Biological Surveys of Buck Gully and the Nearshore Rocky Reefs of Orange and North San Diego Counties

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Juvenile Garibaldi at Buck Gully in 2013, photo credit J. Williams.

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Summary

- From 2008 to 2013, 44 rocky reef surveys were conducted along the distinct stretch of the Orange and North San Diego County coastline including Buck Gully. The nearshore reef habitat at Buck Gully is comprised of high relief benches that transition to boulder habitat in its deeper reaches. The outer edge of the reef is a sand rock ecotone.
- Overall the habitat quality at Buck Gully was high. The benthos was nearly completely covered with living organisms until it transitioned at the rock sand interface at its outer edge. This reef supports a vibrant Giant Kelp community with the typical and expected fish, algae and invertebrate components.
- There were high densities of green and pink abalone, both protected fishery species. These were the highest densities observed in Orange County and North San Diego County during these surveys.
- The reef most similar to Buck Gully and potentially the best reference is Crystal Cove. These two reefs have similar benthic structure, general physical oceanographic parameters, and appear to have comparable biotic structure.
- Indicators of pollution associated with sedimentation and turbidity were not found to be structuring the community at Buck Gully. Sedimentation and associated turbidity appear to have a greater influence on these reef communities to the south.
- Vessel use was monitored from 2008-2013 and the Buck Gully area was primarily accessed by commercial and recreational boaters and vessel use did not change with reserve implementation.
- We did not observe anthropogenic debris in the surveyed area.
- We were not able to ascertain other types of pollution associated with poor water quality within the scope of this study.

Abalone creating zebra goby habitat at Buck Gully in 2013. Photo Credit J. Williams

Introduction

The rocky reef fauna of the Orange County and North San Diego County Coastline constitutes a unique biological zone (Pondella et al. 2011). Nearshore reefs in this area are proximate to the shoreline, typically associated with the palisades and generally end at a depth of 15-20 m. This stretch of coastline has a characteristic warm water fauna (San Diegean) and has a southern exposure. Wave exposure is a significant factor in structuring nearshore Giant Kelp communities (Reed et al. 2011). This coastline is also unique due to the numerous estuaries, coastal lagoons, rivers and embayments that empty into it. The link between these watersheds and associated runoff, the potential eutrophication, pollution and sedimentation issues has been largely unexamined with respect to nearshore rocky reefs and kelp beds. The influence of these processes and their effects on water quality in the region may have significant impacts on rocky reefs in the Southern California Bight (North 1964; Foster and Schiel 2010; Pondella et al. 2011). These impacts can be ascertained through physical and/or chemical effects. Physical effects have been more intensively studied and link turbidity from watersheds with deterioration of reef quality (Pondella et al. 2011; Pondella et al. 2012). Turbidity plumes can reduce light penetration inhibiting the growth of understory and turf algae. Biological communities are sensitive to these turbidity plumes and exhibit fauna that are indicators of these processes. For instance, Tubeworms, especially sand tube worms, and bryozoans are organisms that are specifically adapted for turbid conditions and outcompete other benthic reef taxa. Chronic sedimentation and associated turbidity will also scour reefs in nearshore high energy environs causing reefs to become denuded. At the extreme, unabated sedimentation will bury reefs. Kelp beds are also sensitive to chemical impacts associated with poor water quality (Fink and Manley 2011). Eutrophication can cause reefs to be stressed and in some instances result in urchin barrens (North 1964). Biological characteristics of water quality impacts on these nearshore rocky-reef habitats include: loss of kelp beds, reduced understory and turf algae density, and urchin barrens. The challenge is to understand the nearshore biological and physical processes to determine the relative impacts.

Runoff from Buck Gully feeds into the Newport Beach Marine Life Refuge ASBS (ASBS 32; Figure 1)(Weston 2009). The outline of the reef can be seen from this satellite image and it is clear that the reef habitat is immediately upcoast and downcoast of this freshwater input. Whether or not the reef is buried from sediment originating in the watershed is unknown, but there is a habitat break at Buck Gully. This reef habitat supports a canopy of Giant Kelp as can be observed from aerial surveys (Figure 2)(MBC 2013). This canopy along the Newport Coastline has been increasing since 2006 (MBC 2013). From both satellite and aerial imagery we know that there is significant subtidal rocky reef habitat in the Newport Beach Marine Life Refuge and that this habitat is immediately proximate to Buck Gully.

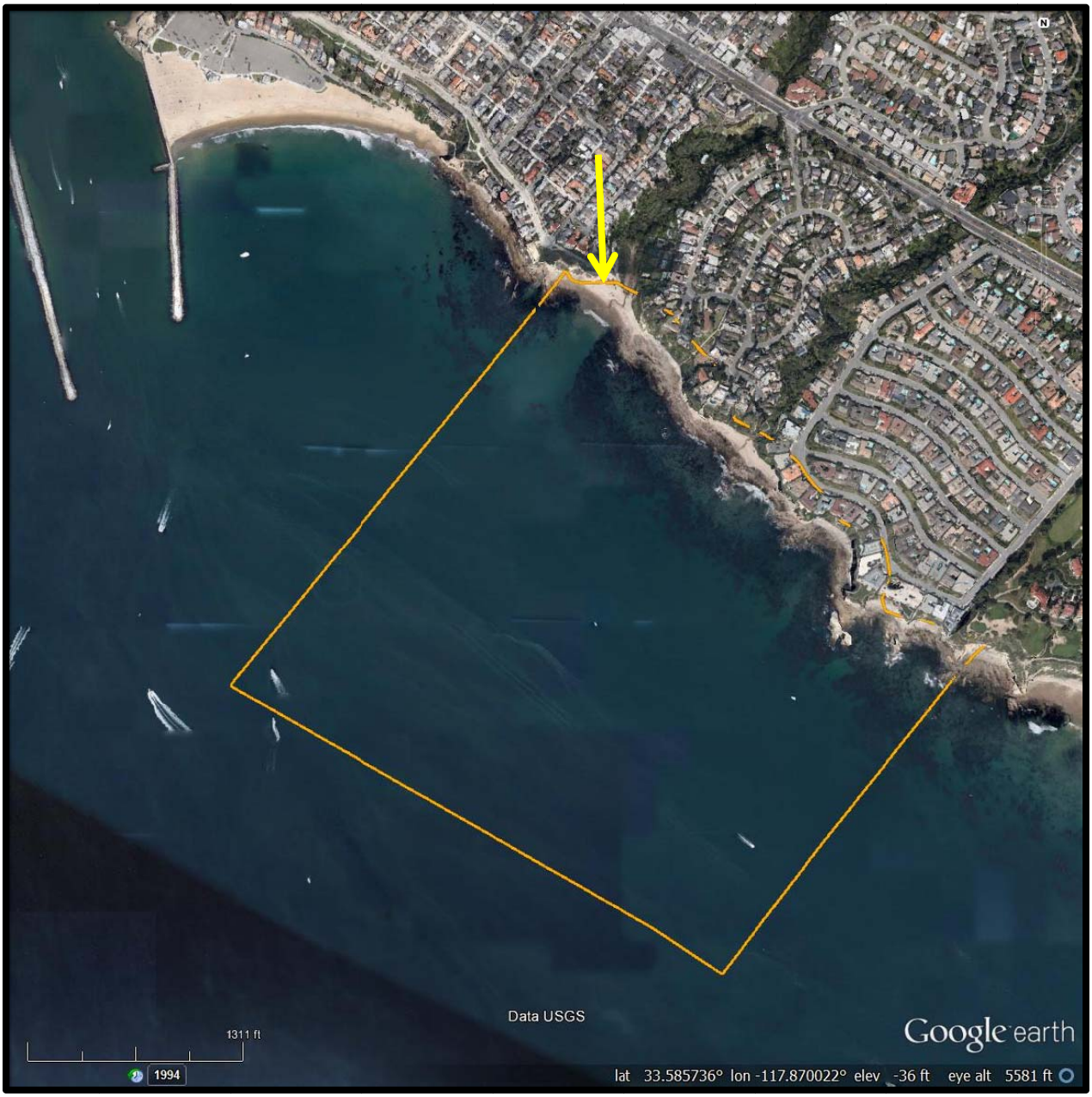

Figure 1. Newport Beach Marine Life Refuge ASBS (orange outline). The mouth of Buck Gully is at the end of the yellow arrow.

Figure 2. Newport Beach Marine Life Refuge ASBS (orange outline). The mouth of Buck Gully is at the end of the yellow arrow and Giant Kelp canopy is in red.

Turbidity plumes, observed from Newport Harbor, have the potential to impact this region (Weston 2009)(Figure 3). At the end of the hydrograph, the concentration of particles coming from Newport Harbor is modeled to influence this reef habitat. The salient issue is the relative impact that Newport Harbor has on these compared to other plumes in the region. In particular, runoff during rain events is not uniform throughout the region (Nezlin 2005). The complex dynamics of the various watersheds and their spatial impacts are not well understood. While these complexities are beyond the scope of this report, determining how well the reefs proximate to Buck Gully are performing relative to other reefs in the region will provide insights into the relative impacts of its freshwater effluent and the plume from Newport Harbor.

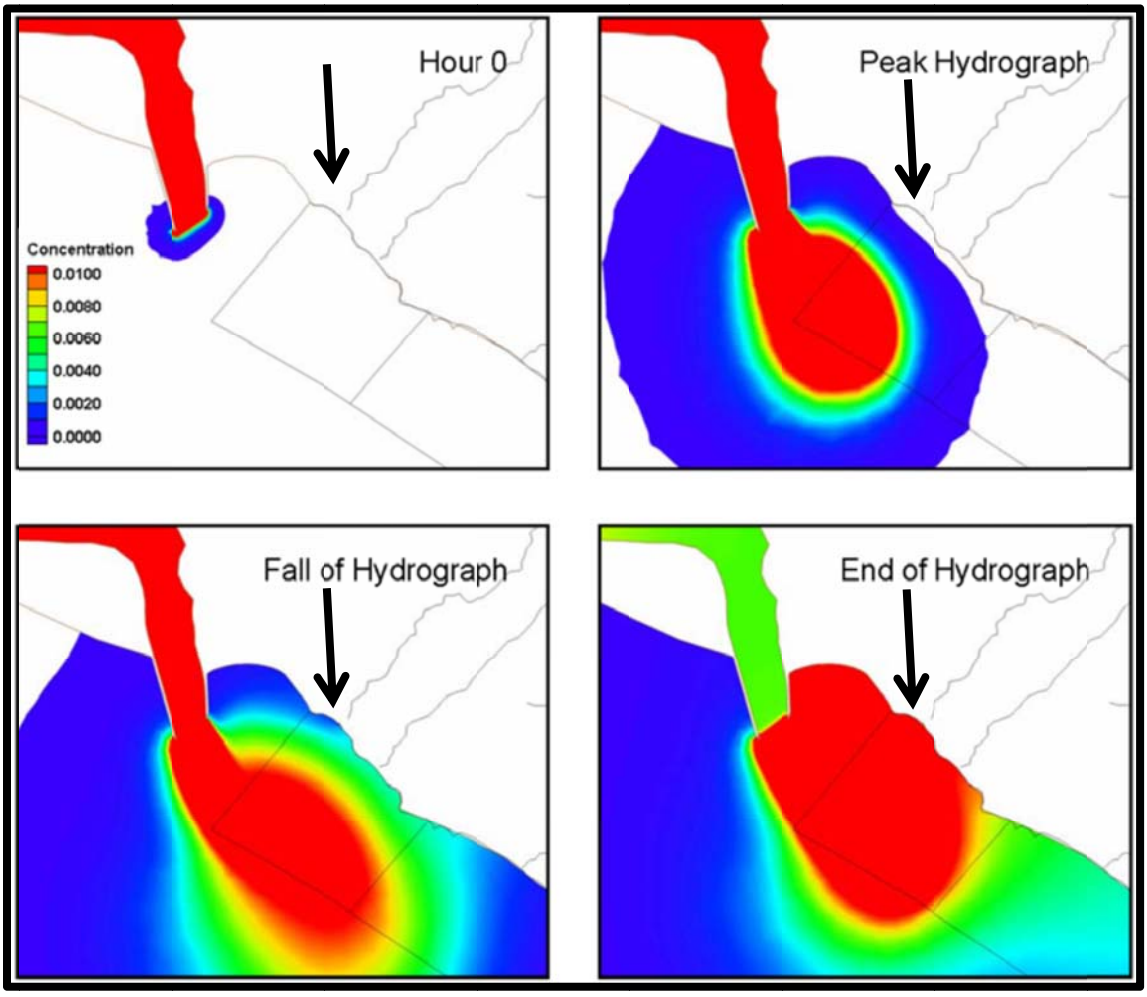

Figure 3. Maximum wet weather loading from Newport Harbor (Weston 2009). The mouth of Buck Gully is at the end of the black arrow.

Rocky Reef Surveys

Kelp beds and rocky reefs along the Orange and North San Diego County coastline were surveyed (Pondella et al. 2011; Claisse et al. 2012; Claisse et al. 2013) from November 7, 2008 to August 15, 2013 at 44 sites (Table 1) using the CRANE (Cooperative Research and Assessment of Nearshore Ecosystems (see Appendix I for methods). Barn Kelp, Crystal Cove, Heisler Park and Little Corona were surveyed during the Bight '08 Rocky Reefs program. All the remaining sites, with the exception of Buck Gully were surveyed in 2011 and 2012 during the MPA Baseline Assessment of the newly established Marine Protected Areas in the Southern California Bight. In 2013, Buck Gully was surveyed. Five surveys, two at Buck Gully and three at Little Corona, were conducted within the Newport Beach Marine Life Refuge ASBS (Figure 4). Benthic reef characteristics were quantified and data used for this study were drawn from the 2011-2013 surveys (Appendix II). The abundance of macrofauna (fishes, invertebrates, and algae; Tables 2-3) was reported from these surveys from the swath and fish components (Appendix III and IV).

Figure 4. Location of Buck Gully (yellow diamonds) and Little Corona (red squares) CRANE surveys conducted in the Newport Beach Marine Life Refuge ASBS (orange outline). The mouth of Buck Gully is at the end of the yellow arrow.

Reef Substrate

In the benthic characterization of these nearshore reefs, they were comprised of primarily bedrock habitats (Appendix II). On average 72.3% of these reefs were bedrock, 9.5% boulders, 6.3% cobble and 12.0% sand. The largest fraction of reefs were comprised of 0.1-1 m relief, followed by low relief benches (0-0.1 m relief; 31%) with mixed high relief components (>1 m relief, 24%). The reef habitat was heterogenous. The inner portion of Buck Gully was all bedrock, with relatively high relief. At the outside edge of the reef, it transitioned at a relatively shallow depth (~10 m) to sand. Emblematic of this transition was the increase of boulder, cobble and sand fractions in the habitat (Appendix II). The benthic structures of the reefs at Buck Gully were most similar to those found at Crystal Cove (Figure 2). The benthic reef habitat at Buck Gully and Crystal Cove were part of the reef cluster that are characterized by high relief and bedrock (Figure 2).

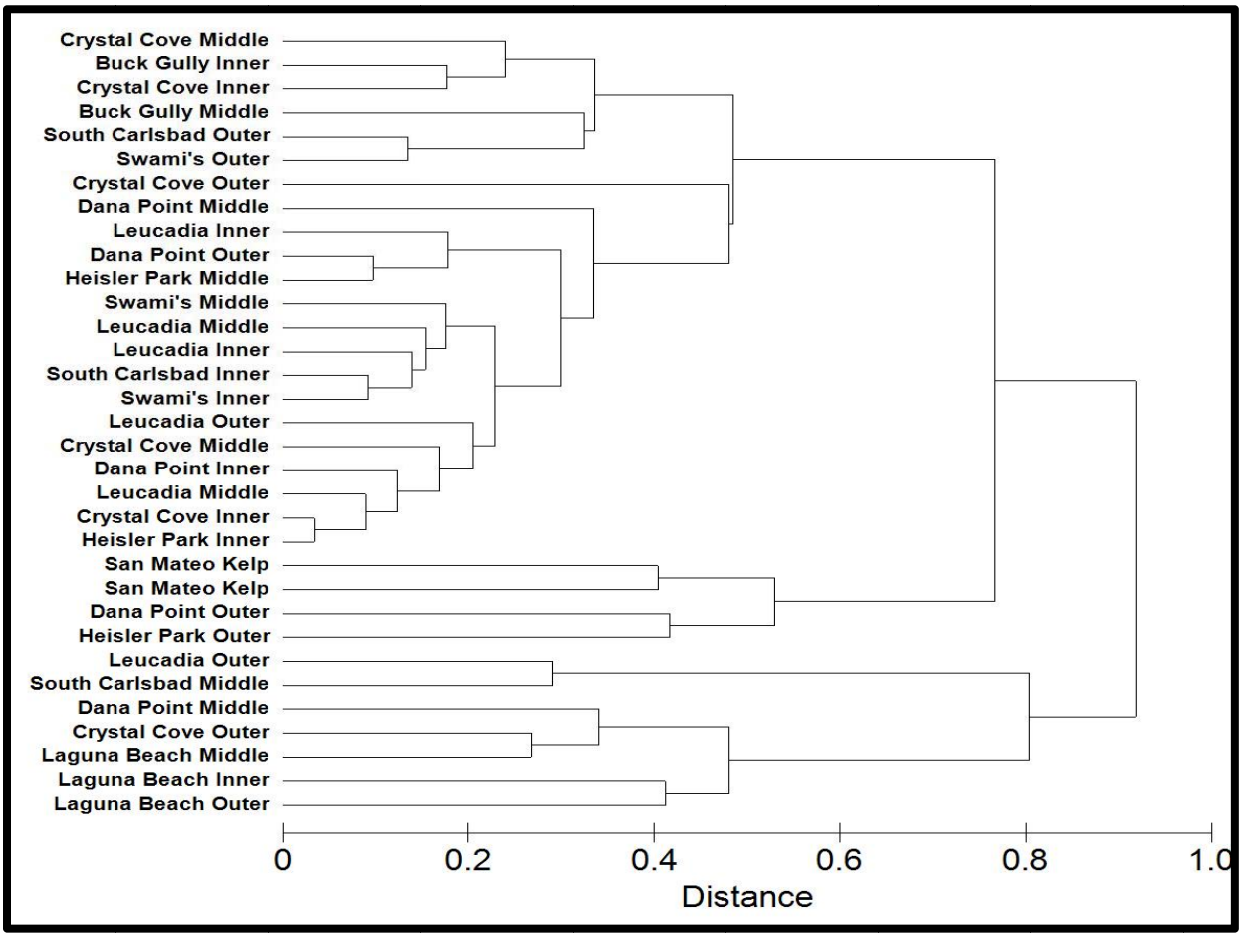

Figure 5. Reef habitat characterized by relief and substrate type using single-linkage Euclidean distances with group averages.

The shallow portion of the Buck Gully reef was dominated by erect coralline algae (54%), surfgrass (*Phyllospadix* sp.; 17% and other red erect algae (turf algae; 14%). The reef was completely covered by biotic components (Appendix II) as opposed to the outer portion. The offshore portion of the Buck Gully reef had fractions of abiotic cover (bare rock 3%, bare sand 8%, and shell debris <1%). These fractions plus the presence of *Diopatra ornata* (ornate tubeworms) and bryozoans are characteristic organisms associated with sand inundation and associated turbidity. Using benthic habitat characteristics (Appendix IV) reefs in this region vary continually along a gradient (Figure 6).

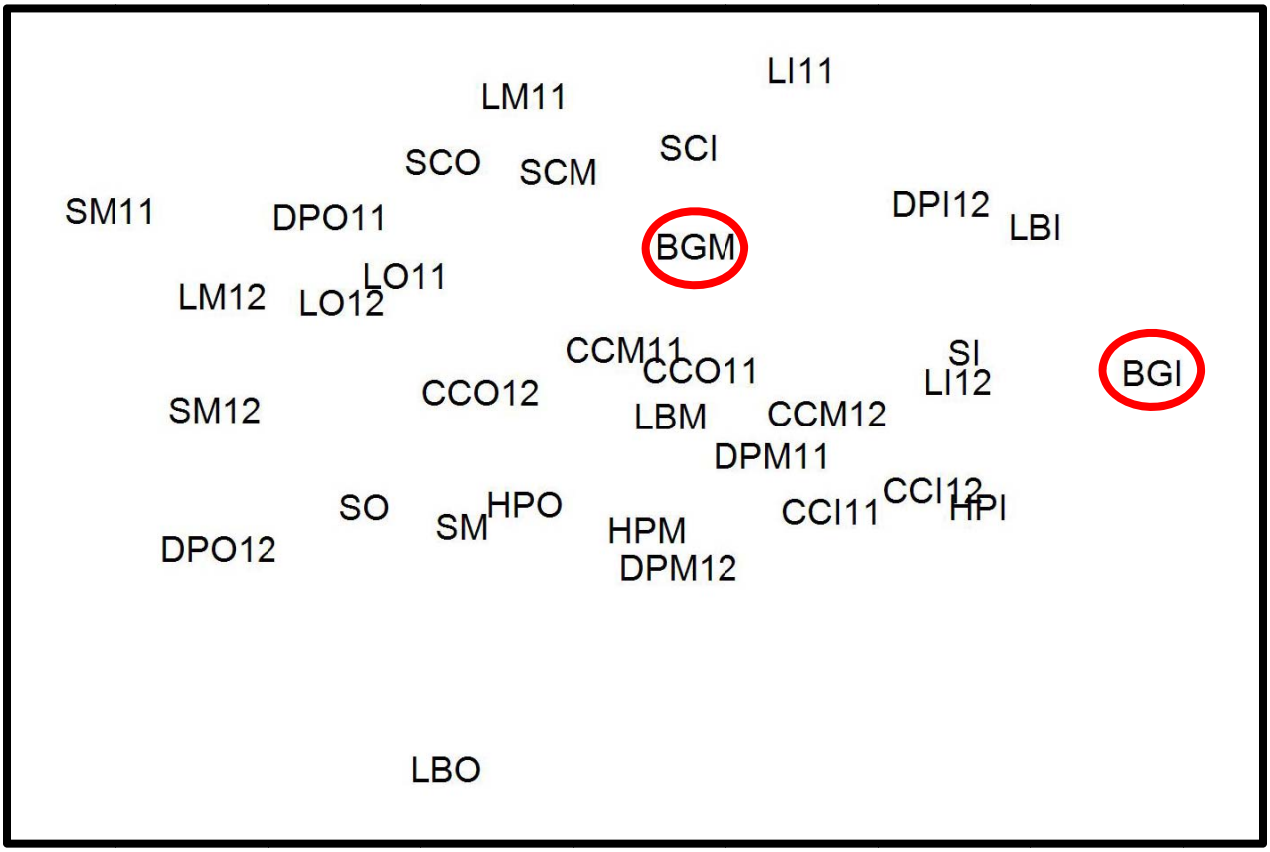

Figure 6. This is a non-metric multidimensional scaling (nMDS) plot of the benthic cover character using Bray-Curtis similarity matrix with a square root transformation (Stress = 0.17). Stations are defined by their acronym, depth strata and year; year and depth are included only where they vary. Buck Gully stations are circled in red.

The outer edge of Buck Gully reef is in the middle of this continuum represented by the lower axis. The inner portion of the reef defines the right edge of the first axis. This analysis of reef benthos appears to be related to turbidity and associated sedimentation effects. As an

example, overlaying the percent contribution of erect-coralline algae the reefs vary as a component of this feature (Figure 7). In contrast, having reef fractions covered by sediment or mud, corresponds to the left side of this featureless variable. Based upon these multivariate techniques it appears that the most appropriate reference reef for Buck Gully is Crystal Cove.

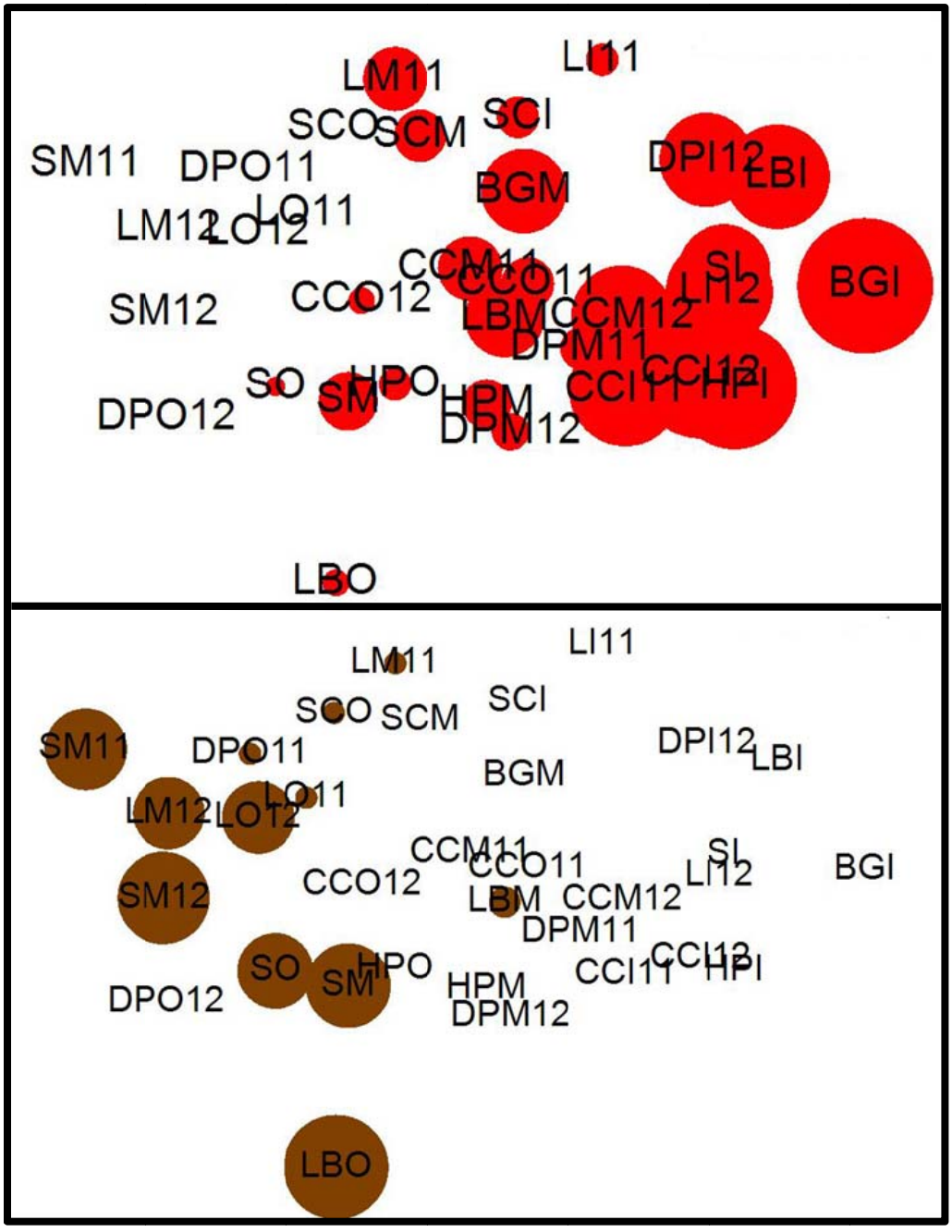

Figure 7. Overlaid on the MDS plot (Figure 3) is the fraction of erect-coralline algae (above) and sediment or mud (below).

Macrofauna

During these surveys 42 invertebrate and 11 macroalgae taxa were observed on these reefs (Table 2). The most abundant group were the two gorgonians (California Golden Gorgonian and Brown Gorgonian, N = 1690 and 266, respectively). The presence of gorgonians was followed by Giant Kelp (N = 1225), which was present at all reefs during these surveys except for Heisler Park in 2008. Other canopy and subcanopy forming macroalgae in the region that were dominant were Chainbladder Kelp (*Cystoseira osmundacea*), Southern Seapalm (*Eisenia arborea*), Southern Palm Kelp (*Pterygophora californica*) and Feather Boa (*Egregia menziesii*). In addition to the habitat forming algae three urchins (Red, Purple and Black) were the most abundant invertebrate taxa after the gorgonians. The highest urchin densities observed were at Heisler Park. For purple urchins there were 1.34/m^2 at the middle depth stratum in 2008 and for red urchins 1.55 and 1.46/m^2 at the middle and outer depth strata in 2102. We did not observe any urchin barrens during these surveys.

The reef at Buck Gully in 2013 had the characteristic giant kelp bed community present. The inner reef was comprised of Chainbladder Kelp and surfgrass beds. Southern Seapalm formed the subcanopy beneath the Giant Kelp in the deeper fractions of the reef. Among the twenty invertebrate and algal taxa observed, numerous commercial, recreational and protected species were present. Rock Scallops, green and pink abalone, giant keyhole limpets, spiny lobster, Warty Sea Cucumber and Red Urchin were observed (Appendix III). In fact more pink and green abalone were observed at Buck Gully than any other site in this survey.

Forty-four species of fishes comprising 9,821 individuals were observed during these surveys (Table 3). The observed fish fauna was also indicative of the well-studied warm temperate (San Diegan) fauna of the region (Stephens et al. 2006). At Buck Gully 14 species were quantified during the 2013 survey including important sportfishes: Kelp Bass, California Scorpionfish and California Sheephead. The only protected species observed was the Garibaldi (closed to fishing), the California state marine fish.

Public Use

The rock-reefs around Buck Gully are heavily utilized by a variety of user groups. There is easy boat access from Newport Harbor to the north. While we were on site we observed numerous shore-based scuba divers utilizing the area around Buck Gully. In 2013 we added a category to our benthic transects for anthropogenic debris (i.e. fishing tackle, trash etc.). We did not observe any debris in the study area. January 1, 2012 the State implemented a series of Marine Protected Areas (MPAs) in the region which resulted in a number of contiguous marine conservation and reserve areas in Orange County (Figure 8) (DFG 2012). Buck Gully feeds into the Crystal Cove State Marine Conservation Area (SMCA). In this conservation area all take of marine resources is prohibited except for recreational catch of finfish, lobster and sea urchin. The commercial fishers are allowed to take coastal pelagic species by round haul net, spiny

lobster and sea urchin. Beach nourishment is allowed. Essentially there is very little restriction on fishing activities in the SMCA. Public access has been monitored through aerial surveys since 2008 (Figure 8)(Ford et al. 2013). Observers recorded GPS coordinates and activities for vessel on regular transects. From 2008-2011 86 observations were made and from 2012 through June 30, 2013 67 observations were recorded, representing vessel use pre and post-MPA implementation. Buck Gully, at the very top of the Crystal Cove SMCA is accessed by recreational and commercial vessels. Considering the general lack of restrictions, it is not surprising that a change in vessel use did not appear to change with this reserve designation.

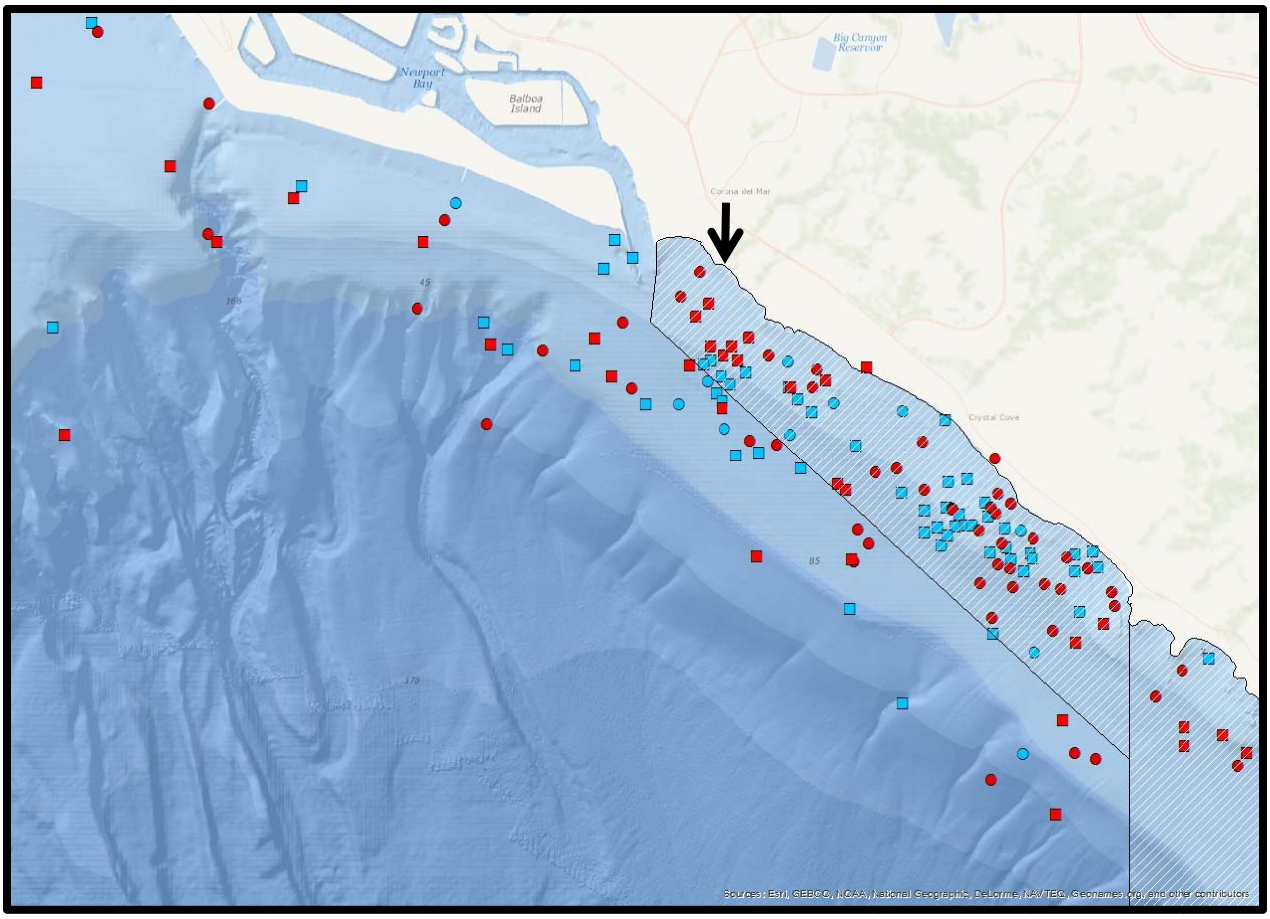

Figure 8. Vessel use observations from aerial overflights (Ford et al. 2013). Red dots and squares are commercial and recreation vessels, respectively, observed from 2008-2011. Blue dots and squares are commercial and recreation vessels observed from January 1, 2012 through June 30, 2013. The Crystal Cove State Marine Conservation Area is outlined in black and Buck Gully is at the end of the black arrow.

Table 1. Sampling locations along the Orange and North San Diego County coastline.

Site	Depth Strata	Date	Latitude	Longitude
Barn Kelp	Inner	16-Nov-2008	33.29473	-117.48680
Barn Kelp	Middle	16-Nov-2008	33.29176	-117.48687
Barn Kelp	Outer	16-Nov-2008	33.29087	-117.48874
Buck Gully	Inner	15-Aug-2013	33.58793	-117.86832
Buck Gully	Middle	15-Aug-2013	33.58706	-117.86904
Crystal Cove	Middle	07-Nov-2008	33.56261	-117.83755
Crystal Cove	Outer	07-Nov-2008	33.56288	-117.83785
Crystal Cove	Inner	16-Sep-2011	33.56407	-117.83450
Crystal Cove	Middle	16-Sep-2011	33.56353	-117.83573
Crystal Cove	Outer	16-Sep-2011	33.56422	-117.83813
Crystal Cove	Inner	14-Nov-2012	33.56455	-117.83588
Crystal Cove	Middle	14-Nov-2012	33.56428	-117.83655
Crystal Cove	Outer	14-Nov-2012	33.56386	-117.83820
Dana Point	Middle	26-Oct-2011	33.27857	-117.43149
Dana Point	Outer	26-Oct-2011	33.27696	-117.43287
Dana Point	Inner	28-Nov-2012	33.47363	-117.72401
Dana Point	Middle	28-Nov-2012	33.47061	-117.72318
Dana Point	Outer	28-Nov-2012	33.46847	-117.72540
Heisler Park	Inner	15-Nov-2008	33.54145	-117.79083
Heisler Park	Middle	15-Nov-2008	33.54023	-117.79300
Heisler Park	Outer	15-Nov-2008	33.53950	-117.79185
Heisler Park	Inner	14-Nov-2012	33.54208	-117.79262
Heisler Park	Middle	28-Nov-2012	33.54098	-117.79227
Heisler Park	Outer	28-Nov-2012	33.53991	-117.79344
Laguna Beach	Inner	14-Sep-2011	33.31887	-117.46767
Laguna Beach	Middle	14-Sep-2011	33.31869	-117.46829
Laguna Beach	Outer	14-Sep-2011	33.31827	-117.46861
Leucadia	Inner	28-Oct-2011	33.03820	-117.18457
Leucadia	Middle	28-Oct-2011	33.03816	-117.18559
Leucadia	Outer	28-Oct-2011	33.03808	-117.18674
Leucadia	Inner	11-Dec-2012	33.06413	-117.30906
Leucadia	Middle	11-Dec-2012	33.06386	-117.31109
Leucadia	Outer	11-Dec-2012	33.06349	-117.31232
Little Corona	Inner	19-Nov-2008	33.58458	-117.86541
Little Corona	Middle	19-Nov-2008	33.58451	-117.86533
Little Corona	Outer	19-Nov-2008	33.58348	-117.86561
San Mateo Kelp	Outer	26-Oct-2011	33.23214	-117.36635
San Mateo Kelp	Outer	06-Dec-2012	33.38733	-117.61096
South Carlsbad	Inner	28-Oct-2011	33.06017	-117.19352
South Carlsbad	Middle	28-Oct-2011	33.05907	-117.19389
South Carlsbad	Outer	28-Oct-2011	33.05899	-117.19467
Swami's	Inner	11-Dec-2012	33.03683	-117.29947
Swami's	Middle	11-Dec-2012	33.03562	-117.30087
Swami's	Outer	11-Dec-2012	33.03504	-117.30325

Table 2. Invertebrate and algal taxa observed along the Orange and North San Diego County coastline surveyed from November 7, 2008 to August 15, 2013.

Taxa	Common Name	Abundance
Acanthodoris lutea	Orange-peel Doris	1
Anthopleura artemisia	Burrowing Anemone	6
Anthopleura elegantissima	Aggregating Anemone	1
Anthopleura sola	Starburst Anemone	79
Astrometis sertulifera	Fragile Rainbow Star	1
Cancer sp.	Rock Crab	1
Centrostephanus coronatus	Black Urchin	369
Chondracanthus sp	Red Algae	12
Codium fragile	Dead Man's Fingers	2
Craniella arb	Sponge	2
Crassedoma giganteum	Rock Scallop	44
Cypraea spadicea	Chestnut Cowry	10
Cystoseira osmundacea	Chainbladder Kelp	633
Desmarestia ligulata	Flattened Acid Kelp	70
Diaulula sandiegensis	Leopard Nudibranch	1
Doris montereyensis	Monterey Sea Lemon Nudibranch	1
Egregia menziesii	Feather Boa	435
Eisenia arborea	Southern Sea Palm	630
Haliotis corrugata	Pink Abalone	12
Haliotis fulgens	Green Abalone	10
Henricia leviuscula	Pacific Blood Star	1
Kelletia kelletii	Kellet's Whelk	73
Laminaria farlowii	Oar Kelp	391
Leptogorgia chilensis	Red Gorgonian	4
Limacia cockerelli	Cockerell's Dorid	2
Linckia columbiae	Fragile Star	14
Macrocystis pyrifera	Giant Kelp	1225
Megastraea undosa	Turban Snail	403
Megathura crenulata	Giant Keyhole Limpet	107
Muricea californica	California Golden Gorgonian	1690
Muricea fruticosa	Brown Gorgonian	266
Norrisia norrisi	Norris's Kelp Snail	14
Octopus bimaculoides	California Two-spot Octopus	5
Orthasterias koehleri	Rainbow Star	2
Pachycerianthus fimbriatus	Tube-Dwelling Anemone	39
Panulirus interruptus	Spiny Lobster	66
Parastichopus californicus	Giant California Sea Cucumber	5
Parastichopus parvimensis	Warty Sea Cucumber	73
Patiria miniata	Bat Star	88
Pisaster brevispinus	Pink Sea Star	2
Pisaster giganteus	Giant Sea Star	160
Pisaster ochraceus	Ochre Sea Star	3
Prostheceraeus bellostriatus	Flatworm	1
Pterygophora californica	Southern Palm Kelp	537
Pugettia producta	Kelp Crab	1

Table 2. continued.

Taxa	Common Name	Abundance
Sargassum horneri	Asian Seaweed	31
Sargassum sp.	Gulfweed	39
Strongylocentrotus franciscanus	Red Urchin	881
Strongylocentrotus purpuratus	Purple Urchin	654
Styela montereyensis	Stalked Tunicate	79
Tethya californiana	Orange Puffball Sponge	58
Tonicella lineata	Lined Chiton	2
Trikentrion catalinae	Sponge	2
Tylodina fungina	Yellow Umbrella Slug	1
Urticina mcpeaki	Sea Anemone	7
Urticina sp.	Sea Anemone	1
	Grand Total:	**9247**

Table 3. The abundance of fishes observed along the Orange and North San Diego County coastline surveyed from November 7, 2008 to August 15, 2013.

Species	Common Name	Abundance
Anisotremus davidsonii	Sargo	11
Atherinops affinis	Topsmelt	874
Atherinopsis californiensis	Jacksmelt	185
Brachyistius frenatus	Kelp Perch	817
Chromis punctipinnis	Blacksmith	2568
Cymatogaster aggregata	Shiner Perch	54
Embiotoca jacksoni	Black Perch	171
Gibbonsia elegans	Spotted Kelpfish	2
Girella nigricans	Opaleye	93
Gymnothorax mordax	California Moray	1
Halichoeres semicinctus	Rock Wrasse	131
Hermosilla azurea	Zebraperch	2
Heterodontus francisci	Horn Shark	2
Heterostichus rostratus	Giant Kelpfish	28
Hyperprosopon argenteum	Walleye Surfperch	250
Hypsurus caryi	Rainbow perch	20
Hypsypops rubicundus	Garibaldi	506
Medialuna californiensis	Halfmoon	48
Micrometrus minimus	Dwarf Surfperch	7
Oxyjulis californica	Senorita	1738
Oxylebius pictus	Painted Greenling	9
Paralabrax clathratus	Kelp Bass	340
Paralabrax nebulifer	Barred Sandbass	158
Phanerodon furcatus	White Seaperch	80
Rhacochilus toxotes	Rubberlip Perch	8
Rhacochilus vacca	Pile Perch	46
Rhinobatos productus	Guitarfish	1
Rhinogobiops nicholsii	Blackeye Goby	9
Sardinops sagax	Pacific Sardine	820
Scomber japonicus	Pacific Mackerel	100
Scorpaena guttata	California Scorpionfish	1
Sebastes atrovirens	Kelp Rockfish	15
Sebastes carnatus	Gopher Rockfish	2
Sebastes chrysomelas	Black and Yellow Rockfish	1
Sebastes serranoides	Olive Rockfish	6
Sebastes serriceps	Treefish	3
Semicossyphus pulcher	California Sheephead	358
Sphyraena argentea	California Barracuda	2
Squatina californica	Pacific Angel Shark	1
Syngnathus californiensis	Kelp Pipefish	1
Trachurus symmetricus	Jack Mackerel	150
Urobatis halleri	Round Stingray	1
Xenistius californiensis	Salema	200
Zapteryx exasperata	Banded Guitarfish	1
	Grand Total	**9821**

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Appendix I – CRANE Methodology

***Sampling Unit*-**a sampling cell consisted of at least 250m of reef habitat. Within each cell four depth strata (if present) were sampled and geo referenced. These strata are the inner (~5m), middle (~10m) and outer (~15m) and deep strata (~25m) portions of a natural reef or kelp bed. Within each depth strata two benthic sampling protocols were completed: Uniform Point Contact (UPC) and macro invertebrate and algae sampling (Swath). For fishes, four benthic, mid-depth and canopy (when present) transects were completed in each depth zone. Canopy transects were completed only if kelp reached the surface. The maximum sampling effort for a reef included 16 benthic fish transects, 16 midwater fish transects, 16 canopy fish transects, 8 UPC and 8 Swath transects. In addition, 100 red and 100 purple urchins were measured in each cell. All transects were 30m; swath and fish transects were 30m x 2m belt transects. Considering their paucity for the majority of the SCB the size and species of any abalone was recorded.

***UPC*-** Percent cover of substrate type, substrate relief and benthic organisms were recorded at each meter mark along the 30 m transect tape. Substrate percentages in the following categories were estimated within each 10 m segment: bedrock ($\geq$ 1 m), boulder (1 m), cobble ($\leq$10 cm), and sand. Substrate relief was the maximum relief within a rectangle centered on the point that is 0.5 meter along the tape and 1 meter wide. 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 were not recorded. If the contact point was on a blade of *Laminaria*, brittlestars or the sea cucumber *Pachythione rubra*, the organism under the point was recorded and it was noted that the point was under one of these organisms. The superlayer was also recorded. In addition to quantifying benthic organisms, the following types of bare substrate were recorded, if contacted: rock, sand, shell debris, and mud.

Swath-The purpose of the swath sampling was to estimate the density of conspicuous sessile and mobile macroinvertebrates (>2.5cm) as well as specific macroalgae. Individual invertebrates and algae were counted along the entire 30 m x 2 m transect. Transects were 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 and then swim back along the transect counting targeted macroalgae. Cracks and crevices were searched and understory algae pushed aside. No organisms were removed. Any organism with more than half of its body inside the swath area was counted.

The following size criteria applied to counting macroalgal species:

- *Macrocystis* 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 were divided into three, 10-meter segments. Species that occurred in high densities (e.g., purple urchins) were sub-sampled if greater than 30 individuals occurred within any of the three 10 m segments on a transect. When 30 individuals of one species were 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 were then extrapolated per segment to calculate an estimated total abundance per transect. All swath taxa densities were estimated based on the count or estimate of the number of each taxa over the 60 m^2 area covered by a single transect and scaled to 100 m^2. Swath species were grouped into large taxonomic categories. Mean number of stipes per *M. pyrifera* holdfast was also calculated.

Fish-The purpose of the fish sampling was to estimate density and length frequency distributions by fish species at each site. A minimum of 3 m of horizontal visibility was the acceptability cutoff. Divers swim in the pre-arranged compass direction for a distance of 30 m while counting and estimating the sizes of the fish along an isobath. All conspicuous fishes encountered along the transects were recorded. Divers count and estimated total length (TL) of small fish (< 15 cm TL) to the nearest cm, and larger fish (> 15 cm) to the nearest 5 cm interval. If a school of fish (>10 fish) is encountered, the number of fish is estimated within each size group. The observer censused 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. 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 was changed to the minimum necessary to remain on rocky habitat. Physical data collected on each transect included observation depth (m), water temperature (C^o), horizontal visibility (m), surge (0-4 relative scale), and kelp canopy cover (%). Transects were 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.

Fishing gear and trash observations-In order to record the amount of marine debris and lost or active fishing gear on rocky reefs, we will count any fishing gear and debris that falls within our 2 meter swath on all fish and swath transects. If any part of this gear or trash is within the swath (i.e. the edge of a lobster trap or a piece of monofilament line), it will be counted. Fishing gear that is attached to fish that are recorded on transect (i.e. hook in mouth, trailing line) will also be recorded. Fishing gear and other objects will be broken down into five categories: Hook and line (recreational) fishing tackle - includes hooks, lures, bobbers, sinkers, fishing rods and fishing line, etc. This category also encompasses spear fishing gear, including spears, tips and guns. Active Traps - lobster hoop nets fall into this category since they serve the same purpose as a trap. Traps - includes abandoned, broken, and deteriorated traps (i.e. parts of traps) and lobster hoop nets. Nets - includes full nets or pieces of net material. Trash - includes anything manmade that was lost or tossed into the ocean and that doesn't fall into one of the fishing gear categories such as plastics, bottles, cans, metal, anchors, ropes, etc.

Appendix II. Substrate, relief and % cover observed on transects along the Orange and North San Diego County coastline surveyed. I = Inner, M = Middle, O = Outer.

	Buck Gully		Crystal Cove					
	2013		2011			2012		
Substrate	I	M	I	M	O	I	M	O
bedrock	100%	70%	87%	83%	37%	77%	84%	73%
boulder		10%	4%	3%	7%	15%	1%	24%
cobble		8%	2%	1%	32%			
sand		12%	7%	14%	25%	8%	15%	3%
Relief								
0.1-1m	56%	66%	63%	52%	54%	97%	95%	59%
>2m				13%				10%
0-.1m	26%	34%	23%	17%	45%		0%	
1-2m	18%		14%	18%	2%	3%	5%	32%
Cover								
Acanthancora cyanocrypta								
Alcyonium rudyi								
bare rock		3%	8%	7%	5%	2%		2%
bare sand		8%	12%	30%	35%	19%	26%	3%
barnacle		3%						
brown algae - erect	5%	3%	3%		2%	8%	9%	1%
brown algae - filamentous								
bryozoan		20%		1%	3%			9%
Chaceia ovoidea	3%	1%						
coralline algae - crustose	6%	13%	25%	12%	22%	9%	15%	13%
coralline algae - erect	54%	21%	37%	12%	8%	49%	30%	2%
Corynactis californica								4%
cup coral		1%		4%				4%
Cystoseira osmundacea								
Diopatra ornata		0%						
Egregia menziesii								
Epizoanthus induratum								
green algae								
hydroid								
Macrocystis holdfast			2%	8%	0%	6%	2%	5%
Muricea californica		5%		5%				3%
Muricea fruticosa								
Pachycerianthus fimbriatus								
Phragmatopoma californica			5%	3%			7%	
Phyllospadix sp.	17%					5%		
Pterygophora holdfast		0%						
red algae - erect	14%	9%	1%	12%	19%		5%	36%
red algae - turf		6%	0%	3%				8%
Sabellid/Serpulid/Spirobranchus/Eudistylia								
Salmacina tribranchiata								
sediment/mud								
Serpulorbis squamigerus								
shell debris		0%	6%	1%	3%	2%	5%	3%
sponge	2%	4%		3%	2%		2%	9%
tunicate - colonial		2%						
tunicate - solitary								

Appendix II. Continued.

	Dana Point					Heisler Park		
	2011			2012		2012		
Substrate	M	O	I	M	O	I	M	O
bedrock	38%	21%	82%	69%	89%	76%	84%	36%
boulder	4%	43%	8%	6%	1%	16%	2%	25%
cobble	8%	29%		25%	7%	1%	11%	28%
sand	50%	7%	10%		2%	8%	2%	11%
Relief								
.1-1m	48%	69%	90%	90%	72%	95%	77%	64%
>2m		0%						29%
0-.1m	45%	10%	7%					
1-2m	7%	21%	3%	10%	28%	5%	23%	7%
Cover								
Acanthancora cyanocrypta					3%		2%	
Alcyonium rudyi					2%			
bare rock	3%	10%	5%	8%	13%	3%	2%	9%
bare sand	50%	6%	26%	15%	17%	6%	6%	7%
barnacle								
brown algae - erect	3%		5%			12%	8%	4%
brown algae - filamentous								
bryozoan		3%	3%				2%	2%
Chaceia ovoidea								
coralline algae - crustose	18%	9%		18%	1%	20%	32%	35%
coralline algae - erect	5%		26%	4%		46%	7%	3%
Corynactis californica		9%						
cup coral					8%		9%	12%
Cystoseira osmundacea								
Diopatra ornata		0%			2%			2%
Egregia menziesii			1%					
Epizoanthus induratum								
green algae								
hydroid		5%						
Macrocystis holdfast	2%	8%		4%	18%	0%	8%	4%
Muricea californica								
Muricea fruticosa								
Pachycerianthus fimbriatus								
Phragmatopoma californica			3%			3%		
Phyllospadix sp.			18%			3%		
Pterygophora holdfast				4%				
red algae - erect	19%	13%	8%	47%	5%	2%	16%	5%
red algae - turf		4%	4%				4%	
Sabellid/Serpulid/Spirobranchus/Eudistylia								
Salmacina tribranchiata								
sediment/mud		1%						
Serpulorbis squamigerus						2%	1%	
shell debris						3%	2%	5%
sponge		14%		1%	26%			11%
tunicate - colonial	0%	8%			6%			2%
tunicate - solitary		7%						

Appendix II. Continued.

	Laguna Beach			Leucadia					
	2011			2011			2012		
Substrate	I	M	O	I	M	O	I	M	O
bedrock	40%	56%	49%	86%	77%	88%	90%	89%	75%
boulder	9%	6%	18%	2%	15%			11%	5%
cobble	1%	15%	16%			3%	1%		3%
sand	50%	24%	17%	12%	8%	9%	9%		17%
Relief									
.1-1m	21%	48%	27%	82%	93%	0%	88%	91%	83%
>2m									
0-.1m	79%	45%	67%		7%	100%	12%	5%	14%
1-2m		7%	6%	18%				4%	3%
Cover									
Acanthancora cyanocrypta									
Alcyonium rudyi									
bare rock	6%		5%	6%	1%	8%			3%
bare sand	13%	14%		23%	17%	22%	26%	6%	30%
barnacle									
brown algae - erect							2%	2%	
brown algae - filamentous									
bryozoan		3%	8%	2%	12%	13%		5%	2%
Chaceia ovoidea						0%			
coralline algae - crustose	6%	24%	22%	4%	2%	8%	7%	1%	2%
coralline algae - erect	32%	18%	2%	3%	12%		34%		
Corynactis californica					3%	6%	1%		
cup coral									
Cystoseira osmundacea		2%							
Diopatra ornata					1%	8%			13%
Egregia menziesii	4%						4%		
Epizoanthus induratum									
green algae				5%					
hydroid				3%	18%			4%	2%
Macrocystis holdfast		7%	12%		0%	7%	3%	8%	8%
Muricea californica								2%	
Muricea fruticosa									
Pachycerianthus fimbriatus									1%
Phragmatopoma californica	9%	12%			5%				
Phyllospadix sp.	25%			34%			3%		
Pterygophora holdfast							2%		
red algae - erect	3%	11%	3%	20%	7%	7%	16%	27%	19%
red algae - turf			0%	1%	2%	0%		1%	1%
Sabellid/Serpulid/Spirobranchus/Eudistylia	2%								
Salmacina tribranchiata		1%	3%						
sediment/mud		2%	23%		1%	1%		11%	11%
Serpulorbis squamigerus							2%		
shell debris		5%	21%		9%	7%			2%
sponge		1%	0%		6%	8%		28%	7%
tunicate - colonial								5%	1%
tunicate - solitary					3%	7%			

Appendix II. Continued.

	San Mateo Kelp		South Carlsbad			Swami's		
	2011	2012	2011			2012		
Substrate	O	O	I	M	O	I	M	O
bedrock	31%	29%	97%	99%	99%	96%	91%	88%
boulder	27%	44%				0%	3%	2%
cobble		2%	3%		1%	1%	6%	4%
sand	42%	26%		1%		3%		6%
Relief								
.1-1m	71%	98%	97%	18%	55%	90%	81%	53%
>2m								
0-.1m	15%		3%	82%	45%	7%	9%	47%
1-2m	13%	2%				2%	11%	0%
Cover								
Acanthancora cyanocrypta								
Alcyonium rudyi								
bare rock		5%	22%	2%	6%	1%	4%	10%
bare sand	7%	10%	27%	27%	15%	27%	5%	14%
barnacle								
brown algae - erect					0%	6%	1%	13%
brown algae - filamentous						3%		
bryozoan	6%	4%	7%	7%	12%			
Chaceia ovoidea			2%				3%	
coralline algae - crustose	5%	3%	5%	3%	3%	9%	5%	1%
coralline algae - erect		0%	5%	8%		25%	10%	1%
Corynactis californica								
cup coral							4%	4%
Cystoseira osmundacea								
Diopatra ornata	41%	19%			5%			5%
Egregia menziesii								
Epizoanthus induratum			3%					
green algae								
hydroid	5%		2%	16%	18%			
Macrocystis holdfast	5%	11%		7%	2%	1%	15%	13%
Muricea californica				0%	2%			4%
Muricea fruticosa								0%
Pachycerianthus fimbriatus								
Phragmatopoma californica			8%	8%	13%			
Phyllospadix sp.			2%			17%		
Pterygophora holdfast								
red algae - erect	0%	1%	12%	7%	15%	8%	22%	6%
red algae - turf	8%		1%					
Sabellid/Serpulid/Spirobranchus/Eudistylia								
Salmacina tribranchiata								
sediment/mud	14%	18%			1%		15%	12%
Serpulorbis squamigerus				0%	1%	2%		
shell debris	4%	1%	1%		2%			5%
sponge	2%	28%	2%	8%	6%		14%	7%
tunicate - colonial	4%						3%	4%
tunicate - solitary				7%				

Appendix III. The abundance of invertebrates and algae observed on transects along the Orange and North San Diego County coastline surveyed. Divide by 120m^2 for the density. I = Inner, M = Middle, O = Outer.

	Barn Kelp			Buck Gully		Crystal Cove							
	2008			2013		2008		2011			2012		
Taxa	I	M	O	I	M	I	O	I	M	O	I	M	O
Acanthodoris lutea													
Anthopleura artemisia											1		
Anthopleura elegantissima			1										
Anthopleura sola				4	5			14	5		11	3	2
Astrometis sertulifera													
Cancer sp.													
Centrostephanus coronatus	6		13							1			1
Chondracanthus sp.													
Codium fragile													
Craniella arb													
Crassedoma giganteum				1				6	1		7		10
Cypraea spadicea											3		
Cystoseira osmundacea			4		87	40	3	4	11	2	10	81	
Desmarestia ligulata													
Diaulula sandiegensis													
Doris montereyensis													
Egregia menziesii								8	3			7	
Eisenia arborea				42				24	3	1	44	11	2
Haliotis corrugata				8	2						1		
Haliotis fulgens				8							2		
Henricia leviuscula													
Kelletia kelletii		1	2		1		3	2	1	1	1		
Laminaria farlowii	3	57	146						4	75		26	62
Leptogorgia chilensis										1			
Limacia cockerelli					2								
Linckia columbiae										1			7
Macrocystis pyrifera	14	18	12	6	19	37		22	19	11	21	35	22

Appendix III. Continued.

	Barn Kelp			Buck Gully		Crystal Cove							
	2008			2013		2008		2011			2012		
Taxa	I	M	O	I	M	I	O	I	M	O	I	M	O
Megastraea undosa				22	46			41	2	2	72	41	1
Megathura crenulata				1	12			1	8	9	1	2	19
Muricea californica	142	65	5		71	46	19		125	58		19	58
Muricea fruticosa	13	2			12	15	27		24	9		1	20
Norrisia norrisi								1			2	2	
Octopus bimaculoides				1				1	1				
Orthasterias koehleri							2						
Pachycerianthus fimbriatus													1
Panulirus interruptus				9				6	2				
Parastichopus californicus													
Parastichopus parvimensis					1				4	2	1		4
Patiria miniata	1	9	11			2	2		3	31			
Pisaster brevispinus													
Pisaster giganteus	3		7		1	4	12		20	2		2	20
Pisaster ochraceus					1			1			1		
Prostheceraeus bellostriatus													
Pterygophora californica		21	115			3	6			3			
Pugettia producta							1						
Sargassum horneri													
Sargassum sp.													
Strongylocentrotus franciscanus					61	19	21	38	31	22	12	46	35
Strongylocentrotus purpuratus			1	67	14		5	19	2		34	9	6
Styela montereyensis	15	20	12						1	1			
Tethya californiana		1	3							1			2
Tonicella lineata													
Trikentrion catalinae													
Tylodina fungina								1					
Urticina mcpeaki										2			
Urticina sp.		1											
Total:	197	195	332	169	335	166	101	189	270	235	224	285	272

Appendix III. Continued.

	Dana Point					Heisler Park						
	2011		2012			2008			2012	2012		
Taxa	M	O	I	M	O	I	M	O	I	I	M	O
Acanthodoris lutea												
Anthopleura artemisia												
Anthopleura elegantissima												
Anthopleura sola		3		1					1	1	9	9
Astrometis sertulifera												
Cancer sp.												
Centrostephanus coronatus						64	113	26				
Chondracanthus sp.												
Codium fragile											2	
Craniella arb												
Crassedoma giganteum		1								4	5	6
Cypraea spadicea		1										
Cystoseira osmundacea	11		1	20		21			1	1	2	5
Desmarestia ligulata												
Diaulula sandiegensis												
Doris montereyensis												
Egregia menziesii			80								1	
Eisenia arborea			21						19	26	1	
Haliotis corrugata											1	
Haliotis fulgens												
Henricia leviuscula												
Kelletia kelletii		2					1			1	1	
Laminaria farlowii				17								
Leptogorgia chilensis		1										2
Limacia cockerelli												
Linckia columbiae												2
Macrocystis pyrifera	6	33	3	44	33			1	3	2	103	55

Appendix III. Continued

	Dana Point					Heisler Park						
	2011		2012			2008			2012		2012	
Taxa	M	O	I	M	O	I	M	O	I	I	M	O
Megastraea undosa				1		9	3	7	47	33	12	
Megathura crenulata		1		2	3						2	6
Muricea californica		44		38	59		27	41			25	25
Muricea fruticosa		4		3	28		7	23			6	4
Norrisia norrisi										3		
Octopus bimaculoides			1									
Orthasterias koehleri												
Pachycerianthus fimbriatus		15			11							2
Panulirus interruptus			3		14						1	
Parastichopus californicus							1	4				
Parastichopus parvimensis											13	43
Patiria miniata		1						5				
Pisaster brevispinus												
Pisaster giganteus	2	1		2	6		1	11			5	8
Pisaster ochraceus												
Prostheceraeus bellostriatus												
Pterygophora californica	100			98			1	3			16	43
Pugettia producta												
Sargassum horneri									1	3	22	5
Sargassum sp.											36	3
Strongylocentrotus franciscanus		30		8	6	2	20		3	8	186	175
Strongylocentrotus purpuratus		11		29	11	34	161		24	25	83	53
Styela montereyensis				1								
Tethya californiana		5			7			1				11
Tonicella lineata												
Trikentrion catalinae		2										
Tylodina fungina												
Urticina mcpeaki		1			2							
Urticina sp.												
Total:	119	156	109	264	180	130	335	122	99	107	532	457

Appendix III. Continued.

	Laguna Beach									Little Corona		
	2011			2011			2012			2008		
Taxa	I	M	O	I	M	O	I	M	O	I	M	O
Acanthodoris lutea						1						
Anthopleura artemisia						3		1				
Anthopleura elegantissima												
Anthopleura sola		3			1	2			1		1	
Astrometis sertulifera						1						
Cancer sp.												
Centrostephanus coronatus			1							85	45	14
Chondracanthus sp.							2		3			
Codium fragile												
Craniella arb												
Crassedoma giganteum		3										
Cypraea spadicea						5			1			
Cystoseira osmundacea	33	18			6		16	82		6	12	22
Desmarestia ligulata								1	66			
Diaulula sandiegensis												
Doris montereyensis												
Egregia menziesii	64	12		3	4		29	47				
Eisenia arborea	40	3		4	66		12	45		25	11	
Haliotis corrugata												
Haliotis fulgens												
Henricia leviuscula												
Kelletia kelletii		9		1	1				2		1	4
Laminaria farlowii												
Leptogorgia chilensis												
Limacia cockerelli												
Linckia columbiae		1							1			
Macrocystis pyrifera	12	21	29		41	21	33	23	70	88	55	30

Appendix III. Continued.

	Laguna Beach			Leucadia						Little Corona		
	2011			2011			2012			2008		
Taxa	I	M	O	I	M	O	I	M	O	I	M	O
Megastraea undosa	4	1	5		4	1	8	3		14	7	3
Megathura crenulata		1	4		4	4	2	3	2		1	
Muricea californica		25	34		7	95	31	24	77		94	159
Muricea fruticosa		3	13			2	2		3		14	19
Norrisia norrisi			1		3		1	1				
Octopus bimaculoides				1								
Orthasterias koehleri												
Pachycerianthus fimbriatus			1						2			
Panulirus interruptus				1	4	3	2		6			
Parastichopus californicus												
Parastichopus parvimensis			2							1	1	1
Patiria miniata			18		4				1			
Pisaster brevispinus									2			
Pisaster giganteus		9	7		1	4	2	1	5			2
Pisaster ochraceus												
Prostheceraeus bellostriatus						1						
Pterygophora californica	18	91	18									
Pugettia producta												
Sargassum horneri												
Sargassum sp.												
Strongylocentrotus franciscanus	1	42	16			22	4	1	23	4	4	1
Strongylocentrotus purpuratus		1	3		3	5			6	25	12	
Styela montereyensis	1		1			1						
Tethya californiana			5						6			
Tonicella lineata					2							
Trikentrion catalinae												
Tylodina fungina												
Urticina mcpeaki		1										
Urticina sp.												
Total:	173	244	158	10	151	171	144	232	277	248	258	255

Appendix III. Continued.

	San Mateo Kelp		South Carlsbad			Swami's			
	2011	2012	2011			2012			
Taxa	O	O	I	M	O	I	M	O	Total
Acanthodoris lutea									1
Anthopleura artemisia			1						6
Anthopleura elegantissima									1
Anthopleura sola							3		79
Astrometis sertulifera									1
Cancer sp.				1					1
Centrostephanus coronatus									369
Chondracanthus sp.						7			12
Codium fragile									2
Craniella arb							1	1	2
Crassedoma giganteum									44
Cypraea spadicea									10
Cystoseira osmundacea			3			118	13		633
Desmarestia ligulata				1	2				70
Diaulula sandiegensis					1				1
Doris montereyensis					1				1
Egregia menziesii			103	5	2	67			435
Eisenia arborea			202	14	4	4	6		630
Haliotis corrugata									12
Haliotis fulgens									10
Henricia leviuscula								1	1
Kelletia kelletii	2	10		1	7		18		73
Laminaria farlowii							1		391
Leptogorgia chilensis									4
Limacia cockerelli									2
Linckia columbiae				1				1	14
Macrocystis pyrifera	32	35	4	34	19	4	23	132	1225

Appendix III. Continued.

	San Mateo Kelp		South Carlsbad			Swami's			
	2011	2012	2011			2012			
Taxa	O	O	I	M	O	I	M	O	Total
Megastraea undosa			1	1			12		403
Megathura crenulata	5	2					9	3	107
Muricea californica	8	61		48	97		15	48	1690
Muricea fruticosa								12	266
Norrisia norrisi									14
Octopus bimaculoides									5
Orthasterias koehleri									2
Pachycerianthus fimbriatus		1						6	39
Panulirus interruptus						8	1	6	66
Parastichopus californicus									5
Parastichopus parvimensis									73
Patiria miniata									88
Pisaster brevispinus									2
Pisaster giganteus	3		1	3	6		9		160
Pisaster ochraceus									3
Prostheceraeus bellostriatus									1
Pterygophora californica								1	537
Pugettia producta									1
Sargassum horneri									31
Sargassum sp.									39
Strongylocentrotus franciscanus		2					5	33	881
Strongylocentrotus purpuratus		2					6	3	654
Styela montereyensis	4	7			15				79
Tethya californiana					1		1	14	58
Tonicella lineata									2
Trikentrion catalinae									2
Tylodina fungina									1
Urticina mcpeaki					1				7
Urticina sp.									1
Total:	54	120	315	109	156	208	123	261	9247

Appendix IV. The abundance of fishes observed on transects along the Orange and North San Diego County coastline surveyed. I = Inner, M = Middle, O = Outer. Divide by 720 m^2 for the density.

	Barn Kelp			Buck Gully				Crystal Cove					
	2008			2013		2008		2011			2012		
Species	I	M	O	I	M	I	O	I	M	O	I	M	O
Anisotremus davidsonii								1			1		2
Atherinops affinis				40	62				75	69	134		
Atherinopsis californiensis													
Brachyistius frenatus		2		2	18			4	54	37		8	18
Chromis punctipinnis		3		1	59	110	198	40	30	2	3	7	222
Cymatogaster aggregata													
Embiotoca jacksoni		1		3	5	7		7	6	8	2	7	2
Gibbonsia elegans													
Girella nigricans					2				1	8	5		3
Gymnothorax mordax								1					
Halichoeres semicinctus				4	5	5	3	10	10	4	1	1	1
Hermosilla azurea											1		
Heterodontus francisci								1					
Heterostichus rostratus				1	12					1		4	
Hyperprosopon argenteum											147		
Hypsurus caryi										1			
Hypsypops rubicundus	3			7	20	13	40	30	49	38	9	10	24
Medialuna californiensis					2			3		1			2
Micrometrus minimus											1		
Oxyjulis californica	23	32		150	99	42	23	47	150	107	2	29	44
Oxylebius pictus									1	1			2
Paralabrax clathratus	2	2	2	2	2	25	12	1	8	21		3	3
Paralabrax nebulifer		3	3			7	6					1	
Phanerodon furcatus										9			
Rhacochilus toxotes													
Rhacochilus vacca								2					1
Rhinobatos productus													
Rhinogobiops nicholsii					2				1				1
Sardinops sagax													
Scomber japonicus													
Scorpaena guttata					1								
Sebastes atrovirens	1						1		2	3			1
Sebastes carnatus										2			
Sebastes chrysomelas													
Sebastes serranoides													4
Sebastes serriceps										3			
Semicossyphus pulcher	5	4	1		2	34	56	2	26	42	5	4	10
Sphyraena argentea													
Squatina californica													
Syngnathus californiensis													
Trachurus symmetricus										50			100
Urobatis halleri													
Xenistius californiensis													
Zapteryx exasperata													

Appendix IV. Continued.

	Dana Point					Heisler Park						Laguna Beach		
	2011		2012			2008			2012		2012	2011		
Species	M	O	I	M	O	I	M	O	I	M	O	I	M	O
Anisotremus davidsonii			5									1		
Atherinops affinis	60													
Atherinopsis californiensis					1					1	7	3	1	1
Brachyistius frenatus		148			68				12	2	51	5	3	7
Chromis punctipinnis		3		5	186	12	139	331		429	283	10	1	68
Cymatogaster aggregata												52		
Embiotoca jacksoni	1	8	4	1			1		5	1	10	1	2	10
Gibbonsia elegans														
Girella nigricans				1	3					10	4	1		1
Gymnothorax mordax														
Halichoeres semicinctus			1			4	3	2	13	7	3	3	8	3
Hermosilla azurea					1									
Heterodontus francisci											1			
Heterostichus rostratus			1						1	4			1	2
Hyperprosopon argenteum														
Hypsurus caryi	1	2										1		
Hypsypops rubicundus			1		1	7	7	7	7	71	30	2	19	18
Medialuna californiensis		1	1		7					1	1	5		7
Micrometrus minimus			1						1			2		
Oxyjulis californica		49	1	2	1	148		16	62	3	11		10	95
Oxylebius pictus				1						2				1
Paralabrax clathratus	3	10	2	9	14	1	1	8	2	5	4		1	
Paralabrax nebulifer	1	2	2	9	17	1	8	42	1	4	1			4
Phanerodon furcatus		1	2										3	
Rhacochilus toxotes		1										1		
Rhacochilus vacca			2						21					
Rhinobatos productus												1		
Rhinogobiops nicholsii					2						2			
Sardinops sagax														
Scomber japonicus														
Scorpaena guttata														
Sebastes atrovirens		1			2					1	1			
Sebastes carnatus														
Sebastes chrysomelas										1				
Sebastes serranoides		1												
Sebastes serriceps														
Semicossyphus pulcher		4	1	6	9	1	14	15	1	6	23	2	11	14
Sphyraena argentea		2												
Squatina californica														
Syngnathus californiensis													1	
Trachurus symmetricus														
Urobatis halleri														
Xenistius californiensis														
Zapteryx exasperata														

Appendix IV. Continued

	Leucadia						Little Corona			San Mateo Kelp	
	2011			2012			2008			2011	2012
Species	I	M	O	I	M	O	I	M	O	O	O
Anisotremus davidsonii											
Atherinops affinis	335	5			9	20				13	
Atherinopsis californiensis	12		8	6							
Brachyistius frenatus		2	46		10	4				19	54
Chromis punctipinnis		1		39			114	76	110		1
Cymatogaster aggregata	2										
Embiotoca jacksoni	6	2	1	5			3	3	6		6
Gibbonsia elegans				1							
Girella nigricans	27	2					4	15			
Gymnothorax mordax											
Halichoeres semicinctus	3	5	1				8	8	4		
Hermosilla azurea											
Heterodontus francisci											
Heterostichus rostratus							1				
Hyperprosopon argenteum	100										
Hypsurus caryi										2	4
Hypsypops rubicundus	6	3					9	20	35		
Medialuna californiensis		4		2				3	6		
Micrometrus minimus	2										
Oxyjulis californica		25	7	21	27	30	32	59	80	4	19
Oxylebius pictus											
Paralabrax clathratus	1	14	16	5	4	1	6	13	13	1	8
Paralabrax nebulifer	2	2		1			3	1	3		9
Phanerodon furcatus	1			1						5	
Rhacochilus toxotes	1			1							
Rhacochilus vacca	1							1		1	
Rhinobatos productus											
Rhinogobiops nicholsii											1
Sardinops sagax											
Scomber japonicus											
Scorpaena guttata											
Sebastes atrovirens										1	
Sebastes carnatus											
Sebastes chrysomelas											
Sebastes serranoides											1
Sebastes serriceps											
Semicossyphus pulcher	1	6					1	10	15	2	3
Sphyraena argentea											
Squatina californica											
Syngnathus californiensis											
Trachurus symmetricus											
Urobatis halleri											
Xenistius californiensis	200										
Zapteryx exasperata											

Appendix IV. Continued.

	South Carlsbad 2011			Swami's 2012			Total
Species	I	M	O	I	M	O	
Anisotremus davidsonii				1			11
Atherinops affinis		12	25	15			874
Atherinopsis californiensis	70	46	29				185
Brachyistius frenatus	1	183	5	1	20	33	817
Chromis punctipinnis			4	20	15	46	2568
Cymatogaster aggregata							54
Embiotoca jacksoni	9	31		6		1	171
Gibbonsia elegans				1			2
Girella nigricans						6	93
Gymnothorax mordax							1
Halichoeres semicinctus	3	1	1	2	1	3	131
Hermosilla azurea							2
Heterodontus francisci							2
Heterostichus rostratus							28
Hyperprosopon argenteum	3						250
Hypsurus caryi		1		8			20
Hypsypops rubicundus				10		10	506
Medialuna californiensis				1		1	48
Micrometrus minimus							7
Oxyjulis californica	51	1	6	28	54	148	1738
Oxylebius pictus				1			9
Paralabrax clathratus	7	33	5	5	50	15	340
Paralabrax nebulifer	2	2	3	1	1	16	158
Phanerodon furcatus	2	18	35			3	80
Rhacochilus toxotes		1				3	8
Rhacochilus vacca		1		14	1	1	46
Rhinobatos productus							1
Rhinogobiops nicholsii							9
Sardinops sagax		500	320				820
Scomber japonicus		100					100
Scorpaena guttata							1
Sebastes atrovirens						1	15
Sebastes carnatus							2
Sebastes chrysomelas							1
Sebastes serranoides							6
Sebastes serriceps							3
Semicossyphus pulcher	2	5	4	1		10	358
Sphyraena argentea							2
Squatina californica			1				1
Syngnathus californiensis							1
Trachurus symmetricus							150
Urobatis halleri	1						1
Xenistius californiensis							200
Zapteryx exasperata		1					1