not well understood and in all cases necessitate a Bight-wide perspective and coordination to contextualize and manage these effects.

Recently it has been demonstrated that significant management actions can have significant positive effects on this complex ecosystem (Pondella and Allen 2008). Currently, potential positive measures to aid this ecosystem has been the creation of Marine Protected Areas (MPAs) in the northern Channel Islands and kelp bed restoration along the mainland. It has been recently announced the California Department of Fish and Game (CDFG) will continue its Marine Life Protection Act (MLPA) process to the SCB in 2009. Thus, there is a great deal of impetus and pressure to generate physical and biological data that can lead to informed decisions concerning this process in the SCB.

While the subtidal reefs in the SCB have been highly studied for decades, quantitative large scale spatial and temporal studies have been relatively limited, with the exceptions of the Channel Islands National Park Service's Kelp Forest Monitoring Program, the Packard Foundation's Partnership for the Interdisciplinary Study of Coastal Oceans (PISCO), the Vantuna Research Group at Occidental College and more recently Reef Check California. In 2003-04 the CDFG supported a cooperative research program referred to as the Cooperative Research Assessment of Nearshore Ecosystems (CRANE) that sampled 88 reefs with standardized protocol from Santa Cruz to the Mexico Border including the southern California islands.

The first quantitative assessment of many of the southern California and Baja Islands (Pondella et al. 2005) found that for fishes, island fauna are generally distinct from each other and that their similarities are not a function of distance, but rather reflect the physical oceanographic regime where they are found. Due to the unique physical oceanographic conditions in the SCB, we do not find a latitutidinal clinal variation in these populations. PISCO and the VRG combined their data for NOAA's (2005) Biogeographic Assessment of the Channel Islands National Marine Sanctuary (CINMS) and found that for the islands (San Miguel and Santa Rosa were not included) there were essentially three groups. A warm group (San Clemente, Santa Catalina, Santa Barbara Anacapa and the east end of Santa Cruz) a transitional fauna (Santa Cruz and San Nicolas) and cold group (Pt. Conception) (Clark et al. 2005). In an analysis of the CRANE data set, San Miguel and Santa Rosa fall into the cold temperate fauna (Tenera 2006). Analyses of the CRANE data found essentially a cool temperate, warm temperate and a transitional fauna in the SCB (Tenera 2006). This survey was completed five years ago and reef sites were not selected in a probabilistic design, thus the integration with the bight program constitutes a critical and timely coordination.

What is necessary is a cohesive collaborative plan that incorporates the entire SCB to address both spatial and temporal concerns within this region. As a result the first next step in continuing to develop this long-term collaborative rocky reef program is participation in Bight'08 under the coordination of SCCWRP. The view of the planning committee is that it is critical to integrate the Bight-wide reef studies with the other regional studies coordinated by SCCWRP in order to place this research into the appropriate context and allowing resource managers to make informed decisions with this unique regional and global perspective. Currently 25 local, state and federal agencies, universities and NGOs and consulting groups are participating in this committee (Table 1).

Table 1. Current Participants in Bight'08 Rocky Reef Program.

California State University, Long Beach (CSULB)
Channel Islands National Marine Sanctuary (CINMS)
Heal the Bay
Los Angeles County Sanitation Districts (LACSD)
Los Angeles Regional Water Quality Control Board (LARWQCB)
Marine Science Institute, UCSB (MSI)
MBC Applied Environmental Sciences (MBC)
Merkel and Associates, Inc.
Minerals Management Service (MMS)
Montrose Settlements Restoration Program (MSRP)
National Marine Fisheries Service (NMFS)
National Park Service (NPS)
Ocean Science Trust (OST)
Partnership for the Interdisciplinary Study of Coastal Oceans (PISCO)
Port of Los Angeles
Reef Check California (RCCA)
San Diego Coastkeeper
San Diego State University (SDSU)
Santa Monica Bay Restoration Commission (SMBRC)
Santa Monica Baykeeper (SMBK)
Scripps Institute of Oceanography (SIO)
Southern California Edison (SCE)
Southern California Coastal Water Research Project (SCCWRP)
United State Geological Survey (USGS)
US Navy
Vantuna Research Group, Occidental College (VRG)

II. STUDY DESIGN

A. Study Objectives

The overall goal of the rocky reef program is to determine the status of rocky reef resources in the southern California bight (SCB). In this study we are striving to achieve a collaborative rocky reef study that will address the following study questions on both the appropriate spatial and temporal scales:

1. What is the distribution of hard bottom (non-trawlable) habitats in the southern California bight?

2. What is the range of natural biological conditions in these reef assemblages?

3. How do these conditions overlay or correlate with anthropogenic factors?

B. Mapping Efforts and Station Assignments

The primary data layer needed for all associated questions is a map of hard bottom habitats in the Southern California Bight. Not all rocky reefs have been mapped and previous mapping efforts are of various resolutions and scales. Currently, mapping efforts in the SCB are ongoing to fill in these data gaps and will not be completed prior to the beginning of this study effort. Thus, we have acquired what we believe to be the best compilations of rocky reef habitat in the SCB. These include the following maps of hard bottom habitats and kelp canopy (Figures 1 and 2). GIS spatial analysis techniques were used to integrate existing spatial data that characterizes bottom type, kelp cover, and bathymetry to create a preliminary habitat map. Using this data in GIS, we met with experts who have conducted multiple subtidal scuba research projects on various geographic areas of the SCB. These working groups delineated and categorized all reefs in the SCB (Figure 3, Table 2). In this assessment, reefs were characterized as artificial reefs, cobble, major reef complexes, offshore reefs and pinnacles, and patchy reefs. Reefs were also coded as island or mainland within each biogeographic realm, San Diegan (warm temperate) or Oregonian (cold temperate). At the islands biogeographic realm was determined by assessment of benthic fish assemblages studied during the previous CRANE survey (Figure 4). In this biogeographic analysis, young-of-year (YOY) fishes whose density is seasonal and highly abundant pelagic species (*Engraulis mordax* and *Sardinops sagax*) that were only present at two sites were trimmed from the data set. All statistics were run using PRIMER (version 6). The number of fishes observed by station were Lox (x+1) transformed. A Bray-Curtis similarity matrix was then calculated and a hierarchical cluster analysis was performed. Using the similarity matrix, non-metric multi-dimensional scaling was performed and presented graphically using 45% similarity ellipses calculated from the Bray-Curtis cluster.

Table 2. Identified hectares and number of natural reefs in the SCB organized by biogeographic region.

	Oregonian	San Diegan	Total
Island	21587 (33)	8430 (44)	30017 (77)
Mainland	8214 (20)	10750 (21)	18964 (41)
Total:	29801 (53)	19180 (65)	48982 (118)

Oil platforms, artificial reefs, breakwaters and jetties were not included in this mapping effort because they are well mapped and not part of the random station draw. For the spatial scale aspect of this program, 60 natural rocky reefs (Figure 5; Table 4) from this map were randomly selected weighted proportionally to biogeographic region and reef size using EPA's Environmental Monitoring and Assessment Program (EMAP) (Stevens 1997). These sites and the polygons they represent can be observed as a layer in the attached file (Bight 08' Rocky Reefs.kmz). If a fixed monitoring site is included coincidentally in the random draw it will be used. When more than one monitoring site is included in a designated reef, the site to be used in the probabilistic design will be randomly selected. The final site sampling plan has a tiered design. The first layer is the 60 sites determined in the EMAP routine. The second layer is any CRANE site (Table 5). The final layer is any additional reef (Table 3).

Special studies are underway to enrich our understanding of additional rocky reef habitats in this nearshore region. These special studies are primarily focused on determining the role of artificial substrates (jetties, breakwaters, oil platforms, and artificial reefs) with respect to the natural reefs in the region. Artificial structures such as these comprise a large amount of additional and some cases critical reef habitat in the southern California Bight. As an example, the Federal Breakwater of the Port of Los Angeles and Port of Long Beach, spans seven miles and is one of the largest rocky reefs in the Bight. We are also conducting a intercalibration experiment between the CRANE protocols and Reef Check California methods.

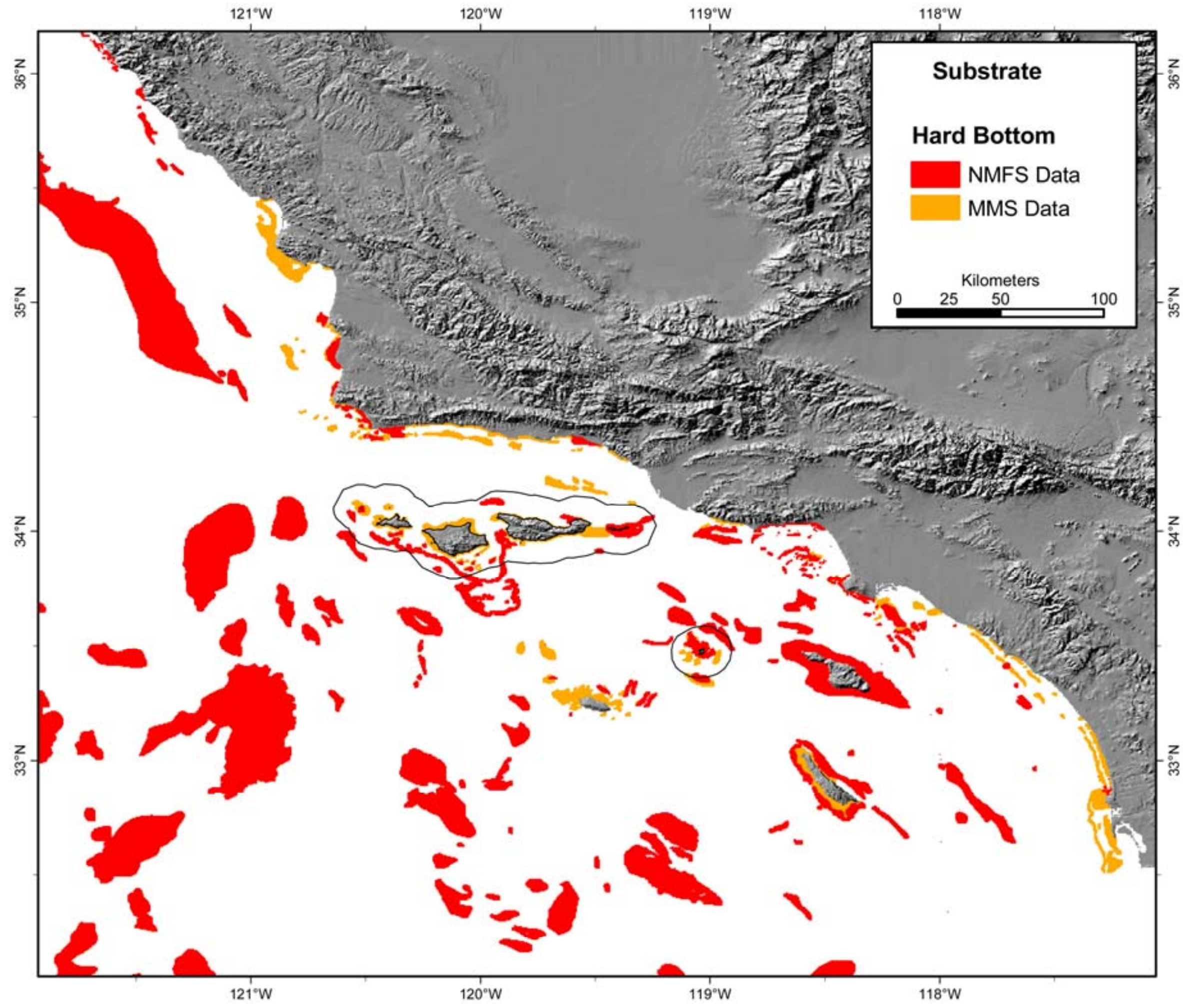

Figure 1. Location of hard substrate from NMFS and MMS databases. Gray line indicates Channel Islands National Marine Sanctuary boundary (source Kellner et al. 2005).

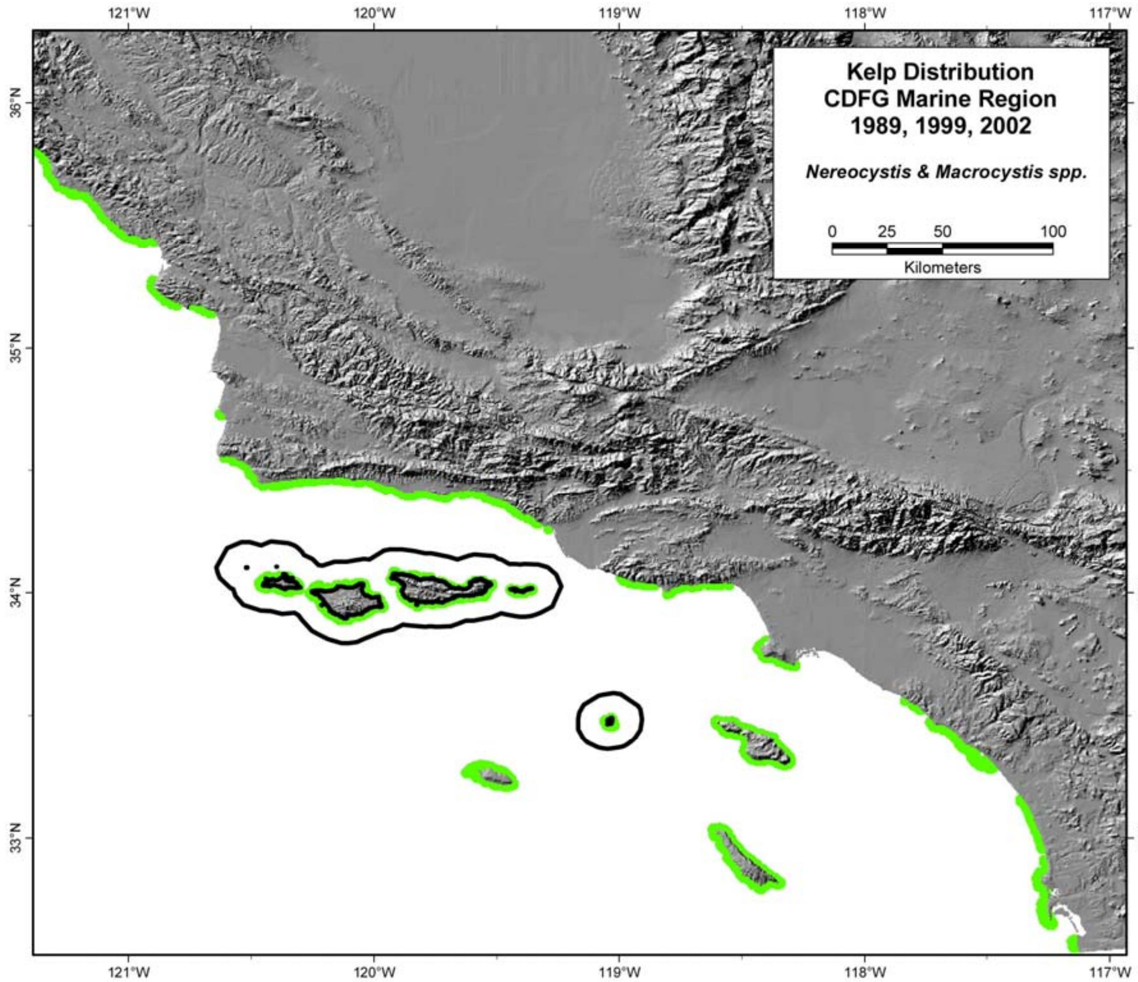

Figure 2. Kelp distribution off southern California. Black line indicates Channel Islands National Marine Sanctuary boundary (source Kellner et al. 2005).

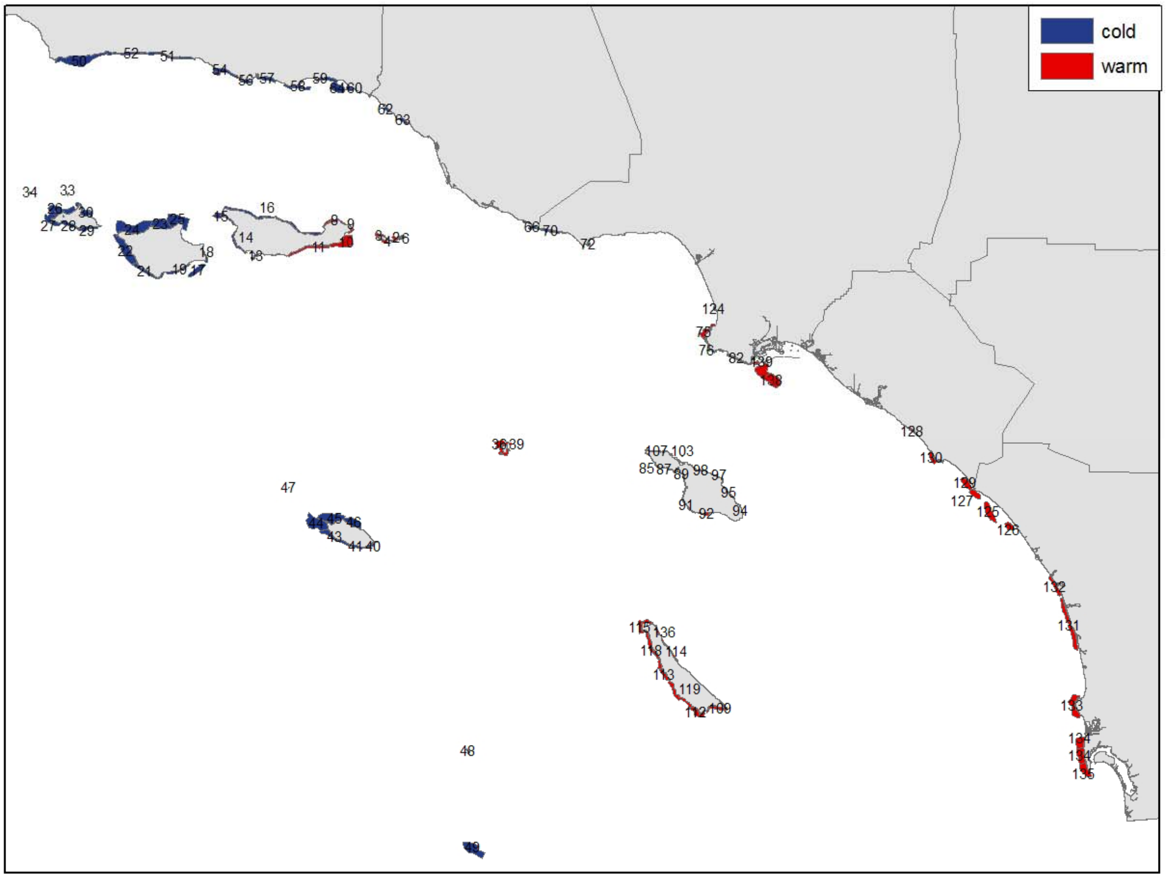

Figure 3. Rocky reefs of the SCB. Reefs are color coded by biogeographic province (cold vs. warm).

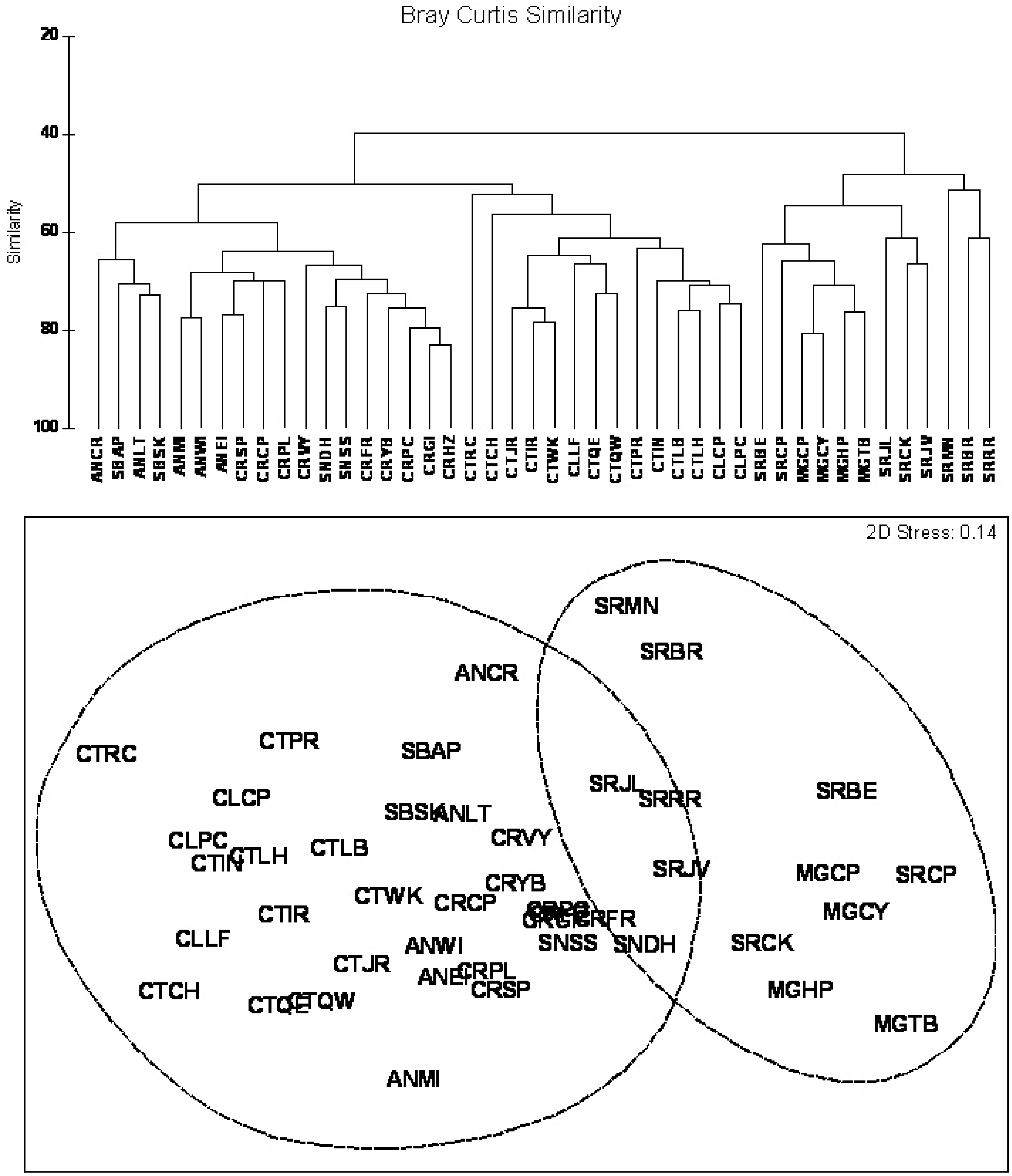

Figure 4. Bray Curtis similarity and MDS plot of the 44 sites sampled in the 2003 CRANE survey. Elipses in the MDS plot represent 45% similarity from the cluster analysis. Abbreviations are in Table 5.

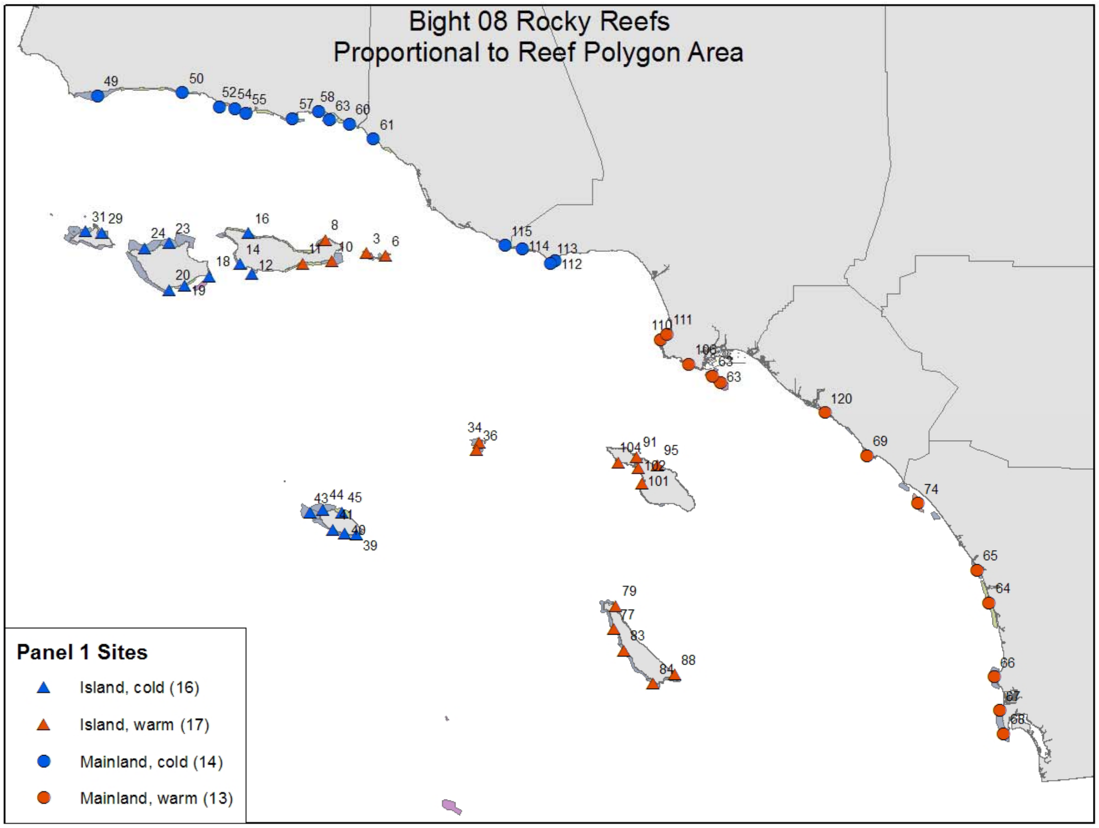

Figure 5. Reef sites (n = 60) identified for the spatial scale assessment in the Bight'08 rocky reef program.

Table 3. Identified rocky reefs in the SCB. Types 1 = major reef complex, 2 = patchy reef, 3 = cobble, 4 = offshore or pinnacle reef, 5 = artificial reef.

Id#	Region	Site	Bioregion	Temp	type	Longitude	Latitude
1	Anacapa	Landing Cove	Island	warm	1	119.369627	34.017134
2	Anacapa	The Hump	Island	warm	1	119.389852	34.012069
3	Anacapa	Port Rock	Island	warm	2	119.434176	34.018309
4	Anacapa	Cat Rock	Island	warm	1	119.419339	34.002545
5	Anacapa	Coral Reef	Island	warm	1	119.435770	34.008907
6	Anacapa	Lighthouse	Island	warm	2	119.368555	34.011497
7	Anacapa	East Fish Camp	Island	warm	2	119.386138	34.004564
8	Santa Cruz	Scorpions	Island	warm	1	119.577385	34.053269
9	Santa Cruz	San Pedro Point	Island	warm	1	119.526028	34.026019
10	Santa Cruz	Yellow Banks	Island	warm	1	119.553621	33.992587
11	Santa Cruz	Blue Banks	Island	warm	2	119.652433	33.984221
12	Santa Cruz	Gull Island	Island	warm	1	119.823857	33.950703
13	Santa Cruz	Malva Real	Island	warm	1	119.814399	33.958198
14	Santa Cruz	Morris to Kenton	Island	warm	1	119.867576	33.977131
15	Santa Cruz	Forneys	Island	warm	1	119.915993	34.056102
16	Santa Cruz	Painted Cave	Island	warm	2	119.768711	34.057342
17	Santa Rosa	Rosa Pinnacles	Island	cold	4	119.995417	33.916005
18	Santa Rosa	East Point	Island	cold	1	119.970487	33.940028
19	Santa Rosa	Ford Point	Island	cold	2	120.054263	33.911759
20	Santa Rosa	Johnson's Lee	Island	cold	1	120.105338	33.898383
21	Santa Rosa	Chickasaw	Island	cold	1	120.155571	33.908710
22	Santa Rosa	Bee Rock	Island	cold	1	120.219422	33.962372
23	Santa Rosa	Carrington Point	Island	cold	1	120.111106	34.031983
24	Santa Rosa	Rodes	Island	cold	1	120.194510	34.014893
25	Santa Rosa	Talcot	Island	cold	1	120.057656	34.046221
26	San Miguel	Castle Rock	Island	cold	1	120.438027	34.049591
27	San Miguel	Judith Rock	Island	cold	1	120.444870	34.025975
28	San Miguel	Miracle Mile	Island	cold	1	120.392388	34.022156

Table 3. Continued

Id#	Region	Site	Bioregion	Temp	type	Longitude	Latitude
29	San Miguel	Crook Point	Island	cold	1	120.335717	34.017362
30	San Miguel	Cuyler Harbor	Island	cold	1	120.342381	34.053673
31	San Miguel	Harris Point	Island	cold	1	120.364167	34.075961
32	San Miguel	Simonton Cove	Island	cold	1	120.396255	34.057399
33	San Miguel	Wilson Rock	Island	cold	4	120.402706	34.099588
34	San Miguel	Richardson's Rock	Island	cold	4	120.517911	34.101563
35	Santa Barbara	Santa Barbara north	Island	warm	1	119.035702	33.485468
36	Santa Barbara	Websters	Island	warm	1	119.053295	33.485825
37	Santa Barbara	Sutil	Island	warm	1	119.046474	33.462764
38	Santa Barbara	Southeast Sealion	Island	warm	1	119.031438	33.462940
39	Santa Barbara	S. Barbara offshore	Island	warm	4	119.018756	33.486777
40	San Nicolas	Daytona Beach	Island	cold	1	119.447355	33.216755
41	San Nicolas	Dutch Harbor	Island	cold	1	119.486060	33.216562
42	San Nicolas	Station 2	Island	cold	1	119.526073	33.227707
43	San Nicolas	Unnamed reef	Island	cold	1	119.572095	33.249066
44	San Nicolas	Boilers	Island	cold	1	119.606241	33.273616
45	San Nicolas	Station 3	Island	cold	1	119.562481	33.284383
46	San Nicolas	Alpha Foul	Island	cold	2	119.499252	33.277894
47	San Nicolas	Begg Rock	Island	cold	4	119.695590	33.362290
48	Tanner Bank	Tanner Bank	Island	cold	4	119.129956	32.696057
49	Cortez Bank	Cortez Bank	Island	warm	4	119.106164	32.447142
50	Mainland North	Cojo Anchorage	Mainland	cold	1	120.374059	34.442885
51	Mainland North	Refugio	Mainland	cold	1	120.081962	34.458965
52	Mainland North	Gaviota	Mainland	cold	2	120.216357	34.467947
53	Mainland North	Naples Reef	Mainland	cold	1	119.952646	34.422569
54	Mainland North	Inshore Naples	Mainland	cold	3	119.937859	34.430907
55	Mainland North	Ellwood	Mainland	cold	1	119.899818	34.418317
56	Mainland North	Isly Reef	Mainland	cold	1	119.861498	34.405226
57	Mainland North	More Mesa	Mainland	cold	2	119.797321	34.413186
58	Mainland North	Mohawk	Mainland	cold	1	119.701730	34.395016

Table 3. Continued

Id#	Region	Site	Bioregion	Temp	type	Longitude	Latitude
59	Mainland North	Carp Reef	Mainland	cold	1	119.612974	34.416802
60	Mainland North	Rincon	Mainland	cold	2	119.538869	34.392798
61	Mainland North	La Conchita Banana	Mainland	cold	0	119.505327	34.383204
62	Mainland North	Soledad	Mainland	cold	1	119.422241	34.342284
63	Mainland North	Pitas	Mainland	cold	2	119.372461	34.315649
64	Mainland North	Horseshoe Kelp	Mainland	cold	4	119.575412	34.393578
64	Mainland North	Horseshoe Kelp	Mainland	warm	4	118.233455	33.672677
65	Mainland North	Deer Creek	Mainland	cold	1	118.985003	34.059537
66	Mainland North	Deep Hole	Mainland	cold	1	118.963695	34.047706
67	Mainland North	Leo Carrillo	Mainland	cold	1	118.932455	34.042628
68	Mainland North	Nicholas Canyon	Mainland	cold	1	118.906695	34.037954
69	Mainland North	El Matador	Mainland	cold	1	118.889132	34.035605
70	Mainland North	Encinal Canyon	Mainland	cold	1	118.870112	34.034865
71	Mainland North	Point Dume	Mainland	cold	4	118.805859	33.999287
72	Mainland North	Little Dume	Mainland	cold	1	118.791930	34.005724
73	Mainland South	Flat Rock	Mainland	warm	1	118.405531	33.802309
74	Mainland South	Ridges	Mainland	warm	1	118.422430	33.789442
75	Mainland South	Rocky Point	Mainland	warm	1	118.432109	33.777127
76	Mainland South	R. Palos Verdes	Mainland	warm	1	118.422034	33.760970
77	Mainland South	Point Vicente	Mainland	warm	1	118.410031	33.739506
78	Mainland South	Long Point	Mainland	warm	1	118.397642	33.734580
79	Mainland South	Abalone Cove	Mainland	warm	2	118.377185	33.738297
80	Mainland South	Bunker Point	Mainland	warm	1	118.350807	33.724947
81	Mainland South	Three Palms	Mainland	warm	1	118.331725	33.719135
82	Mainland South	Whites Point	Mainland	warm	1	118.308558	33.710263
83	Mainland South	Point Fermin Reef	Mainland	warm	1	118.289713	33.703674
84	Santa Catalina	Ironbound	Island	warm	1	118.576783	33.447395
85	Santa Catalina	Ribbon Rock	Island	warm	1	118.564284	33.434804

Table 3. Continued

Id#	Region	Site	Bioregion	Temp	type	Longitude	Latitude
86	Santa Catalina	Cape Cortez	Island	warm	1	118.539646	33.433961
87	Santa Catalina	Lobster Bay	Island	warm	1	118.521935	33.428962
88	Santa Catalina	Pin Rock	Island	warm	1	118.503963	33.423253
89	Santa Catalina	Banana Rock	Island	warm	1	118.482481	33.389641
90	Santa Catalina	Little Harbor	Island	warm	1	118.482517	33.374831
91	Santa Catalina	Ben Weston	Island	warm	2	118.469013	33.328719
92	Santa Catalina	Salte Verde	Island	warm	1	118.424588	33.315527
93	Santa Catalina	East Quarry	Island	warm	1	118.304767	33.322821
94	Santa Catalina	Lovers Cove	Island	warm	1	118.317440	33.343604
95	Santa Catalina	Torqua	Island	warm	1	118.345908	33.370571
96	Santa Catalina	Hen Rock	Island	warm	1	118.367292	33.398468
97	Santa Catalina	Italian Gardens	Island	warm	1	118.377457	33.410770
98	Santa Catalina	Rippers Cove	Island	warm	1	118.429385	33.428534
99	Santa Catalina	West Quarry	Island	warm	1	118.465005	33.441274
100	Santa Catalina	Blue Cavern	Island	warm	1	118.477783	33.448763
101	Santa Catalina	Wrigley	Island	warm	1	118.487414	33.445887
102	Santa Catalina	Ship Rock	Island	warm	4	118.491654	33.463217
103	Santa Catalina	Eagle Reef	Island	warm	4	118.509774	33.459972
104	Santa Catalina	Lionhead	Island	warm	1	118.502080	33.451246
105	Santa Catalina	Indian Rock	Island	warm	1	118.529283	33.469253
106	Santa Catalina	Parson's Landing	Island	warm	1	118.546926	33.475941
107	Santa Catalina	Black Point	Island	warm	1	118.578625	33.476201
108	San Clemente	Lil Flower	Island	warm	1	118.361860	32.832279
109	San Clemente	Pyramid Cove	Island	warm	1	118.375970	32.818270
111	Santa Catalina	West Kelp	Island	warm	1	118.599881	33.468636
112	San Clemente	China Point	Island	warm	1	118.435938	32.805559
113	San Clemente	Eel Point	Island	warm	1	118.536149	32.900018
114	San Clemente	Navy Reef	Island	warm	1	118.516641	32.960678
115	San Clemente	Target Rock	Island	warm	1	118.606079	33.010859

Table 3. Continued

Id#	Region	Site	Bioregion	Temp	type	Longitude	Latitude
116	San Clemente	Northwest Harbor	Island	warm	1	118.590482	33.038714
117	San Clemente	Reflector Reef	Island	warm	1	118.565862	33.025713
118	San Clemente	West Clemente	Island	warm	1	118.569627	32.959319
119	San Clemente	East Clemente	Island	warm	1	118.488347	32.841186
120	Mainland South	Port of LA 1	Mainland	warm	5	118.271413	33.704050
121	Mainland South	Port of LA 2	Mainland	warm	5	118.257011	33.706796
122	Mainland South	Port of LA 3	Mainland	warm	5	118.254147	33.715719
123	Mainland South	Port of LA 4	Mainland	warm	5	118.266841	33.708359
124	Mainland South	King Harbor	Mainland	warm	5	118.398731	33.843268
125	Mainland South	San Onofre	Mainland	warm	3	117.545777	33.325690
126	Mainland South	Barn Kelp	Mainland	warm	1	117.486872	33.291764
127	Mainland South	San Mateo Kelp	Mainland	warm	1	117.593397	33.373749
128	Mainland South	Laguna Beach	Mainland	warm	1	117.784118	33.535041
129	Mainland South	San Clemente Reef	Mainland	warm	5	117.620651	33.402724
130	Mainland South	Dana Point	Mainland	warm	1	117.721284	33.461371
131	Mainland South	Cardiff-Encinitas	Mainland	warm	2	117.303287	33.043031
132	Mainland South	Carlsbad	Mainland	warm	1	117.345303	33.136072
133	Mainland South	La Jolla	Mainland	warm	1	117.285702	32.831748
134	Mainland South	Point Loma north	Mainland	warm	1	117.267481	32.724302
135	Mainland South	Point Loma south	Mainland	warm	1	117.254668	32.676597
136	San Clemente	Wilson Cove	Island	warm	1	118.551681	33.005913
137	Mainland South	Port of LA 5	Mainland	Warm	5	118.23185	33.714348

Table 4. The 60 sites randomly chosen for the probabilistic design, current research sites and CRANE sites within them.

Id#	Region	Site	Agency-Current Study Site	CRANE 2003
3	Anacapa	Port Rock	PISCO-West Isle	Anacapa West Isle
6	Anacapa	Lighthouse	PISCO-Lighthouse	Southwest Lighthouse
79	San Clemente	Reflector Reef		
77	San Clemente	West Clemente		
83	San Clemente	Eel Point		
88	San Clemente	Lil Flower		Little Flower
84	San Clemente	China Point		China Point
31	San Miguel	Simonton Cove		
29	San Miguel	Cuyler Harbor	PISCO- Cuyler and Harris Pt.	Cuyler and Harris Pt.
44	San Nicolas	Station 3		
45	San Nicolas	Alpha Foul		
43	San Nicolas	Boilers		
41	San Nicolas	Station 2		
39	San Nicolas	Daytona Beach		Sand Spit
40	San Nicolas	Dutch Harbor		Daytona Beach
34	Santa Barbara Island	Santa Barbara north		
36	Santa Barbara Island	Sutil		
91	Santa Catalina	Lionhead	VRG/LACSD	
104	Santa Catalina	Ironbound and Ribbon Rock	VRG/LACSD	
95	Santa Catalina	Rippers Cove	VRG/LACSD	
102	Santa Catalina	Pin Rock to Banana Rock	VRG/LACSD	Ripper's Cove
101	Santa Catalina	Little Harbor	VRG/LACSD	
16	Santa Cruz	Painted Cave	PISCO-Painted Cave and Hazards	Painted Cave and Hazards
8	Santa Cruz	Scorpions	PISCO-Scorpion Anchorage, Scorpion Point, Cavern Point, Potato Pasture, Coche Point	Coche Point and Scorpion
10	Santa Cruz	Yellow Banks	PISCO-Yellowbanks	Yellowbanks
14	Santa Cruz	Morris to Kenton		
11	Santa Cruz	Blue Banks	PISCO-Valley	Blue Banks
12	Santa Cruz	Gull Island	PISCO-Gull Island	Gull Island
23	Santa Rosa	Rodes	PISCO-Beacon Reef	Beacon Reef
24	Santa Rosa	Talcott	PISCO-Rodes Reef	Rodes Reef
18	Santa Rosa	East Point		
19	Santa Rosa	Ford Point	PISCO-Jolla Vieja	Jolla Vieja

Table 4. Continued

Id#	Region	Site	Agency-Current Study Site	CRANE 2003
20	Santa Rosa	Johnson's Lee	PISCO-Johnson's Lee South, Johnson's Lee North	Johnson's Lee
50	Mainland North	Refugio		
49	Mainland North	Cojo Anchorage	PISCO-Cojo Anchorage	Cojo
52	Mainland North	Naples Reef	PISCO-Naples Reef	Naples Reef
54	Mainland North	Ellwood		
58	Mainland North	Carp Reef		
55	Mainland North	Isly Reef		
63	Mainland North	Horseshoe Kelp		
57	Mainland North	Mohawk		
60	Mainland North	La Conchita Banana		
61	Mainland North	Soledad		
115	Mainland North	Deep Hole	VRG/SMBK	
114	Mainland North	Leo Carrillo to Encinal	VRG/SMBK	
112	Mainland North	Little Dume	VRG/SMBK	
113	Mainland North	Point Dume	VRG/SMBK	
63	Mainland North	Horseshoe Kelp SP	VRG/LACSD	
63	Mainland North	Horseshoe Kelp SP	VRG/LACSD	
111	Mainland South	Flat Rock	VRG/LACSD	
110	Mainland South	Rocky Point and Ridges	VRG/LACSD	Rocky Point
106	Mainland South	Bunker Point to Whites Point	VRG/LACSD	
120	Mainland South	Little Corona		
69	Mainland South	Dana Point		Dana Point
74	Mainland South	San Onofre		San Onofre
65	Mainland South	Carlsbad		Carlsbad
64	Mainland South	Cardiff-Encinitas		Encinitas
66	Mainland South	La Jolla	SDSU	La Jolla
67	Mainland South	Point Loma north	SDSU	Point Loma North
68	Mainland South	Point Loma south	SDSU	

Table 5. CRANE survey sites in the SCB and current commitment (occupied) in 2008 program.

Site Name	Code	County or Island	Latitude (N)	Longitude (W)	Occupied
Cojo	CJ	Santa Barbara	34.44508	120.41583	x
Naples[2]	NP	Santa Barbara	34.42218	119.95187	x
Cuyler	MGCY	San Miguel Island	34.05027	120.34587	x
Harris Point	MGHP	San Miguel Island	34.05278	120.33738	x
Tyler Bight	MGTB	San Miguel Island	34.02653	120.4067	x
Crook Point	MGCP	San Miguel Island	34.01718	120.32888	x
Rodes Reef	SRRR	Santa Rosa Island	34.0325	120.1072	x
Beacon Reef	SRBR	Santa Rosa Island	34.0492	120.0432	x
Monacos[2]	SRMN	Santa Rosa Island	33.9845	120.0087	x
Bee Rock	SRBE	Santa Rosa Island	33.9539	120.2119	x
Cluster Point	SRCP	Santa Rosa Island	33.9238	120.18945	x
Chickasaw	SRCK	Santa Rosa Island	33.8999	120.1361	x
Johnson's Lee	SRJL	Santa Rosa Island	33.8941	120.1079	x
Jolla Vieja	SRJV	Santa Rosa Island	33.9092	120.0677	x
Forney	CRFR	Santa Cruz Island	34.05303	119.90693	x
Painted Cave	CRPC	Santa Cruz Island	34.07287	119.87098	x
Hazards	CRHZ	Santa Cruz Island	34.05658	119.82117	x
Pelican	CRPL	Santa Cruz Island	34.03065	119.69665	x
Coche Point	CRCP	Santa Cruz Island	34.04497	119.60153	x
Scorpion	CRSP	Santa Cruz Island	34.04847	119.54637	x
Gull Isle	CRGI	Santa Cruz Island	33.9499	119.8236	x
Valley	CRVY	Santa Cruz Island	33.98433	119.64148	x
Yellowbanks	CRYB	Santa Cruz Island	33.99037	119.5545	x
Anacapa West Isle	ANWI	Anacapa Island	34.01698	119.43292	x
Anacapa Middle Isle	ANMI	Anacapa Island	34.00932	119.38877	x
Anacapa East Isle	ANEI	Anacapa Island	34.01767	119.36368	x
Cat Rock	ANCR	Anacapa Island	34.0035	119.4241	x
Southwest Lighthouse	ANLT	Anacapa Island	34.0116	119.3661	x
Malibu[2]	MB	Los Angeles	34.02785	118.69552	x
King Harbor	KH	Los Angeles	33.84143	118.39492	x
Rocky Point	RK	Los Angeles	33.78053	118.42793	x
Point Vicente	PV	Los Angeles	33.7441	118.41962	x
Dana Point	DP	Orange	33.47962	117.7257	
San Mateo	MT	Orange	33.38842	117.6008	
San Onofre	SO	San Diego	33.34445	117.55735	
Barn Kelp	BK	San Diego	33.28935	117.4898	
Carlsbad	CB	San Diego	33.12792	117.33693	
Encinitas	EN	San Diego	33.03408	117.29655	
Cardiff	CF	San Diego	32.9954	117.27813	
La Jolla	LJ	San Diego	32.8209	117.28505	x
Point Loma North	PLN	San Diego	32.72382	117.25965	x
Point Loma South	PLS	San Diego	32.68668	117.26618	x
Sand Spit	SNSS	San Nicolas Island	33.21622	119.44362	
Dutch Harbor	SNDH	San Nicolas Island	33.21288	119.47053	
Arch Point	SBAP	Santa Barbara Island	33.48633	119.02793	x

Table 5. Continued

Site Name	Code	County or Island	Latitude (N)	Longitude (W)	Occupied
South Kelp	SBSK	Santa Barbara Island	33.47085	119.02932	x
West Kelp[2]	CTWK	Santa Catalina Island	33.4718	118.60447	
Johnson's Rocks[2]	CTJR	Santa Catalina Island	33.47673	118.58887	
Isthmus Reef	CTIR	Santa Catalina Island	33.44782	118.48932	x
Intakes	CTIN	Santa Catalina Island	33.44708	118.4851	x
West Quarry[2]	CTQW	Santa Catalina Island	33.44245	118.47143	
Ripper's Cove	CTRC	Santa Catalina Island	33.42857	118.42992	x
East Quarry	CTQE	Santa Catalina Island	33.3157	118.30333	
Lobster Bay	CTLB	Santa Catalina Island	33.4276	118.52032	
Catalina Harbor[2]	CTCH	Santa Catalina Island	33.4262	118.51145	
Pin Rock[2]	CTPR	Santa Catalina Island	33.42352	118.50433	x
Little Harbor	CTLH	Santa Catalina Island	33.38925	118.48088	x
Little Flower	CLLF	San Clemente Island	32.84023	118.36855	
Pyramid Cove	CLPC	San Clemente Island	32.80873	118.43772	
China Point	CLCP	San Clemente Island	32.80873	118.43772	x

C. Quality Assurance and Quality Control

The rocky reef field leaders met on May 29, 2008 to review all field protocols in dry lab setting. Field audits and coordination are overseen by three regional QA/QC officers, each a principal investigator from CRANE, and will follow the format used during CRANE (Tenera 2006). QA/QC officers oversee the training of all personnel in their study region. This training first includes the oversight of the testing of field technicians with various types of training materials which includes techniques and taxonomic materials. In addition all field technicians are trained for fish size class estimations prior to commencing field work. After the oversight of the dry lab training, the QA/QC officers are responsible for auditing the field crews throughout the sampling season. The QA/QC officers and field leaders conduct at least one intercalibration field sampling event to insure consistency among the various field programs, with the objective of consistency in sampling techniques.

<u>QA/QC OFFICERS</u>

Northern Region-Dr. Jennifer Caselle (caselle@msi.cusb.edu)
Central Region-Dr. Dan Pondella (Pondella@oxy.edu)
Southern Region-Dr. Matt Edwards (Edwards@sciences.sdsu.edu)

D. Field Program

D.1 Sampling Unit

A sampling unit in this program is the equivalent of one-half of a PISCO or CRANE study site, which will be referred to as a sampling cell. A cell will consist of a fixed stretch of coastline, occupying at least 250 m of reef habitat. Within each cell four depth zones (if present) will be sampled. Each depth strata needs to be geo referenced. The core sampling unit for a PISCO/CRANE cell is three depth strata based upon the natural contours of a reef. These strata are the inner (~5m), middle (~10m) and outer (~15m) portions of a natural reef or kelp bed. In the Bight '08 program we have added a deep strata (~25m) when this habitat is available. Thus, the sampled target depths for sites are 5 m, 10 m, 15 m and 25 m contours (or equivalent inshore, middle, and outer and deep portions of a reef; Figure 6). Within each depth zone two benthic sampling protocols, Unified Point Contact (UPC) and macro invertebrate and algae (Swath), will be completed. For fishes, in each depth zone four benthic, mid-depth and canopy (when present) 30 m belt transects will be completed. If kelp reaches the surface, then the canopy transects are completed. The minimum sampling effort for a reef is the core sampling unit from PISCO/CRANE cell, which includes 12 benthic fish transects, 12 midwater fish transects, 12 canopy (when present) fish transects, 6 UPC and 6 Swath transects. 100 red and 100 purple urchins are size classed at each site. A team of four divers can sample a cell within a sampling day. Other sampling configurations are used depending on the specific distributions of rock reefs and depth profiles at a site as determined by the principal investigator. However, the same number of replicates for the core sampling unit would need to be completed.

Figure 6. Example of the four sampling depth strata on a natural reef.

D.2 Fish Sampling

The purpose of the fish sampling is to estimate fish density and length frequency distributions by species at each site. Good visibility is critical and a minimum of 3 m is necessary to conduct these transects. Within each cell, a total of four benthic, four middepth and four canopy (when present) 30 m x 2 m replicate transects are sampled. The sampled target depths for sites with three zones were approximately the 25m, 15 m, 10 m, and 5 m depths (or equivalent reef zones, deep, outer-edge, middle, and inshore portion), respectively. The height of the 'mid-water' transect varies as a function of bottom depth and is approximately half way up the water column. Canopy transects are conducted immediately below the kelp canopy when present.

Observers begin the transects by loosely clipping the end of the transect measuring tape to a kelp frond or placing it beneath a rock. The pair of divers swim in the pre-arranged compass direction for a distance of 30 m while counting and estimating the sizes of the fish. All conspicuous fishes encountered along the transects are recorded. Divers count and estimated total length (TL) of small fish (< 15 cm [5.9 in] TL) to the nearest cm, and larger fish (> 15 cm) to the nearest 5 cm (2.0 in) interval. If a school of fish (>10 fish) is encountered, the number of fish is estimated within each size group. The observer censuses fishes within the boundaries of an imaginary observation "box" slightly ahead of them as they swim along, sometimes stopping, scanning and searching within discrete areas of the "box" that is delimited by the 2 m transect width and natural features such as kelp plants or large boulders. The diver holds the data board in front of them and records data periodically so that they could maintain fish counts and size estimates with minimal distraction. If there is an intervening obstacle, the transect continued over it so long as the depth change was less than 2.5 m. If the obstacle is greater than 2.5 m in height, the transect circumvented it. Transects are completed even if sand is encountered. When there was sand for more than 5 m and it appeared that the habitat continued primarily as sand, the transect direction is changed to the minimum necessary to remain on rocky habitat. Physical data collected on each transect included observation depth (m), water temperature (Cº), horizontal visibility (m), surge (0-4 relative scale), and kelp canopy cover (%).

Transects are completed in 3-6 minutes depending on the number of fishes and the complexity of the habitat. Upon completing a transect, the divers then swim to the starting point of their next replicate transect within the same zone by choosing a haphazard direction along a similar depth contour. The preferred distance between transects is at least 10 m.

Canopy transects can be completed at two levels of expertise. 1) a fully trained scientist who is familiar with young-of-year (YOY) fishes. At this level fishes of all sizes are enumerated and size classed. 2) a normal scientific diver who is proficient in identifying and sizing fishes on benthic and midwater transects. These divers would record all adult and subadults by species and YOY's could be recorded at higher taxonomic levels.

D.3 Invertebrate and Macroalgae sampling

Swath, sea urchin sampling and uniform point contact (UPC) are conducted within each depth zone, a total of eight 30 m x 2 m replicate transects are sampled. Transects are deployed beforehand parallel to the bathymetry and maintained within a ± 2.5 m depth range. As with the fish transects, if there is an intervening obstacle, the transect is continued over it unless it was greater than 2.5 m in height, in which case the transect circumvented it. Visibility of at least 3 m is necessary.

D.4 Swath Sampling

The purpose of the swath sampling is to estimate the density of conspicuous, solitary and mobile invertebrates as well as specific macroalgae. Individual invertebrates and plants are counted along the entire 30 m x 2 m transect. Transects are completed even if sand is encountered but when there was sand for more than 5 m, the direction of the transect was changed to the minimum necessary to remain on rocky habitat. Divers slowly swim one direction counting targeted invertebrates (from a pre-printed list on the data sheet) and then swim back along the transect counting targeted macroalgae. Cracks and crevices were searched and understory algae pushed aside. No organisms are removed. Any organism with more than half of its body inside the swath area is counted.

The following size criteria applied to counting macroalgal species:

- *Macrocystis* plants taller than 1 m (3.3 ft), and number of stipes per plant at 1 m above the substrate. *Macrocystis* is not subsampled.
- *Nereocystis*, *Pterygophora*, *Laminaria setchellii* and *Eisenia arborea* taller than 30 cm (11.8 in)
- *Laminaria farlowii* with blade greater than 10 cm (3.9 in) wide
- *Cystoseira osmundacea* greater than 6 cm (2.4 in) wide
- *Costaria* and *Alaria* no size restrictions

Transects are divided into three, 10-meter segments. Species that occurred in high densities (e.g., purple urchins) are sub-sampled if greater than 30 individuals occurred within any of the three 10 m segments on a transect. *Macrocystis* is not subsampled. Normally a diver counts all target species within each 10 m segment, but when 30 individuals of one species are counted, the diver records the meter mark at which the threshold abundance is reached and then stopped counting that species for the remainder of that segment. The species continued to be counted at the start of each following segment and the same threshold abundance rule was applied. The subsampled abundances are then extrapolated per segment to calculate an estimated total abundance per transect. Considering their paucity for the majority of the SCB the size and species of any abalone is recorded.

D.5 Uniform Point Contact Benthos Sampling

Percent cover of substrate type, substrate relief and benthic organisms are recorded at each meter mark along the 30 m transect tape. Substrate percentages in the following categories are estimated within each 10 m segment: bedrock ($\geq$ 1 m), boulder (1 m), cobble ($\leq$10 cm), and sand. Substrate relief is the maximum relief within a rectangle centered on the point that is 0.5 meter along the tape and 1 meter wide (Figure 2-4). To contact benthic organisms, the line is pushed down and the species under the tape is recorded. If the line could not contact the substrate, the diver's finger was used to mark the spot. Epiphytes, epizooids and mobile organisms are not recorded. If the contact point was on a blade of *Laminaria*, brittlestars or the sea cucumber *Pachythione rubra*, the organism under the point is recorded and it is noted that the point was under one of these organisms. The superlayer is also recorded. In addition to quantifying benthic organisms, the following types of bare substrate are recorded, if contacted: rock, sand, shell debris, and mud. Considering their paucity for the majority of the SCB the size and species of any abalone is recorded.

D.6 Sea Urchin Sampling

In order to gain a more accurate estimate of the size frequency distribution of local sea urchins populations, specimens are collected and measured in the areas on and around each transect. In areas where urchins are abundant at least 100 red and 100 purple urchins are collected and their test diameters measured to the nearest centimeter. Specimens were collected from each depth zone and multiple areas of the site, if possible. To avoid bias in size measurements, all emergent urchins are collected from each patch unless the patch is very large, in which case only a portion of the patch is completely collected. Urchins are measured either underwater or on the boat. Very small urchins (< 1 cm) under the spine canopy of larger urchins are not measured. If it is not possible to collect 100 of each species within a total dive time of one hour, the search for urchins is suspended. Considering their paucity for the majority of the SCB the size and species of any abalone is recorded.

E. Special Studies

E.1 Oil Rig Surveys

Oil rigs have a previously determined optimal sampling strategy due to their configuration. Midwater community surveys will be conducted via SCUBA transects at six of the seven petroleum platforms on the San Pedro Shelf (Edith, Eureka, Eva, Esther, and the Ellen-Elly complex and five in the Santa Barbara Channel (Gilda, Grace B, Platform B, Holly, and Irene. Conspicuous fish counts will be collected via fish transecting methods described by Love et al. (2003). A dive team descended to the first crossbeam above 31 m and followed a rectangular transect pattern along the major horizontal crossbeams. Upon completion at the 30m level, divers ascended to the next crossbeam and repeat the same transect pattern. Every major horizontal crossmemeber was surveyed from three major depth zones: Level 1, range 1 to 10 m; Level 2, range 11 to 20m; Level 3, range 21 to 32 m (Love et al. 2003). Survey divers identified, counted and estimated the size for all fish encountered in a standardized volume along the structure. Fish size estimation was done using five centimeter bin units. The second diver functioned as a safety diver, as well as periodically operating a digital video camera. The video footage was used for groundtruthing fish identification and as a method of controlling for observer variability.

E.2 Port of Los Angeles Surveys

Studying the reefs of the Port of Los Angeles, situated at the center of the SCB, is important for a variety of reasons. First, the Federal Breakwater and associate rocky groins constitute the largest reef complex in the SCB. What percentage of the total reef habitat in SCB this represents is currently unknown. From the data products generated under the first study question, we will be able to determine the contribution of these structures to amount of hard substrate in the Bight. Secondly, there is limited data on the biological resources associated with these reef structures (Froeschke et al. 2005). Due to the high relief reefs and continual kelp coverage, these structures contribute significant amounts of resources (biomass and species diversity) to the region. The Port of Los Angeles has long been a focus of pier, shore and jetty fishing. These activities are likely to increase in scope and magnitude in and around the Port. There is the long term potential to increase these nearshore-fishing opportunities and creating a research program that will generate data to evaluate these opportunities is timely and necessary. Thus, there is a necessity to collect and interpret data about the organisms, which are being extracted by these activities. In addition, this research effort will augment the current biological baseline survey being conducted in the Port.

Five sites (Figure 7) in the Port during the 2008 sampling season will be surveyed by the Southern California Marine Institute.. The first is the Federal Breakwater proximate to Cabrillo Beach. This site will be particularly important for generating data that can be used in the development of a fishing pier at that location. The second and third sites are Federal Breakwater around Angel's Gate. These sites are intensively fished and due to a variety of physical factors, (i.e. depth, relief, currents) support a diverse kelp and rocky reef ecosystem that is highly productive. The fourth site is the rocky groin on the perimeter of the shallow water habitat. These types of habitats were shown to be highly productive in San Diego Bay (Pondella et al. 2006). The fifth site is the rocky perimeter of Pier 400.

Figure 7. Study sites in the Port of Los Angles for the Bight 08' Rocky Reef study.

E.3 Artificial Reef Surveys

Known artificial reefs in the SCB have been mapped and are included as their own GIS layer. Surveys of artificial reefs will follow the same protocols as the natural reefs. The principal investigator based upon reef configuration will determine the allocation of replicates. In addition to the five sites in the Port of Los Angeles and the breakwaters of King Harbor, Redondo Beach we are targeting all of the artificial reefs in Los Angeles and Orange Counties.

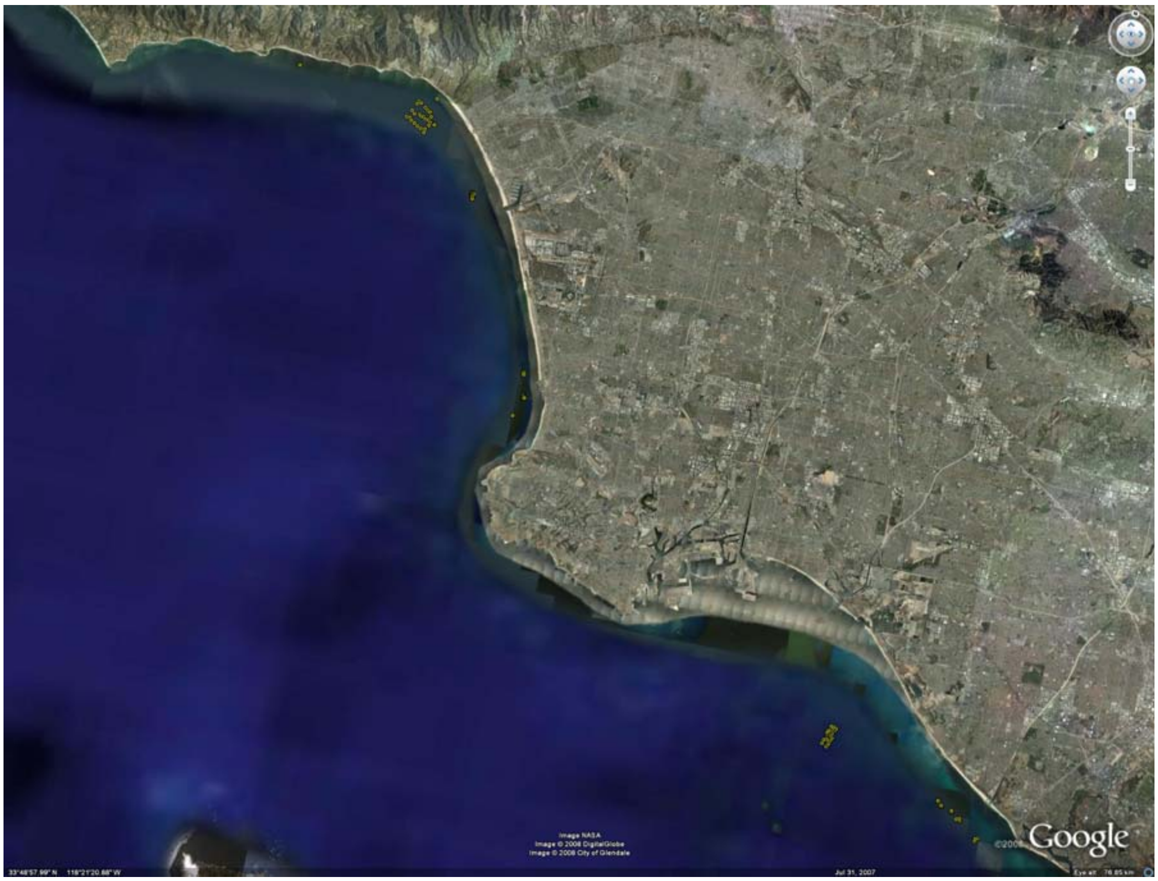

Figure 8. Locations of artificial reefs in Los Angeles and Orange Counties.

E.4 Reef Check California (RCCA) Surveys

RCCA protocol has been modeled after the CRANE and PISCO methods. The sampling unit is identical to CRANE/PISCO methods, 30 x 2 m (x 2 m for fish). An RCCA site is 250 m of linear coastline while CRANE/PISCO sites are 500 m split into 2 areas of approximately 250 m. When compared to half, either the upcoast or downcoast area, of a CRANE/PISCO site RCCA has the same sample size for benthic surveys (n = 6) and a slightly higher replicate count, 18 instead of 12 replicate transects, for fish surveys. When designing a monitoring protocol, it is important to match the scientific skills of the intended users with the scientific requirements of the program. By selecting a subset of key indicators and requiring rigorous training, testing and certification, the RCCA monitoring protocol has been specifically designed to suit the State's management needs at a level that can effectively utilize the vast resources of community-based RCCA trained divers. The RCCA protocol indicator species list is smaller overall than the PISCO/CRANE list in order to ensure the data quality of RCCA surveys, while still providing key information needed to improve nearshore marine management in California. All the RCCA indicator species are also surveyed by PISCO/CRANE. All comparable metrics from the RCCA surveys will be used.

In Bight 08' we will conduct a calibration experiment between the RCCA and those being conducted by volunteers and scientific divers. These will be blind comparisons conducted this fall. The remaining RCCA surveys and dates are listed in Table 6. The regional coordinators of the scientific dive teams will coordinate with Colleen Wisniewski RCCA's Southern California Program Manager (colleen@reefcheck.org; 619.255.9706) to survey the remaining unoccupied sites in the reef draw so that they may be as temporally close to the RCCA surveys as possible. SCCWRP and the rocky reef committee in coordination with RCCA will examine all common metrics from the two programs in the calibration study.

Table 6. Remaining RCCA sites that overlap with Bight 08' stations in the SCB and potential sampling dates.

Site_Name	Latitude	Longitude	Fall 2008 (Sept-Nov)
Naples Reef	34.4219	-119.9515	10/4/2008-potential date
IV Reef	34.4031	-119.8661	10/11/2008-potential date
Cueva Valdez	34.055	-119.81	10/29/2008
Malaga Cove	33.8037	-118.3984	begin 0ct 12
Little Corona Del Mar	33.5898	-117.8687	oct 25 begin
Heisler Park - (LBAOP)	33.5423	-117.7950	oct/nov
Crystal Cove-(LBAOP)	33.5714	-117.8412	oct/nov
Salt Creek (LBAOP)			oct/nov
Torqua	33.3830	-118.35	late sept
Del Mar	32.9714	-117.2722	Oct LG boat??
S. Solana Beach			maybe late October??
North Hill Street (N Point Loma)	32.7286	-117.2650	start sept 13
BroomtailReef (S Point Loma)	32.6942	-117.2681	start Oct 18

F. Anthropogenic Effects

Critical to various resource managers concerns and needs is the development of a reef index of health. The data generated under the second study question will include all parameters necessary for the evaluation of this index. We will form a subcommittee to oversee this process study. The initial index development will begin with at least two datasets (CRANE and VRG SMBRC reef study) and optimally then be applied to the Bight 08' data.

We currently recognize that there are various natural and anthropogenic factors affecting reef communities on localized scales. These include harmful algal blooms (HAB), turbidity, river plumes, sedimentation, overfishing, pollution, marine protected areas (MPA's), and kelp bed restoration. Our goal is to overlay the natural biological conditions determined in this program with the various data layers generated in the other Bight 08' programs enabling the beginning of a understanding of how these various factors may relate to each other. This will facilitate perhaps more detailed process studies of these potential effects.

G. Liability and Diver Safety

Divers must adhere to the "scientific diving" guidelines of the American Academy of Underwater Sciences (AAUS) or equivalent dive programs. "Scientific diving" gives the researcher much more regulatory flexibility for complex tasks than "commercial" divers. Scientific diving is defined in Cal/OSHA regulations in Title 8 of the California Code of Regulations (8CCR) in section 6051 et. seq. The parallel Federal OSHA reference is 29 CFR 1910.402. Federal and Cal/OSHA have granted an exemption from the rigid commercial diving standard/regulations, for scientific diving. This exemption is allowed ONLY if the diving operations are performed solely as a necessary part of a scientific, research, or educational activity by employees and students whose sole purpose for diving is to perform scientific research tasks. In addition to this mandate, the following elements of a scientific diving program must be established and maintained to qualify as a scientific diving program. Strictly adhering to safe scientific diving practices under the guidelines of AAUS allows the Cal/OSHA exemption to be enacted. In addition participating institutions must carry a minimum of $1,000,000 general liability insurance.

Reef Check California (RCCA) utilizes volunteer divers. They use very specific language when divers go through the training course emphasizing that divers conduct RCCA survey dives at their "own will" and they use "the safe diving practices they were taught in their scuba certification course". When divers go through a RCCA Training Course the RCCA staff who teach the course are covered by a group professional liability insurance policy with a $2 million aggregate which they purchase through NAUI. The policy provides the typical coverage all scuba instructors carry in California. The divers sign NAUI releases, an RCCA release, and a release for whatever dive charter boat we use for the training.

For this reason, the vast majority of RCCA surveys are NOT conducted under a home institution's AAUS auspices, however, basic scientific guidelines outlined by AAUS are followed (e.g. alternate air souce, buddy system, etc.). RCCA does have divers that are AAUS affiliated from university and agency partners (i.e. UCSB, HSU, CDFG and MLML) that do conduct RCCA dives under AAUS auspice of their home institution when we use boats that require that, such as CDFG or Sanctuary/NOAA boats for surveys. The home institution writes the LOR and they assume the liability for that diver. For the actual surveys volunteer divers conduct them at their "own will" meaning that they were going diving anyway and chose to conduct a RCCA survey when they are underwater. They often charter boats for surveys and these operate just like any dive charter in that the vessel operator assumes the liability for all divers on the boat.

H. Timeline and Report Chapters

Timeline
Field Sampling: 6/1/2008-12/31/2008
Data Submittal: 3/31/2009
QA/QC: 5/30/2009
Analysis>Oral Report: 12/31/2009
Written Report: 6/30/2010

Chapters
Marine Protected Areas
Time Series Assessment
Assessment Index Development
Reef Mapping
Biological Assemblages
Artificial reef vs natural reef comparison
Rigs vs natural reef comparison
Utilization of RCCA data
Integration with other Bight 08' components

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