Regional Beach Sand Project
Post-construction Monitoring Report
for Intertidal, Shallow Subtidal,
and Kelp Forest Resources

Prepared for:
San Diego Association
of Governments (SANDAG)
401 B Street, Suite 800
San Diego, California 92101

Prepared by:
AMEC Earth & Environmental, Inc.
5510 Morehouse Drive
San Diego, California 92121

July 2002
Regional Beach Sand Project
Post-construction Monitoring Report for Intertidal, Shallow Subtidal, and Kelp Forest Resources

Prepared for:
San Diego Association of Governments (SANDAG)
401 B Street, Suite 800
San Diego, California 92101

Prepared by:
AMEC Earth & Environmental, Inc.
5510 Morehouse Drive
San Diego, California 92121

July 2002
TABLE OF CONTENTS

EXECUTIVE SUMMARY ....................................................................................................... 1
PROJECT OVERVIEW ........................................................................................................... 2
  MARINE RESOURCES MONITORING .................................................................................. 3

LIST OF REPORTS

ROCKY INTERTIDAL MONITORING REPORT ................................................................. RI-1
SHALLOW SUBTIDAL MONITORING REPORT ................................................................. SS-1
KELP FOREST MONITORING REPORT ........................................................................ KF-1
LOBSTER MONITORING REPORT .................................................................................... LB-1
EXECUTIVE SUMMARY

The purpose of the Regional Beach Sand Project (RBSP) was to dredge up to two million cubic yards (cy) of sand from up to six offshore borrow sites and replenish 12 beaches along the coast of San Diego County from Oceanside to the north to Imperial Beach to the south. Construction started on April 6, 2001 and was completed on September 23, 2001.

During the environmental review process, sediment transport modeling was conducted to determine the eventual fate of the sand to avoid any potential impacts to marine resources. These resources include rocky intertidal platforms, shallow subtidal reefs, and kelp beds. Despite the results of the modeling, concern from commercial fisherman and the resources agencies required that SANDAG prepare a monitoring plan to ensure that there would be no impacts on these resources, and that if significant impacts did result, that appropriate mitigation measures be implemented. This plan was approved by the agencies and its implementation was considered a permit condition. SANDAG is currently implementing the monitoring program to find out how the sand moves from the initial 12 beaches and spreads out along the region's entire 60-mile coastline, and the potential effect on the marine environment.

The location of monitoring sites was determined by the model-predicted sedimentation patterns where partial sedimentation could occur to hard substrate with indicator species. Monitoring locations were also established in areas of concern to commercial fisherman. Results from the first year of a four-year monitoring program indicate that there was a fair amount of variability in substrate type and biota between monitoring locations. Also apparent at some locations were annual changes such as seasonal sand transport and increases in several kelp species.

Since implementation of the RBSP, several monitoring locations in the shallow subtidal area have experienced changes in sand cover. However, these increases most likely were not due to the replenishment activities because fluctuations were similar to levels observed prior to any construction (i.e., natural sand transport). In addition, sand deposited at most of the receiver sites remained in place until the first major winter storm (November 2001). Despite several large winter storms in November and December 2001, the winter of 2001/2002 could be categorized as a relatively mild winter (i.e., few large swell events). This may have contributed to the lack of offshore sediment deposition. However, the largest change in sand cover was observed at two control locations further suggesting natural fluctuation and little impact from replenishment activities. Observations also suggest that the majority of the sand has migrated downcoast along the shoreline from the receiver site.

This report summarizes the results from the first year of a four-year monitoring program. Therefore, the results are preliminary. Subsequent monitoring will further document the variability associated with each site, and since other beach replenishment activities are being proposed, these data will provide a basis to document any potential effects from the RBSP.
PROJECT OVERVIEW

The purpose of the Regional Beach Sand Project (RBSP) was to dredge up to two million cubic yards (cy) of sand from up to six offshore borrow sites and replenish 12 beaches along the coast of San Diego County from Oceanside to the north to Imperial Beach to the south. Construction started on April 6, 2001 and was completed on September 23, 2001. Table 1 lists the receiver site, construction schedule, the borrow site used for replenishment material, and the quantities deposited at each receiver site.

Table 1. Regional Beach Sand Project Construction Schedule

<table>
<thead>
<tr>
<th>Receiver Site</th>
<th>Construction Dates</th>
<th>Borrow Site</th>
<th>Quantity (cy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Torrey Pines State Beach</td>
<td>April 6 - April 26</td>
<td>SO-5</td>
<td>245,000</td>
</tr>
<tr>
<td>Del Mar</td>
<td>April 27 - May 9</td>
<td>SO-5</td>
<td>183,000</td>
</tr>
<tr>
<td>Mission Beach, San Diego</td>
<td>May 10 - May 21</td>
<td>MB-1</td>
<td>151,000</td>
</tr>
<tr>
<td>Imperial Beach</td>
<td>May 22 - June 4</td>
<td>MB-1</td>
<td>120,000</td>
</tr>
<tr>
<td>Leucadia</td>
<td>June 5 - June 14</td>
<td>SO-7</td>
<td>132,000</td>
</tr>
<tr>
<td>Fletcher Cove, Solana Beach</td>
<td>June 15 - June 24</td>
<td>SO-5</td>
<td>146,000</td>
</tr>
<tr>
<td>South Carlsbad State Beach</td>
<td>June 25 - July 5</td>
<td>SO-7</td>
<td>158,000</td>
</tr>
<tr>
<td>North Carlsbad</td>
<td>July 6 - August 1</td>
<td>SO-5/SO-7</td>
<td>225,000</td>
</tr>
<tr>
<td>Cardiff State Beach, Encinitas</td>
<td>August 2 - August 10</td>
<td>SO-6</td>
<td>101,000</td>
</tr>
<tr>
<td>Moonlight Beach, Encinitas</td>
<td>August 11 - August 16</td>
<td>SO-6/SO-7</td>
<td>105,000</td>
</tr>
<tr>
<td>Batiquitos</td>
<td>August 17 - August 23</td>
<td>SO-7</td>
<td>117,000</td>
</tr>
<tr>
<td>Oceanside</td>
<td>August 24 - September 23</td>
<td>SO-7</td>
<td>421,000</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>2,104,000</td>
</tr>
</tbody>
</table>

A joint Environmental Impact Report/Environmental Assessment (EIR/EA) was prepared by the San Diego Association of Governments (SANDAG) and the U.S. Navy (Navy) in accordance with the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA) to address the potential environmental consequences of the dredging and nourishment project. The Draft EIR/EA was released for a 45-day public review period in March 2000 and the SANDAG Board of Directors certified the Final EIR/EA in June 2000. The Navy served as the NEPA lead for the document.
because they were providing funding for the project. Navy funding resulted from actions associated with the previously permitted USS Stennis Homeporting project. As part of that project, the Navy proposed to use dredged material from San Diego Bay to nourish various San Diego region beaches with 5.5 million cy of sand. After approximately 284,000 cy were placed near Oceanside, Del Mar, and Mission Beach, munitions were found in the dredged material and for safety reasons the material was instead disposed in an approved offshore location (LA-5). However, the Navy still had to fulfill a commitment for beach nourishment and monies were federally appropriated and provided to SANDAG to implement beach nourishment using another sand source.

Based on the *Coastal Monitoring Plan* prepared by the Navy for sand replenishment associated with the Homeporting project, and approved by the U.S. Army Corps of Engineers (USACE) in October 1997, the EIR/EA provided a framework for monitoring and mitigation for the RBSP. The *Final Operations Procedures, Mitigation Monitoring and Contingency Measures Plan for the San Diego Regional Beach Sand Project* (Monitoring Plan) identified and outlined the required monitoring prior to, during, and post-construction to meet the conditions of various permits, agreements, and variances including:

- 404 Permit No. 1999-15076-RLK by the USACE;
- 401 Water Quality Certification 00C-063 by the Regional Water Quality Control Board (RWQCB);
- Coastal Development Permit No. 6-00-38 by the California Coastal Commission;
- Biological Opinion FWS Log. No. 1-6-01-F-1046 by the U.S. Fish and Wildlife Service (USFWS); and
- Settlement Agreement between the California Lobster and Trap Fishermen’s Association (CLTFA) and SANDAG.

Pre-construction and construction monitoring efforts were identified to verify that known site-specific resources would not be adversely affected (e.g., water quality, subtidal reefs, and grunion). Post-construction monitoring would document the long-term ramifications of the project and verify no long-term, adverse effect to marine resources, and mitigation was identified in conceptual terms, to be implemented if an impact was identified during the monitoring program.

**Marine Resources Monitoring**

The RBSP was the first project of its kind in the San Diego region; however, surveys conducted from previous beach replenishment efforts identified marine resources in the vicinity of several of the receiver sites. These resources included rocky intertidal platforms, shallow subtidal reefs, and kelp beds. During the environmental review process, sediment transport modeling was conducted to determine the eventual fate of the sand to avoid any potential impacts to these resources. Although modeling suggested there would be no impact on these resources, concern from commercial fisherman and the resources agencies required that SANDAG implement a monitoring program to ensure
that there would be no impacts. SANDAG is currently implementing the monitoring program to find out how the sand moves from the initial 12 beaches and spreads out along the region's entire 60-mile coastline, and the potential affects on the marine environment.

This report presents results from post-construction monitoring surveys for marine biological resources conducted since implementation of the RBSP. Marine biological monitoring locations were established prior to the implementation of the RBSP to document the condition and state of marine resources. Several of these monitoring locations were established in 1997 for the Navy's beach replenishment efforts, and provide a long-term data set as to the natural variability in the nearshore region. The location of monitoring test and control sites was driven by the model-predicted sedimentation patterns and locations where partial sedimentation could occur to hard substrate with indicator species. The monitoring locations and methodology have also been established based on coordination with the commercial lobster fishermen as represented by Mr. John Guth of the CLTFA.

This report contains four sections pertaining to specific marine resources identified during the environmental review process, and includes the rocky intertidal habitat, shallow subtidal habitat, kelp forest habitat, and lobster monitoring.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROCKY INTERTIDAL MONITORING REPORT</td>
<td>RI-1</td>
</tr>
</tbody>
</table>
ROCKY INTERTIDAL MONITORING REPORT

Dr. Jack Engle of the University of California, Santa Barbara, is currently conducting the rocky intertidal monitoring under contract with the Navy. The reports included here are three survey reports from Spring 2001 to Spring 2002. A 2001/2002 Annual Report will be available from the Navy in Fall 2002. Dr. Engle will continue to conduct the rocky intertidal monitoring for the RBSP through Spring 2005.
Dear Mitch:

This report letter summarizes accomplishments under contract N68711-97-LT-70034 for the eighth semi-annual survey period of the San Diego County Rocky Intertidal Monitoring Project. Tasks accomplished include rocky intertidal key species surveys at Cardiff Reef in Cardiff by the Sea, Scripps Reef in La Jolla, and Navy North and Navy South sites on the Pt. Loma Peninsula in San Diego.

Sampling Report

The Spring 2001 rocky intertidal sampling at the 4 locations was conducted during the period March 7-10 (Table 1) by a team of 5 employees and volunteers (Table 2). Daytime low tides ranged from -0.9 ft to –1.5 ft. Despite rainstorms that occurred a few days prior, sea conditions were fair to good for sampling. Therefore, we were able to survey all key species photoplots, circular plots, and transects successfully (Table 3). Timed searches for abalone and sea stars were conducted at all 4 sites, but were difficult at Scripps Reef due to moderate surf sweeping over the low intertidal zone, even at low tide. No black abalone were found at any site. Nine ochre stars were discovered at Cardiff Reef, but none elsewhere.

Most fixed plots were easily locatable at the 4 sites, and nearly all plot markers were intact. A few marker repairs were made at Navy North. Mussel growth obscured some bolts at Cardiff and Scripps. To avoid disturbing mussels, we used a metal detector to locate hidden bolts. In addition to the key species surveys, we documented conditions at all 4 sites. Also, the access to Swami’s Reef at Encinitas was visited (at high tide) for evaluation in case future surveys are planned there. The field activities are described by site as follows:

Cardiff Reef

There was some evidence of storm disturbance at Cardiff Reef since the Fall 2000 survey, but the effects were patchy and not severe. A portion of the inshore barnacle zone was lightly scoured where cobble and sand apparently swept across the reef. No broken out ledges or mussel shell accumulations were noted; however, a few small patches of mussels were lost on inner and outer reefs (as evidenced by relatively bare areas containing ephemeral algae and byssal threads).
Sand levels were the lowest possible. Table Top projection (with goose barnacle plots 2 and 3) was 2 m above the base bedrock. The roadcut contained little cobble. There was no sand along the seawall, and only a little cobble, with the lower wall ledge fully exposed. Hardly any drift kelp was present at the site. There was a moderate amount of ephemeral green algae on the inshore barnacle reef. Barnacle plots had more adult and juvenile acorn barnacles, but much was still bare rock. Patches of *Balanus glandula* and small mussels were observed in scattered damp spots outside the plots. The shoreward goose barnacle Plot 1 that lost all biotic cover by Fall 1998 now has mostly acorn barnacles on the upper ledge, with increasing amounts of small goose barnacles and small mussels below. Other goose barnacle plots appeared healthy. Inshore mussel Plot 1 that had lost all mussels in Winter 97/98 showed gradually increasing mussel cover in depressions. Expanding mussel cover via recruitment and growth was evident in the other mussel plots as well, and more bolts had become overgrown. The offshore mussel plots appeared typical, except mussel Plot 1, that lost most mussel cover before Fall 2000, is green with *Ulva*. Mussel recruits were not evident. Owl limpet numbers dropped in 4 of the 5 plots, apparently due to encroachment of mussels that reduced open space for grazing. Plot 4 counts dropped from a record high of 93 in Fall 1999 to 40 now. Overall, inshore plots have experienced less fluctuation in limpet densities since initiation of monitoring than offshore plots. The line-intercept transects were easy to sample because they were completely exposed during this great low tide. Overall, red turf decreased and sand turf increased since Fall 2000, with most of the changes occurring in Transect 3. Surfgrass cover declined. Much of it was thinned out, tattered, and bleached, with dark cover of epiphytic *Smithora*. Nine ochre seastars were found during this sample, when conditions were excellent for searching crevices.

**Scripps Reef**

Survey conditions were generally okay, except that the surf was higher than usual, making it more difficult to sample surfgrass and seastars along the outer reef edge. Like Cardiff, there was evidence of some storm disturbance here since Fall 2000. A few mussel patches had been torn out, mussel shells were found in pools below their zone, and much of the surfgrass appeared tattered. Some patches where mussels were lost before last fall were covered with dense ephemeral green algae (e.g., Plot 1), while others (e.g., Plot 5) were mostly bare. Sand levels were low on the beach downcoast to the pier, with many rocks exposed. At the reef there was little sand in the low areas between rocks. There was little drift kelp and other algae at the site and adjacent sand beach. Acorn barnacles showed typical high cover, with recruits also noted. Rockweed looked healthy, with typical cover; however, rockweed still was quite sparse at this site. Mussel Plots 2-4 had typical heavy cover such that most plot bolts were overgrown. Mussel Plots 1 and 5 have not recovered from mussel losses before Fall 2000. Goose barnacle cover looked typical, with some recruits evident within existing clumps. Owl limpet numbers were slightly lower than prior counts, but all limpets appeared healthy. Sand turf decreased and red turf increased cover since last fall. Sand tube worms still are rare along the turf transects. Surfgrass cover declined to the lowest values since monitoring began. Grass patches were sparse, tattered, and often bleached. Southern sea palms were still present along the outer reef fringe, but some were blade-less stipes. Boa kelp was relatively uncommon. No ochre seastars were found (compared to 26 last fall); however, the strong surf made searching crevices along the outer reef difficult.

**Navy North**

The swell was not a problem for the hike up the coast to this site. Conditions were good for sampling all plots, although the outer surfgrass transects received occasional wave splash. Evidence of storm disturbance at this site included a dislodged boulder along the mussel/goose barnacle shelf and a few bare spots in surfgrass beds. There were many old smashed lobster traps on the upper
beach. Sand levels were moderately low on nearby beaches, and there was little sand influence on the reef. Acorn and thatched barnacles generally appeared similar to Fall 2000, with patches of coralline turf and young rockweed encroaching in some plots. Rockweed was healthy, with bright orange/yellow reproductive tips. All plots except the lower zone Plot 5 had good cover. Mussel and goose barnacle cover remained at low levels, with practically no recruitment observed. Previous losses from Plots 5, 6, and 10 (where the rock block broke out) remain, with no recovery evident. Breakout of a 5x4x2 ft block by plot 6 removed more mussels and goose barnacles. Owl limpet counts were typical in Plots 1-3, and increased slightly in Plots 4-6. Green ephemeral algae still covered the rock just above the center of the offshore pinnacle limpet plots. Turf transects appeared similar to Fall 2000, except that the most exposed turf was partially bleached. Surfgrass cover, while still high, declined slightly, with some grass thinned, tattered, and bleached. Sargassum weed was 1-1.5 m long in pools. Sea palms and boa kelp remained fairly rare at the site. No ochre seastars were found.

Navy South

Sea conditions at Navy South were okay for the surveys despite a threat of rain. Like the other three sites, there was some evidence of storm disturbance since last fall. Occasional small bare patches were observed in surfgrass beds and some rock slabs were found overturned. There were few large heads of sand castle worm tubes remaining in the tunnel. Sand levels were low in the coves. There was minimal kelp wrack on the beaches. Most key species at Navy South exhibited typical cover, generally similar to Fall 2000 conditions. There was little or no mussel or goose barnacle recruitment. Rockweed cover was healthy, with orange/yellow reproductive tips evident. Turf cover was good, but partially bleached. Surfgrass cover, though high, declined slightly. Uppermost plants were thinned, tattered, and bleached. Sea palms and boa kelp were rare. Owl limpet numbers at Navy South increased slightly, primarily due to increased numbers found in Plots 4 and 6. No ochre seastars were found.

Preview of Future Activities

The San Diego County Rocky Intertidal Study is on schedule with the project timeline. Spring 2001 data will be entered in the computer for analysis. The 2000/2001 Annual Report will be prepared for submission in June 2001. The Fall 2001 sampling will be scheduled for a good mid-day low tide series in November.

Sincerely,

John M. Engle
Associate Research Biologist
Table 1. Spring 2001 Field Activities for the San Diego County Rocky Intertidal Monitoring Project.

<table>
<thead>
<tr>
<th>Date</th>
<th>Site</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 7</td>
<td>Cardiff Reef</td>
<td>Rocky intertidal spring sampling</td>
</tr>
<tr>
<td>March 8</td>
<td>Navy North, Pt. Loma</td>
<td>Rocky intertidal spring sampling</td>
</tr>
<tr>
<td>March 9</td>
<td>Navy South, Pt. Loma</td>
<td>Rocky intertidal spring sampling</td>
</tr>
<tr>
<td>March 10</td>
<td>Scripps Reef</td>
<td>Rocky intertidal spring sampling</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Name</th>
<th>Affiliation</th>
<th>Project Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jack Engle</td>
<td>University of California, Santa Barbara</td>
<td>Employee</td>
</tr>
<tr>
<td>Jessie Altstatt</td>
<td>University of California, Santa Barbara</td>
<td>Employee</td>
</tr>
<tr>
<td>Erik Erikson</td>
<td>University of California, Santa Barbara</td>
<td>Employee</td>
</tr>
<tr>
<td>Corey Chan</td>
<td>California Department of Fish and Game</td>
<td>Volunteer</td>
</tr>
<tr>
<td>David Young</td>
<td>University of California, San Diego</td>
<td>Volunteer</td>
</tr>
</tbody>
</table>

Table 3. Summary of Key Species Assemblages Monitored at the Four San Diego County Sites.

In addition to key species, other species or higher taxa are sampled within plots/transects. For example, green anemones (*Anthopleura elegantissima*) and sand tube worms (*Phragmatopoma californica*) are scored in red algal turf transects. Black abalone (*Haliotis cracherodii*) and ochre sea stars (*Pisaster ochraceus*), though not currently present at the sites, are searched for during timed searches in case they reappear.

<table>
<thead>
<tr>
<th>Species</th>
<th>Cardiff Reef</th>
<th>Scripps Reef</th>
<th>Navy North</th>
<th>Navy South</th>
<th>Total Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rockweed (<em>Pelvetia fastigiata</em>)</td>
<td>5 PP</td>
<td>5 PP</td>
<td>5 PP</td>
<td>5 PP</td>
<td>3</td>
</tr>
<tr>
<td>Red Turf (<em>Corallina spp. et al.</em>)</td>
<td>3 LT</td>
<td>3 LT</td>
<td>2 LT</td>
<td>2 LT</td>
<td>4</td>
</tr>
<tr>
<td>Surf Grass (<em>Phyllospadix spp.</em>)</td>
<td>3 LT</td>
<td>3 LT</td>
<td>4 LT</td>
<td>4 LT</td>
<td>4</td>
</tr>
<tr>
<td>White Barnacle (<em>Chthamalus spp.</em>)</td>
<td>5 PP</td>
<td>5 PP</td>
<td>6 PP</td>
<td>6 PP</td>
<td>4</td>
</tr>
<tr>
<td>Goose Barnacle (<em>Pollicipes polymerus</em>)</td>
<td>5 PP</td>
<td>5 PP</td>
<td>5 PP</td>
<td>5 PP</td>
<td>2</td>
</tr>
<tr>
<td>Owl Limpet (<em>Lottia gigantea</em>)</td>
<td>5 CP</td>
<td>5 CP</td>
<td>6 CP</td>
<td>6 CP</td>
<td>4</td>
</tr>
<tr>
<td>California Mussel (<em>Mytilus californianus</em>)</td>
<td>10 PP</td>
<td>5 PP</td>
<td>5 PP</td>
<td>5 PP</td>
<td>4</td>
</tr>
</tbody>
</table>

**Total Key Species Per Site**  6  7  7  7

Key to survey techniques: CP=Circular Plot  LT=Line Transect  PP=Photoplot
Dear Mitch:

This report letter summarizes accomplishments under contract #N68711-97-LT-70034 for the ninth semi-annual survey period of the San Diego County Rocky Intertidal Monitoring Project. Tasks accomplished include rocky intertidal key species surveys at Cardiff Reef in Cardiff by the Sea, Scripps Reef in La Jolla, and Navy North and Navy South sites on the Pt. Loma Peninsula in San Diego.

**Sampling Report**

The Fall 2001 rocky intertidal sampling at the 4 locations was conducted during the period November 14-17 (Table 1) by a team of 8 employees and volunteers (Table 2). Daytime low tides ranged from -0.7 ft to -1.1 ft. Despite rainstorms that occurred a few days prior, sea conditions were fair to good for sampling. Therefore, we were able to survey all key species photoplots, circular plots, and transects successfully (Table 3). Late afternoon low tides coupled with cloudy conditions, especially at Cardiff and Scripps, resulted in poor lighting for site overview photographs. No overview photos were taken at Cardiff, where the low tide occurred at sunset. Timed searches for abalone and sea stars (including low tide zones) were conducted at all 4 sites. No black abalone were found at any site. Thirty-one ochre stars were discovered at Cardiff Reef and nineteen at Scripps Reef, but none at Navy North or South.

Most fixed plots were easily locatable at the 4 sites, and nearly all plot markers were intact. A few marker repairs were made at Navy North. Mussel growth obscured many mussel plot bolts at Cardiff and Scripps. To avoid disturbing mussels, we used a metal detector to locate hidden bolts. In addition to the key species surveys, we documented conditions at all 4 sites. Field observations are summarized by site as follows:

**Cardiff Reef**

There was little evidence of storm or sediment scour disturbance at Cardiff Reef since the Spring 2001 survey. The portion of the inshore barnacle zone adjacent to the old road cut was lightly scoured (and covered with ephemeral algae) where cobble and sand apparently swept over on occasions, but nearby barnacle plots showed no evidence of disturbance. No broken out ledges or
mussel shell accumulations were noted. Sand/gravel levels were moderate upcoast and downcoast of the reef, higher than Spring 2001, and slightly lower than Fall 2000. Table Top projection (with goose barnacle plots 2 and 3) was 1.4 m above the base bedrock, compared to 2.0 m in Spring 2001 and 1.2 m in Fall 2000. The roadcut contained moderate amounts of sand/gravel/cobble. There was also a moderate amount of sand/gravel/cobble along the seawall, with the lower wall ledge partially buried. Scattered, low amounts of drift kelp were present along the seawall, downcoast, and on the offshore mussel reef. There was relatively little slippery green algal cover on the inshore barnacle reef. Barnacle plots had notably increased acorn barnacle cover. Patches of *Balanus glandula* and small mussels were observed in scattered damp spots outside the plots. The shoreward goose barnacle Plot 1 that lost all biotic cover by Fall 1998 now had mostly acorn barnacles, with small amounts of goose barnacles and mussels present. Other goose barnacle plots appeared healthy. Like Spring 2001, mussel cover was nearly 100% (often covering the marker bolts as well) in many inshore and offshore mussel plots, except where particular plots were apparently disturbed by past storm events. Inshore mussel Plot 1 that had lost all mussels in Winter 97/98 now had over 50% cover of mussels. Offshore mussel Plot 1, that lost most mussel cover by Fall 2000, has shown no recovery in mussel cover and recruits were not evident. Owl limpet numbers were similar to last spring, except that Plot 4 continued to decline, apparently due to encroachment of mussels that reduced open space for grazing. Plot 4 counts dropped from a record high of 93 in Fall 1999 to 25 now. Overall, inshore plots have experienced less fluctuation in limpet densities since initiation of monitoring than offshore plots. The line-intercept transects were completely exposed at low tide. Starting with this sampling, red turf and sand turf categories were combined for standardization with other monitoring sites and because these graded categories were difficult to score consistently. Turf cover declined slightly since Spring 2001, and was replaced by small patches of bare substrate. Overall, surfgrass cover was similar to last spring, but now it is healthier in appearance. Thirty-one ochre seastars were found during this sample, when conditions were excellent for searching crevices.

**Scripps Reef**

Survey conditions were good at the reef, with all plots nicely uncovered by the late afternoon low tide. There was some evidence of storm disturbance here since Spring 2001. No torn-out mussel patches were noted, but moderate numbers of old mussel shells were found in low areas. A few overturned rocks were found and minor amounts of sand scour along reef margins observed. Sand levels were high on the beach downcoast to the pier, with few rocks exposed. At the reef there was moderate sand in the low areas between rocks. There were small amounts drift kelp and driftwood at the site and adjacent sand beach. Acorn barnacles showed typical high cover, with recruits also noted. Some rockweed appeared discolored, but cover was typical – still limited to few areas at the site. Mussel Plots 2-4 had essentially 100% cover, with most plot bolts overgrown. Mussel Plots 1 and 5 have not recovered from mussel losses before Fall 2000. Goose barnacle cover looked typical. Owl limpet numbers and sizes also were similar to spring counts. The combined sand turf/red turf remained relatively unchanged. Sand tube worms still are rare along the turf transects. Surfgrass cover, which last spring had declined to the lowest values since monitoring began, recovered to Fall 2000 levels in 2 of the 3 transects, but declined further in the third transect. Grass patches are no longer tattered or bleached. Southern sea palms were still present along the outer reef fringe. Boa kelp was relatively uncommon. Nineteen ochre seastars were found (none were found last spring when strong surf made searching crevices along the outer reef difficult) compared to 26 last fall.
Navy North

The swell was not a problem for the hike up the coast to this site. The water was murky due to recent rain runoff. Conditions were good for sampling all plots, although the outer surfgrass transects received wave splash even at low tide. Evidence of storm disturbance at this site included minor layered bedrock breakouts along the mussel ledge and around the offshore limpet plots. Additional bolts on the mussel bench were bent over and 2 offshore limpet plot bolts were gone. A major landslide had occurred far downcoast. Sand levels were moderately high on nearby beaches, but there was little sand influence on the reef. Acorn barnacle cover increased slightly since Spring 2001, but thatched barnacle cover declined as patches of coralline turf and young rockweed encroached. Rockweed appeared healthy. All plots except the lower zone Plot 5 had good cover. The already low mussel cover declined substantially, particularly in the two plots that had the highest cover. It is likely that the powerful storm waves that bent mussel marker bolts also caused removal of medium-sized mussels. No recruitment was observed. Goose barnacle losses also occurred in several plots, but not in others. Previous goose barnacle losses from Plots 5 and 6 (where the rock block broke out) remain, with no recovery evident. Owl limpet counts declined in all plots, consistent with bolt losses in two plots and observations of weathered rock with scattered small breakouts, presumably caused by storm swells. Surfgrass cover increased slightly since last spring, except in one transect. The surfgrass appeared healthy and unbleached. Sargassum weed was 0.3-0.6 m long in pools. Sea palms and boa kelp remained fairly rare at the site. No ochre seastars were found.

Navy South

Sea conditions at Navy South were okay for the surveys despite moderate swells and murky water due to recent rain runoff. Like Navy North and Scripps, there was some evidence of storm disturbance since last spring. Patchy small bedrock break-out spots and occasional overturned rocks were noted. Two turf transect bolts were completely bent over. As before, there were few large heads of sand castle worm tubes remaining in the tunnel. Sand levels were low in the coves. There were low amounts of fresh kelp wrack on the reefs and beaches. Most key species dynamics at Navy South were similar to those at Navy North. Acorn barnacle cover increased slightly while thatched barnacle cover decreased overall. Mussel cover declined in nearly all plots. Goose barnacle abundances changed little since Spring 2001. There was little or no mussel or goose barnacle recruitment. Rockweed cover was up in several plots, but down in one plot. All rockweed appeared healthy. Like Navy North, owl limpet numbers declined in nearly all plots, with wave weathering of the substrate noted here and there. Turf and surfgrass covers were typical, with healthy plants. Sargassum weed was 0.3-0.6 m long in pools. Sea palms and boa kelp were rare. No ochre seastars were found.

Preview of Future Activities

The San Diego County Rocky Intertidal Study is on schedule with the project timeline. Fall 2001 data will be entered in the computer for analysis. The 2001/2002 Annual Report will be prepared for submission in June 2002. The Spring 2002 sampling will be scheduled for a good mid-day low tide series in March.

Sincerely,

John M. Engle
Associate Research Biologist
Table 1. Fall 2001 Field Activities for the San Diego County Rocky Intertidal Monitoring Project.

<table>
<thead>
<tr>
<th>Date</th>
<th>Site</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>November 14</td>
<td>Navy North, Pt. Loma</td>
<td>Rocky intertidal fall sampling</td>
</tr>
<tr>
<td>November 15</td>
<td>Navy South, Pt. Loma</td>
<td>Rocky intertidal fall sampling</td>
</tr>
<tr>
<td>November 16</td>
<td>Scripps Reef</td>
<td>Rocky intertidal fall sampling</td>
</tr>
<tr>
<td>November 17</td>
<td>Cardiff Reef</td>
<td>Rocky intertidal fall sampling</td>
</tr>
</tbody>
</table>

Table 2. Personnel Participating in San Diego Rocky Intertidal Surveys during Fall 2001.

<table>
<thead>
<tr>
<th>Name</th>
<th>Affiliation</th>
<th>Project Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jack Engle</td>
<td>University of California, Santa Barbara</td>
<td>Employee</td>
</tr>
<tr>
<td>Jessie Altstatt</td>
<td>University of California, Santa Barbara</td>
<td>Employee</td>
</tr>
<tr>
<td>Erik Erikson</td>
<td>University of California, Santa Barbara</td>
<td>Employee</td>
</tr>
<tr>
<td>Simon Allen</td>
<td>Private</td>
<td>Volunteer</td>
</tr>
<tr>
<td>Richard Herrmann</td>
<td>Private</td>
<td>Volunteer</td>
</tr>
<tr>
<td>Robin Lewis</td>
<td>California Department of Fish and Game</td>
<td>Volunteer</td>
</tr>
<tr>
<td>David Young</td>
<td>University of California, San Diego</td>
<td>Volunteer</td>
</tr>
<tr>
<td>Alex Vejar</td>
<td>California Department of Fish and Game</td>
<td>Volunteer</td>
</tr>
</tbody>
</table>

Table 3. Summary of Key Species Assemblages Monitored at the Four San Diego County Sites.

In addition to key species, other species or higher taxa are sampled within plots/transects. For example, green anemones (*Anthopleura elegantissima*) and sand tube worms (*Phragmatopoma californica*) are scored in red algal turf transects. Black abalone (*Haliotis cracherodii*) and ochre sea stars (*Pisaster ochraceus*), though not currently present at the sites, are searched for during timed searches in case they reappear.

<table>
<thead>
<tr>
<th>Species</th>
<th>Cardiff Reef</th>
<th>Scripps Reef</th>
<th>Navy North</th>
<th>Navy South</th>
<th>Total Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rockweed (<em>Pelvetia fastigiata</em>)</td>
<td>5 PP</td>
<td>5 PP</td>
<td>5 PP</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Red Turf (<em>Corallina spp. et al.</em>)</td>
<td>3 LT</td>
<td>3 LT</td>
<td>2 LT</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Surf Grass (<em>Phyllospadix spp.</em>)</td>
<td>3 LT</td>
<td>3 LT</td>
<td>4 LT</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>White Barnacle (<em>Chthamalus spp.</em>)</td>
<td>5 PP</td>
<td>5 PP</td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Pink Barnacle (<em>Tetraclita rubescens</em>)</td>
<td></td>
<td>5 PP</td>
<td>5 PP</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Goose Barnacle (<em>Pollicipes polymerus</em>)</td>
<td>5 PP</td>
<td>5 PP</td>
<td>6 PP</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Owl Limpet (<em>Lottia gigantea</em>)</td>
<td>5 CP</td>
<td>5 CP</td>
<td>6 CP</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>California Mussel (<em>Mytilus californianus</em>)</td>
<td>10 PP</td>
<td>5 PP</td>
<td>5 PP</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td><strong>Total Key Species Per Site</strong></td>
<td>6</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

Key to survey techniques:  CP=Circular Plot  LT=Line Transect  PP=Photoplot
Dear Mitch:

This report letter summarizes accomplishments under contract #N68711-97-LT-70034 for the tenth semi-annual survey period of the San Diego County Rocky Intertidal Monitoring Project. Tasks accomplished include rocky intertidal key species surveys at Cardiff Reef in Cardiff by the Sea, Scripps Reef in La Jolla, and Navy North and Navy South sites on the Pt. Loma Peninsula in San Diego.

**Sampling Report**

The Spring 2002 rocky intertidal sampling at the 4 locations was conducted during the period March 22-27 (Table 1) by a team of 19 employees and volunteers (Table 2). Daytime low tides ranged from +0.3 ft to −1.2 ft. The sea conditions were fair to good for sampling. Therefore, we were able to survey all key species photoplots, circular plots, and transects successfully (Table 3). An additional turf transect was added at Navy North and South sites so there would be 3 replicates for consistency with other monitoring sites. Overview photographs were taken of all fixed plots and transects. Standardized sequential panoramic habitat photos were taken from representative reference locations. Comprehensive biological and topographic surveys were conducted at Scripps Reef by a team from UC Santa Cruz as part of an MMS program comparing regional monitoring sites. Timed searches for abalone and sea stars (including low tide zones) were conducted at all 4 sites. No black abalone were found at any site. Seventeen ochre stars were discovered at Cardiff Reef and ten at Scripps Reef, but none at Navy North or South.

Most fixed plots were easily locatable at the 4 sites, and nearly all plot markers were intact. Major storm damage resulted in rock breakouts at Cardiff and Navy North that disturbed particular plots and required repairs to plot markers. Sketch maps were made of changed rock positions. A few marker repairs were also made at Navy South. Mussel growth obscured many mussel plot bolts at Cardiff and Scripps. To avoid disturbing mussels, we used a metal detector to locate hidden bolts. In addition to the key species surveys, we documented conditions at all 4 sites. Field observations are summarized by site as follows:
Cardiff Reef

There was major evidence of storm-induced breakouts of two reef sections at Cardiff Reef since the Fall 2001 survey. The eastern third of “Table Top” rock had broken away in two large pieces, causing complete loss of goose barnacle Plot 2 (now located beneath a 1.3 m diameter section). It is expected that all mussels and goose barnacles on the broken-out sections will die because they are now positioned below their optimum zone. A new goose barnacle Plot 2 was established on bare rock surface in approximate position of the original plot (to follow succession). Another goose barnacle plot (Plot 7) was added to the closest undisturbed rock surface containing goose barnacle cover comparable to that of Plot 2 prior to the break-out. A second reef break-out occurred in a surge channel at the north end of owl limpet Plot 1, affecting the outer 0.4 m of this plot. Sections of this breakout were found as far away as 13 m. No unusual cobble/gravel/sand was observed. Sand levels were unexpectedly high for this time of year (perhaps due to beach replenishment activities upcoast?), while cobble/gravel abundances were low. Table Top projection was 1.1 m above the substrate, compared to 1.4 m in Fall 2002, 2.0 m in Spring 2001 and 1.2 m in Fall 2000. The roadcut was filled with sand, but sand/cobble/gravel levels along the seawall were low, with the ledge nearly all exposed. Sand levels were high along the outer edge of the offshore mussel reef, coming right up to the lower edge of the mussel zone, with occasional mussels buried. Scattered, moderate amounts of drift kelp were present mostly downcoast from the site. There was relatively little slippery green algal cover on the inshore barnacle reef. Barnacle plots had moderate acorn barnacle cover. The shoreward goose barnacle Plot 1 that lost all biotic cover by Fall 1998 now has dense acorn barnacles in upper portion and increasing goose barnacle and mussel cover in lower portion. Except for the Plot 2 loss, other goose barnacle plots appeared healthy. Mussel cover overall was good (often covering the marker bolts) in many inshore and offshore mussel plots; however, there were patchy losses, some with byssal threads remaining, presumably due to the same storm swells that caused reef breakouts. Inshore mussel Plot 1 that had lost all mussels in Winter 97/98 now has over 60% cover of mussels. Offshore mussel Plot 1, that lost most mussel cover by Fall 2000, has shown no recovery in mussel cover and recruits were not evident. Owl limpet numbers were generally similar to last year. Overall, inshore plots have experienced less fluctuation in limpet densities since initiation of monitoring than offshore plots. The line-intercept transects were completely exposed at low tide. Turf cover increased slightly since Fall 2001, with levels now comparable to Spring 2001. Surfgrass cover dropped by about 25%, with much of remaining grass thinned out, tattered, and bleached. Seventeen ochre seastars were found during this sample, when conditions were good for searching crevices.

Scripps Reef

Survey conditions were fairly good at the reef, with all plots uncovered by the low tide, except the surfgrass transects were periodically awash. There was scattered evidence of storm disturbance here since Fall 2001. Scattered torn-out mussel patches were noted (with byssal threads and dried goose barnacle stalks remaining), and moderate numbers of old mussel shells were found in low areas. A few overturned rocks and boulders were found. Sand levels were low-moderate on the beach downcoast to the pier, with numerous rocks exposed. At the reef there was some sand in the low areas between rocks. There were moderate amounts fresh drift kelp at the site and adjacent sand beach. Acorn barnacles showed typical high cover, with recruits noted. Rockweed cover appeared typical – still limited to few areas at the site. Overall, mussel cover at the site was still quite good, but several mussel plots showed patchy losses. Mussel Plots 1 and 5 have not recovered from mussel losses before Fall 2000. Plot 3 lost about half of mussels since Fall 2001, which have been replaced with dense, low Ulva algae. Goose barnacle cover looked typical. Owl limpet numbers increased moderately in all plots. The combined sand turf/red turf cover increased since last year. Sand tube worms still are rare along the turf transects. Surfgrass cover, which last year
had declined to the lowest values since monitoring began, continued to decline in all transects. Remaining grass patches are tattered and bleached. Southern sea palms were still present along the outer reef fringe. Boa kelp was relatively uncommon. Ten ochre seastars were found compared to 19 last fall.

**Navy North**

The swell was moderate for the hike up the coast to this site. Conditions were good for sampling all plots, although the outer surfgrass transects received wave splash even at low tide. Evidence of storm disturbance at this site included a major break-out of three mussel ledge blocks that included most of Plots 5 and 6. Now nearly all bolts on the mussel bench are bent over. Some small breakouts above (but not affecting) limpet plots 4-6 were observed. Sand levels were moderate on nearby beaches, but there was little sand influence on the reef. High amounts of fresh drift kelp were present immediately upcoast of the mussel reef. Acorn and thatched barnacle cover appeared typical. Rockweed was healthy, with yellowish-orange reproductive tips. All plots except the lower zone Plot 5 had good cover. The already low mussel cover declined further with the ledge break-out. No recruitment was observed. Goose barnacle cover was slightly better than mussel cover, but still poor overall. Owl limpet counts generally were similar to those in Fall 2002. Turf transect cover appeared similar to last year. Surfgrass cover declined slightly along one transect, but was similar to Fall 2002 in the other three transects. Most surfgrass appeared healthy, but there was some thinning and uppermost patches were bleached. Sargassum weed was 0.3-1.0 m long in pools. Sea palms and boa kelp remained fairly rare at the site. No ochre seastars were found.

**Navy South**

Sea conditions at Navy South were moderate for the surveys. There was less evidence of storm disturbance here since last fall compared to that at Cardiff and Navy North. Patchy small bedrock break-outs in grass/turf and limpet zones and occasional overturned rocks were noted. It is notable that now nearly all large heads of sand castle worm tubes are gone from the tunnel, with only a thin crusty worm tube layer remaining. Sand levels were relatively low in the coves. There were moderate amounts of fresh kelp wrack on the reefs and beaches. Most key species dynamics at Navy South were similar to those at Navy North. Acorn and thatched barnacle cover were typical. Mussel cover remains low. Goose barnacle abundances changed little since Fall 2001. There was little or no mussel or goose barnacle recruitment. Rockweed cover was typical. All rockweed appeared healthy, with yellowish-orange reproductive tips. Owl limpet numbers were similar in most plots, with only slight overall decline. Turf and surfgrass covers were typical, with mostly healthy plants, except grass was moderately thinned and uppermost plants bleached. Sargassum weed was 0.3-1.1 m long in pools. Sea palms and boa kelp were rare. No ochre seastars were found.

**Preview of Future Activities**

The San Diego County Rocky Intertidal Study is on schedule with the project timeline. Spring 2002 data will be entered in the computer for analysis. The Interim Five-Year Report (1997-2002) will be prepared for submission in July 2002. In Fall 2002, Navy North and Navy South will continue to be monitored under this Navy contract. Cardiff and Scripps will continue to be surveyed under a new contract with AMEC, Inc. for the San Diego Association of Governments.

Sincerely,

John M. Engle
Associate Research Biologist
Table 1. Spring 2002 Field Activities for the San Diego County Rocky Intertidal Monitoring Project.

<table>
<thead>
<tr>
<th>Date</th>
<th>Site</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 22, 23 &amp; 27</td>
<td>Cardiff Reef</td>
<td>Intertidal sampling &amp; comprehensive surveys</td>
</tr>
<tr>
<td>March 22, 24 &amp; 27</td>
<td>Scripps Reef</td>
<td>Intertidal sampling &amp; comprehensive surveys</td>
</tr>
<tr>
<td>March 25</td>
<td>Navy North, Pt. Loma</td>
<td>Intertidal sampling</td>
</tr>
<tr>
<td>March 26</td>
<td>Navy South, Pt. Loma</td>
<td>Intertidal sampling</td>
</tr>
</tbody>
</table>

Table 2. Personnel Participating in San Diego Rocky Intertidal Surveys during Spring 2002.

<table>
<thead>
<tr>
<th>Name</th>
<th>Affiliation</th>
<th>Project Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jack Engle</td>
<td>University of California, Santa Barbara</td>
<td>Employee</td>
</tr>
<tr>
<td>Jessie Altstatt</td>
<td>University of California, Santa Barbara</td>
<td>Employee</td>
</tr>
<tr>
<td>Stevie DeJong</td>
<td>University of California, Santa Barbara</td>
<td>Employee</td>
</tr>
<tr>
<td>Erin Maloney</td>
<td>University of California, Santa Cruz</td>
<td>Volunteer</td>
</tr>
<tr>
<td>Kristen Kusic</td>
<td>University of California, Santa Cruz</td>
<td>Volunteer</td>
</tr>
<tr>
<td>Alison Kendall</td>
<td>University of California, Santa Cruz</td>
<td>Volunteer</td>
</tr>
<tr>
<td>Megan Williams</td>
<td>University of California, Santa Cruz</td>
<td>Volunteer</td>
</tr>
<tr>
<td>Bonnie Becker</td>
<td>Cabrillo National Monument</td>
<td>Volunteer</td>
</tr>
<tr>
<td>Tiffany Luas</td>
<td>Cabrillo National Monument</td>
<td>Volunteer</td>
</tr>
<tr>
<td>Adrienne Huber</td>
<td>Cabrillo National Monument</td>
<td>Volunteer</td>
</tr>
<tr>
<td>Dale Sweetnam</td>
<td>California Department of Fish and Game</td>
<td>Volunteer</td>
</tr>
<tr>
<td>Robin Lewis</td>
<td>California Department of Fish and Game</td>
<td>Volunteer</td>
</tr>
<tr>
<td>Corey Chan</td>
<td>California Department of Fish and Game</td>
<td>Volunteer</td>
</tr>
<tr>
<td>Alex Vejar</td>
<td>California Department of Fish and Game</td>
<td>Volunteer</td>
</tr>
<tr>
<td>Simon Allen</td>
<td>Private</td>
<td>Volunteer</td>
</tr>
<tr>
<td>Richard Herrmann</td>
<td>Private</td>
<td>Volunteer</td>
</tr>
<tr>
<td>Bob Gladden</td>
<td>Private</td>
<td>Volunteer</td>
</tr>
<tr>
<td>Mark Novak</td>
<td>Private</td>
<td>Volunteer</td>
</tr>
<tr>
<td>Neil Adams</td>
<td>Private</td>
<td>Volunteer</td>
</tr>
</tbody>
</table>

Table 3. Summary of Key Species Assemblages Monitored at the Four San Diego County Sites.

In addition to key species, other species or higher taxa are sampled within plots/transects. For example, green anemones (*Anthopleura elegantissima*) and sand tube worms (*Phragmatopoma californica*) are scored in red algal turf transects. Black abalone (*Haliotis cracherodii*) and ochre sea stars (*Pisaster ochraceus*), though not currently present at the sites, are searched for during timed searches in case they reappear.

<table>
<thead>
<tr>
<th>Species</th>
<th>Cardiff Reef</th>
<th>Scripps Reef</th>
<th>Navy North</th>
<th>Navy South</th>
<th>Total Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rockweed (<em>Pelvetia fastigiata</em>)</td>
<td>5 PP</td>
<td>5 PP</td>
<td>5 PP</td>
<td>5 PP</td>
<td>3</td>
</tr>
<tr>
<td>Red Turf (<em>Corallina spp. et al.</em>)</td>
<td>3 LT</td>
<td>3 LT</td>
<td>3 LT</td>
<td>3 LT</td>
<td>4</td>
</tr>
<tr>
<td>Surf Grass (<em>Phyllospadix spp.</em>)</td>
<td>3 LT</td>
<td>3 LT</td>
<td>4 LT</td>
<td>4 LT</td>
<td>4</td>
</tr>
<tr>
<td>White Barnacle (<em>Chthamalus spp.</em>)</td>
<td>5 PP</td>
<td>5 PP</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Pink Barnacle (<em>Tetraclita rubescens</em>)</td>
<td></td>
<td>5 PP</td>
<td>5 PP</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Goose Barnacle (<em>Pollicipes polymerus</em>)</td>
<td>5 PP</td>
<td>5 PP</td>
<td>6 PP</td>
<td>6 PP</td>
<td>4</td>
</tr>
<tr>
<td>Owl Limpet (<em>Lottia gigantea</em>)</td>
<td>5 CP</td>
<td>5 CP</td>
<td>6 CP</td>
<td>6 CP</td>
<td>4</td>
</tr>
<tr>
<td>California Mussel (<em>Mytilus californianus</em>)</td>
<td>10 PP</td>
<td>5 PP</td>
<td>5 PP</td>
<td>5 PP</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total Key Species Per Site</strong></td>
<td>6</td>
<td>7</td>
<td>7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Key to survey techniques:   CP=Circular Plot   LT=Line Transect    PP=Photoplot
SHALLOW SUBTIDAL MONITORING REPORT
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>SECTION</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTRODUCTION</td>
<td>SS-1</td>
</tr>
<tr>
<td>METHODS</td>
<td>SS-1</td>
</tr>
<tr>
<td>Study Sites</td>
<td>SS-1</td>
</tr>
<tr>
<td>Methods for Biota Studies</td>
<td>SS-3</td>
</tr>
<tr>
<td>Data Analysis</td>
<td>SS-4</td>
</tr>
<tr>
<td>Field Monitoring Periods</td>
<td>SS-4</td>
</tr>
<tr>
<td>RESULTS</td>
<td>SS-4</td>
</tr>
<tr>
<td>North Carlsbad</td>
<td>SS-4</td>
</tr>
<tr>
<td>South Carlsbad</td>
<td>SS-6</td>
</tr>
<tr>
<td>Batiquitos/Leucadia</td>
<td>SS-7</td>
</tr>
<tr>
<td>Moonlight Beach</td>
<td>SS-8</td>
</tr>
<tr>
<td>Swamis (Control)</td>
<td>SS-9</td>
</tr>
<tr>
<td>Cardiff</td>
<td>SS-10</td>
</tr>
<tr>
<td>Cardiff (Control)</td>
<td>SS-11</td>
</tr>
<tr>
<td>Solana Beach</td>
<td>SS-12</td>
</tr>
<tr>
<td>DISCUSSION</td>
<td>SS-14</td>
</tr>
<tr>
<td>LITERATURE CITED</td>
<td>SS-17</td>
</tr>
</tbody>
</table>

# LIST OF FIGURES

<table>
<thead>
<tr>
<th>FIGURE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Monitoring Locations at North Carlsbad.</td>
</tr>
<tr>
<td>2</td>
<td>Monitoring Locations at South Carlsbad and Batiquitos</td>
</tr>
<tr>
<td>3</td>
<td>Monitoring Locations at Batiquitos and Leucadia</td>
</tr>
<tr>
<td>4</td>
<td>Monitoring Locations at Moonlight Beach and Cardiff</td>
</tr>
<tr>
<td>5</td>
<td>Monitoring Locations at Cardiff and Solana Beach</td>
</tr>
<tr>
<td>6</td>
<td>Percent Cover of Three Substrate Types at North Carlsbad</td>
</tr>
<tr>
<td>7</td>
<td>Percent Cover of Three Substrate Types at NC-SS-2 Since 1997</td>
</tr>
<tr>
<td>8</td>
<td>Percent Cover of Surfgrass at North Carlsbad</td>
</tr>
<tr>
<td>9</td>
<td>Percent Cover of Surfgrass and Feather Boa Kelp at NC-SS-2 Since 1997</td>
</tr>
<tr>
<td>10</td>
<td>Mean Shoot Density of Surfgrass per 0.0625 m² at North Carlsbad</td>
</tr>
<tr>
<td>11</td>
<td>Percent Cover of Feather Boa Kelp at North Carlsbad</td>
</tr>
<tr>
<td>12</td>
<td>Number of Sea Palms at North Carlsbad</td>
</tr>
<tr>
<td>13</td>
<td>Number of Sea Palms and Sea Fans at NC-SS-2 Since 1997</td>
</tr>
<tr>
<td>14</td>
<td>Percent Cover of Sea Fans at North Carlsbad</td>
</tr>
<tr>
<td>15</td>
<td>Percent Cover of Three Substrate Types at South Carlsbad</td>
</tr>
</tbody>
</table>
16 Percent Cover of Surfgrass at South Carlsbad ...........................................................SS-28
17 Mean Shoot Density of Surfgrass per 0.0625 m² at South Carlsbad ..........................SS-29
18 Percent Cover of Feather Boa Kelp at South Carlsbad ...............................................SS-29
19 Number of Sea Palms at South Carlsbad .................................................................SS-30
20 Percent Cover of Three Substrate Types at Batiquitos/Leucadia ...............................SS-31
21 Percent Cover of Three Substrate Types at BL-SS-3 Since 1997 ..............................SS-32
22 Percent Cover of Surfgrass at Batiquitos/Leucadia ..................................................SS-32
23 Percent Cover of Surfgrass and Feather Boa Kelp at BL-SS-3 Since 1997 ..................SS-33
24 Mean Shoot Density of Surfgrass per 0.0625 m² at Batiquitos/Leucadia ....................SS-33
25 Percent Cover of Feather Boa Kelp at Batiquitos/Leucadia .....................................SS-34
26 Number of Sea Palms at Batiquitos/Leucadia .........................................................SS-34
27 Number of Sea Palms at BL-SS-3 Since 1997 ..........................................................SS-35
28 Number of Sea Fans at Batiquitos/Leucadia ............................................................SS-35
29 Percent Cover of Three Substrate Types at Moonlight ...........................................SS-36
30 Percent Cover of Surfgrass at Moonlight .................................................................SS-36
31 Mean Shoot Density of Surfgrass per 0.0625 m² at Moonlight ..................................SS-37
32 Percent Cover of Feather Boa Kelp at Moonlight ....................................................SS-37
33 Number of Sea Palms at Moonlight ..........................................................................SS-38
34 Percent Cover of Three Substrate Types at Swamis ................................................SS-39
35 Percent Cover of Surfgrass at Swamis .....................................................................SS-40
36 Number of Sea Palms at Swamis ...........................................................................SS-40
37 Percent Cover of Feather Boa Kelp at Swamis .........................................................SS-41
38 Number of Sea Palms at Swamis ...........................................................................SS-41
39 Percent Cover of Three Substrate Types at Cardiff ..................................................SS-42
40 Percent Cover of Surfgrass at Cardiff .....................................................................SS-42
41 Mean Shoot Density of Surfgrass per 0.0625 m² at Cardiff .......................................SS-43
42 Percent Cover of Feather Boa Kelp at Cardiff ..........................................................SS-43
43 Number of Sea Palms at Cardiff .............................................................................SS-44
44 Percent Cover of Three Substrate Types at Cardiff (Control) ....................................SS-45
45 Percent Cover of Three Substrate Types at CC-SS-2 Since 1997 ..............................SS-46
46 Percent Cover of Surfgrass at Cardiff (Control) .......................................................SS-46
47 Percent Cover of Surfgrass and Feather Boa Kelp at CC-SS-2 Since 1997 ...............SS-47
48 Mean Shoot Density of Surfgrass per 0.0625 m² at Cardiff (Control) .......................SS-47
49 Percent Cover of Feather Boa Kelp at Cardiff (Control) ..........................................SS-48
50 Number of Sea Palms at Cardiff (Control) ...............................................................SS-48
51 Number of Sea Palms at CC-SS-2 Since 1997 ..........................................................SS-49
52 Percent Cover of Three Substrate Types at Solana Beach .......................................SS-50
53 Percent Cover of Surfgrass at Solana Beach ..............................................................SS-51
54 Mean Shoot Density of Surfgrass per 0.0625 m² at Solana Beach ............................SS-51
55 Percent Cover of Feather Boa Kelp at Solana Beach ................................................SS-52
56 Number of Sea Palms at Solana Beach ....................................................................SS-52
57 Picture of Low-Relief Reef Adjacent to Sand Channel ............................................SS-53
58 Picture of Surfgrass, Coralline Algae, and Small Kelps Partially Covered With Sand ...SS-53
59 Picture of South Carlsbad Receiver Site in December 2001 Depicting Sand Migrating Downcoast .............................................................SS-54
# LIST OF TABLES

<table>
<thead>
<tr>
<th>TABLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Positions of Shallow Subtidal and Kelp Forest Monitoring Locations (NAD83)</td>
</tr>
</tbody>
</table>

# LIST OF APPENDICES

<table>
<thead>
<tr>
<th>APPENDIX</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Summary Data</td>
</tr>
</tbody>
</table>
INTRODUCTION

Shallow subtidal habitat is defined as the area of hard substrate (i.e., reef) closest to the shore or beach. It is a dynamic environment as this is the area where seasonal sand transport occurs and where wave energy is released (i.e., surf). It is also the area that would potentially be impacted first by migrating sand from the replenishment area(s). Generally these reefs are located approximately 200 meters (m) from the back beach in water ranging in depth from three to five meters. The reefs can be characterized as either high-relief (being greater than one meter high) or low-relief substrate primarily sandstone, separated by longitudinal sand channels, and are patchily distributed and scattered, meaning that they are not continuous along the coastline. This habitat also supports both commercially and recreationally important species such as kelp bass (*Paralabrax clathratus*), sheephead (*Semicossyphus pulcher*), and lobster (*Panulirus interruptus*), and it has been suggested that the nearshore surfgrass habitat acts as a recruitment and nursery area for many invertebrates and fishes. For these reasons, many of the resource agencies have designated the reefs as sensitive marine resources.

Surveys have also indicated several species that are present on the reefs (e.g., feather boa kelp, surfgrass, sea fans, and sea palms). All of these species are perennial, and in the case of sea fans may live for over 50 years (Abbott and Hollenberg 1978; Black 1974; Grigg 1975, 1977). In addition, these species are sensitive to varying degrees of sand scour or burial. For example, a relatively small amount of sand on, or falling on, the bottom can reduce the survivorship of microscopic life history stages (Devinny and Volse 1978; Littler et al. 1983; Foster and Schiel 1985). Therefore, reefs that support these species are considered persistent and are generally not covered by sand.

The objective of the monitoring is to evaluate whether beach replenishment operations result in any significant, long-term adverse impacts to sensitive marine resources in the vicinity of the beach replenishment sites.

METHODS

STUDY SITES

Under the Navy ‘s monitoring program, two shallow subtidal reefs identified to support indicator species were established as test reefs (Leucadia and North Carlsbad) and a control reef was established at Cardiff. The control reef was located close enough to experience similar conditions, but far enough away from the receiver beaches to avoid any direct impacts from the replenishment activities.

Based on the results of modeled-predicted sand deposition, all three Navy sites were not predicted to have any sedimentation from the RBSP, therefore new sampling locations were established in areas of concern at North Carlsbad, South Carlsbad, Batiquitos/Leucadia, Moonlight Beach, Cardiff (Restaurant Row), and Solana Beach. The shallow subtidal monitoring locations are shown in Figures 1 through 5, and the positions (latitude/longitude – NAD83) are shown in Table 1. The data are separated into shallow subtidal (SS) and kelp (K) monitoring...
# Table 1. RBSP Post-construction Monitoring Locations (NAD83)

## Shallow Subtidal Locations

<table>
<thead>
<tr>
<th>Location</th>
<th>Code</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Carlsbad</td>
<td>NC-SS-1 33</td>
<td>9.556</td>
<td>117 21.521</td>
</tr>
<tr>
<td></td>
<td>NC-SS-2* 33</td>
<td>8.908</td>
<td>117 21.030</td>
</tr>
<tr>
<td></td>
<td>NC-SS-3 33</td>
<td>8.779</td>
<td>117 20.933</td>
</tr>
<tr>
<td>South Carlsbad</td>
<td>SC-SS-1 33</td>
<td>6.619</td>
<td>117 19.577</td>
</tr>
<tr>
<td>Batiquitos/Leucadia</td>
<td>BL-SS-1 33</td>
<td>4.744</td>
<td>117 18.868</td>
</tr>
<tr>
<td></td>
<td>BL-SS-2 33</td>
<td>4.363</td>
<td>117 18.722</td>
</tr>
<tr>
<td></td>
<td>BL-SS-3* 33</td>
<td>3.944</td>
<td>117 18.541</td>
</tr>
<tr>
<td>Moonlight</td>
<td>ML-SS-1 33</td>
<td>3.487</td>
<td>117 18.344</td>
</tr>
<tr>
<td>Swamis (Control)</td>
<td>SW-SS-1 33</td>
<td>2.186</td>
<td>117 17.960</td>
</tr>
<tr>
<td></td>
<td>SW-SS-2 33</td>
<td>2.039</td>
<td>117 17.857</td>
</tr>
<tr>
<td></td>
<td>SW-SS-3 33</td>
<td>1.935</td>
<td>117 17.718</td>
</tr>
<tr>
<td>Cardiff</td>
<td>CF-SS-1 33</td>
<td>0.822</td>
<td>117 17.113</td>
</tr>
<tr>
<td>Cardiff (Control)</td>
<td>CC-SS-1 33</td>
<td>0.092</td>
<td>117 16.936</td>
</tr>
<tr>
<td></td>
<td>CC-SS-2* 32</td>
<td>59.932</td>
<td>117 16.880</td>
</tr>
<tr>
<td></td>
<td>CC-SS-3 32</td>
<td>59.827</td>
<td>117 16.821</td>
</tr>
<tr>
<td>Solana Beach</td>
<td>SB-SS-1 32</td>
<td>59.544</td>
<td>117 16.730</td>
</tr>
<tr>
<td></td>
<td>SB-SS-2 32</td>
<td>58.940</td>
<td>117 16.623</td>
</tr>
<tr>
<td></td>
<td>SB-SS-3 32</td>
<td>58.750</td>
<td>117 16.581</td>
</tr>
</tbody>
</table>

## Kelp Locations

<table>
<thead>
<tr>
<th>Location</th>
<th>Code</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Batiquitos/Leucadia</td>
<td>BL-K-1 33</td>
<td>4.661</td>
<td>117 18.986</td>
</tr>
<tr>
<td></td>
<td>BL-K-2* 33</td>
<td>4.368</td>
<td>117 18.852</td>
</tr>
<tr>
<td></td>
<td>BL-K-3 33</td>
<td>3.904</td>
<td>117 18.623</td>
</tr>
<tr>
<td>Encinitas</td>
<td>EN-K-1 33</td>
<td>3.774</td>
<td>117 18.587</td>
</tr>
<tr>
<td></td>
<td>EN-K-2 33</td>
<td>3.442</td>
<td>117 18.440</td>
</tr>
<tr>
<td></td>
<td>EN-K-3 33</td>
<td>2.932</td>
<td>117 18.260</td>
</tr>
<tr>
<td>Swamis (Control)</td>
<td>SW-K-1 33</td>
<td>2.24</td>
<td>117 18.069</td>
</tr>
<tr>
<td></td>
<td>SW-K-2* 33</td>
<td>1.983</td>
<td>117 17.933</td>
</tr>
<tr>
<td></td>
<td>SW-K-3 33</td>
<td>1.825</td>
<td>117 17.730</td>
</tr>
<tr>
<td>Cardiff</td>
<td>CF-K-1 33</td>
<td>0.969</td>
<td>117 17.247</td>
</tr>
<tr>
<td></td>
<td>CF-K-2 33</td>
<td>0.744</td>
<td>117 17.140</td>
</tr>
<tr>
<td></td>
<td>CF-K-3 33</td>
<td>0.181</td>
<td>117 17.045</td>
</tr>
<tr>
<td>Solana Beach</td>
<td>SB-K-1* 32</td>
<td>59.499</td>
<td>117 16.951</td>
</tr>
<tr>
<td></td>
<td>SB-K-2 32</td>
<td>59.222</td>
<td>117 16.902</td>
</tr>
<tr>
<td></td>
<td>SB-K-3 32</td>
<td>58.870</td>
<td>117 16.752</td>
</tr>
<tr>
<td>Point Loma (Control)</td>
<td>PL-K-1* 32</td>
<td>42.025</td>
<td>117 15.856</td>
</tr>
<tr>
<td></td>
<td>PL-K-2 32</td>
<td>41.965</td>
<td>117 15.843</td>
</tr>
<tr>
<td></td>
<td>PL-K-3 32</td>
<td>41.892</td>
<td>117 15.838</td>
</tr>
</tbody>
</table>

* Navy Site
locations. Unlike the Navy program which established single monitoring locations at key points, multiple sampling locations were established at most receiver sites (up to three monitoring locations per receiver site). Similarly, the monitoring locations were non-randomly selected and were established in areas of concern and/or in areas most likely to be impacted from sand deposition. This was based initially on the base map of existing conditions produced for the EIR/EA, and ground-truthed by reconnaissance surveys and communication with the CLTFA. The change in methodology was due to concern from lobster fishermen regarding the long-term movement of the sand.

The two general criteria used for determining the suitability of a monitoring location included: 1) that it was in the vicinity of the receiver site, either offshore or downcoast or in the area of modeled deposition, and 2) that it was approximately 250 m² in area, and contained a relatively high percentage of high and/or low-relief reef. This methodology provided greater spatial information regarding sediment transport and possible impacts from sand deposition. The Navy's site at North Carlsbad, Encinitas, Cardiff (i.e., Table Tops) would continue to be monitored. The Cardiff site still serves as a control site, and an additional control site was established at Swami's Reef. Based on existing information and reconnaissance surveys, several of the proposed locations (e.g., South Carlsbad, Moonlight, and Cardiff) did not support the necessary area to establish replicate monitoring locations. Therefore, only a single monitoring location was established at these areas.

METHODS FOR BIOTA STUDIES

Because several sites were carried forward from the Navy program, diving biologists have mapped the habitat and associated biota within a permanently established study area at each of those sites. All the new study areas were established as follows. The offshore edge of each study area was positioned approximately 300 m from the back beach. A permanent, longitudinal transect (running parallel to shore) 40 m long was established at this location. A minimum of five, 50-m long by 2-m wide band transects (total area = 100 m²), spaced at a minimum of ten meter intervals were established perpendicular to shore from the longitudinal transect. These band transects were divided into five meter intervals (i.e., five by two meter quadrats). Biologists qualitatively mapped substrate type in each quadrat to characterize the percent cover of sand and rock, and estimated vertical relief as low-relief (less than one meter high) or high-relief (greater than one meter high).

Within the same quadrat, biologists estimated the abundance or percent cover of key indicator species identified as:

- giant kelp (*Macrocystis pyrifera*)
- feather boa kelp (*Egregia menziesii*)
- surfgrass (*Phyllospadix* spp.)
- sea palms (*Eisenia arborea*)
- sea fans (*Muricea* spp.)
In addition to percent cover data, surfgrass densities were determined by counting the number of shoots in 0.25m x 0.25m quadrats (area = 0.0625 m²) every five meters along the transect (i.e., 10 quadrats per transect), and the number of lobsters recorded in each 100 m² band transect.

**DATA ANALYSIS**

All data were entered into an Excel spreadsheet and arithmetic mean and standard error calculated and either graphed or tabularized. For the Final Report (2005), all sites with replicate monitoring locations (e.g., North Carlsbad, Batiquitos, Swami’s, Cardiff control, and Solana Beach), a nested analysis of variance (ANOVA) will be used to determine statistical differences among percent cover or abundance data at each site for the sampling period, and to make comparisons between test and control sites. A nested ANOVA can also provide statistical analysis at various hierarchical levels such as within and/or between sampling periods, sites, monitoring locations, and transects. For sites where replicate monitoring locations could not be established (e.g., South Carlsbad, Moonlight, Cardiff) statistical comparisons can be made with the control site by using 95% confidence levels. The data will be transformed prior to analysis if violations of homoscedasticity are present. If violations of homoscedasticity are still present after transformations, ANOVA have been done on untransformed data. ANOVA is robust considering heterogeneity of variances as long as the sample size is equal or nearly equal. Sediment data collected during the survey will be analyzed and assessed to determine if any trends observed can be correlated to observed biological data.

**FIELD MONITORING PERIODS**

Predisposal or baseline monitoring occurred in Spring 2001 prior to project initiation. Post-disposal monitoring occurs semi-annually in the spring and fall following sand replenishment activities, through spring 2005. Spring and fall sampling is ideal because it will coincide with the natural onshore and offshore movement of sand.

**RESULTS**

During the development of the monitoring plan, it was thought that having replicate monitoring locations would provide a more robust and powerful experimental design; however, the surveys have documented that there is a high amount of variability in measured factors. Therefore, the data are being presented at the monitoring location level (e.g., SW-SS-2) instead of at the site level (e.g., Swamis). This will provide more detail and insight to spatial differences within a given area.

**NORTH CARLSBAD**

At North Carlsbad, sediment transport models suggested that the sand would be transported downcoast towards the jetty at the entrance to Agua Hedionda Lagoon. The monitoring locations were placed on hard substrate directly offshore of the receiver site (NC-SS-1) and downcoast of the receiver site (NC-SS-2 and 3) (Figure 1).
Substrate

Of the three monitoring locations at North Carlsbad, NC-SS-1 appears different, as sand is more common than at the other two monitoring locations (Figure 6). Low-relief substrate is still the most common substrate at NC-SS-1 accounting for 47.2% of the substrate. From Spring 2001 to Spring 2001, the percent cover of low-relief substrate remained relatively stable ranging from a low of 40.0% in Fall 2001 to a high of 55.7% in Spring 2002. Sandy habitat accounted for 44.9% of the substrate at NC-SS-1, with values ranging from a high of 52.0% in Spring 2001 to a low of 30% in Spring 2002. High-relief substrate accounted for 7.9% of the substrate present at NC-SS-1, and data indicates a slight increase during the course of the monitoring. A low of 2.0% was found in Spring 2001, with a high of 13.3% present in Spring 2002.

The other two sites at North Carlsbad showed similar patterns and values (considering the variation around the mean) in percent cover. Low-relief was more common at NC-SS-2 (64.1% compared to 49.4% at NC-SS-3), while high-relief substrate and sand were more common at NC-SS-3 (high-relief at: 18.2% and sand at 17.7% at NC-SS-2, compared to 23.5% and 27.1% at NC-SS-3, respectively). The sites are relatively close together and are located downcoast of the receiver site. This area may also be the where sand from the Oceanside receiver site may eventually migrate, as sand transport is typically downcoast in the Oceanside littoral cell and the jetties may act as a barrier to further downcoast transport.

NC-SS-2 is a site that has been monitored since 1997 for the Navy’s beach replenishment effort. There is slight decreasing trend in low-relief substrate; however, most of the substrate types have remained relatively constant since 1997 (Figure 7).

Biota

Percent cover of surfgrass at NC-SS-2 and NC-SS-3 was similar with the exception of low percent cover in Spring 2001 at NC-SS-2 (Figure 8), and with the exception of this value are significantly higher than the percent cover observed at NC-SS-1. The mean percent cover of surfgrass at NC-SS-1 was 15.5%, with values ranging from 8.0 to 21.2%. The mean percent cover at NC-SS-2 was 32.2%, with values ranging from 8.1 to 48.8%. The mean percent cover at NC-SS-3 was 42.7%, with values ranging from 36.5 to 52.2%. There was a similar trend at all locations, with the highest values observed during the fall and the lowest values observed in the spring. This is most likely due to the oceanographic conditions as winter storms and colder water may reduce densities and slow growth.

Surfgrass coverage at NC-SS-2 has fluctuated; however trends observed since implementation of the RBSP are within a range observed at the site since 1997 (Figure 9).

Surfgrass shoot density also exhibited a similar trend with two sites having similar values and patterns (NC-SS-1 and NC-SS-2), while NC-SS-3 exhibited an opposite trend (Figure 10). Shoot densities at NC-SS-1 ranged from 2.1 to 8.4 shoots per 0.0625 m² (mean = 5.1 per 0.0625 m²), while shoot densities at NC-SS-2 ranged from 4.9 to 11.6 shoots per 0.0625 m² (mean = 7.9 per 0.0625 m²). The mean shoot density at NC-SS-3 was similar to the other sites (7.1 per 0.0625 m²), although as stated earlier, there was an opposite trend compared to the other sites.
Percent cover of feather boa kelp remained relatively stable at all sites, although there were slight differences in coverage (Figure 11). The highest values were observed at NC-SS-2 with values ranging from 6.5 to 10.2% (mean = 8.9%). Very low coverage of feather boa kelp was observed at NC-SS-1 with values generally less than 0.2% cover (mean = 0.1%). Coverage at NC-SS-3 was between the other sites with values ranging from 4.8 to 5.5% cover (mean = 5.2%). Since 1997, coverage of feather boa kelp at NC-SS-2 has exhibited a very stable pattern with few fluctuations (Figure 9).

Abundance of sea palms exhibited a similar pattern as feather boa kelp, with the highest densities observed at NC-SS-2 (mean = 2.1 per 10 m²), lowest densities at NC-SS-1 (mean = 0.02 per 10 m²), and stable densities at all sites since Spring 2001 (Figure 12). Since 1997, sea palm densities at NC-SS-2 have remained relatively low (less than 1 per 10m²) through Spring 2000, but increased to approximately 2 per 10m² in Fall 2000 and have remained stable through Spring 2002 (Figure 13).

Sea fans have only been observed at NC-SS-1 with a mean density of 0.3 per 10 m² (Figure 14). No sea fans were recorded in Spring 2001; however, abundance of sea fans in Fall 2001 and Spring 2002 was 0.5 per 10m². Sea fan abundance at NC-SS-2 has remained relatively constant since 1997 (Figure 13).

No giant kelp has been observed at North Carlsbad.

**SOUTH CARLSBAD**

Only one monitoring location (SC-SS-1) was established at South Carlsbad within the vicinity of the receiver site. The monitoring location was placed at the closest reef area downcoast of the receiver site (Figure 2).

**Substrate**

The monitoring location can be characterized as primarily sand with a moderate occurrence of low-relief reef (Figure 15). There was a decrease in sand coverage in Fall 2001 to 39.3% from 62.7% in Spring 2001. This corresponded to a slight increase in coverage of low and high-relief reef. However, sand coverage increased to 94% in Spring 2002, with low-relief reef being the other substrate present (6%).

**Biota**

Despite the high coverage of sand in Spring 2002, surfgrass density was highest in Spring 2002 (27.6%) (Figure 16). The density of surfgrass in Spring 2001 was 16.8%, and exhibited a slight decrease in Fall 2001 (14.3%). The density of surfgrass shoots exhibited a similar trend with percent cover with a slight decrease in Fall 2001 (1.5 per 0.0625 m²) and an increase in Spring 2002 (4.3 per 0.0625 m²) (Figure 17). The majority of the surfgrass shoots were buried in sand although they appeared healthy.
The percent cover of feather boa kelp was relatively low (mean = 0.4%), with little fluctuation between surveys (Figure 18). The highest percent cover was observed in Fall 2001 (0.7%), while the lowest cover was observed in Spring 2001 (0.1%). Sea palms was found in relatively low densities, but were present during all surveys (Figure 19).

No sea fans or giant kelp have been observed at South Carlsbad.

**BATIQUITOS/LEUCADIA**

The Batiquitos and Leucadia receiver sites were located in close proximity to one another. The nearshore region offshore of these receiver sites contains a large area of low-relief substrate, with patchy high-relief substrate. Sediment transport models suggested that sand from Batiquitos would be transported directly offshore of the receiver site. One monitoring location (BL-SS-1) was placed on hard substrate directly offshore and downcoast of the Batiquitos receiver site, and the other two monitoring locations were established offshore (BL-SS-2) and downcoast (BL-SS-3) of the Leucadia receiver site (Figure 3).

**Substrate**

Similar to North Carlsbad, one of the three monitoring locations at Batiquitos/Leucadia, BL-SS-1 appears different, as sand is more common than at the other two monitoring locations, accounting for 61.7% of the substrate at BL-SS-1 (Figure 20). From Fall 2001 to Spring 2002, the percent cover of sandy substrate declined from 68.9% to 49.5%. In addition, there was a decrease in the percent cover of low-relief substrate, from 23.7 in Fall 2001 to 12.7% in Spring 2002. These declines corresponded to an increase in percent cover of high-relief substrate from Fall 2001 (7.5%) to Spring 2002 (37.7%).

BL-SS-2 exhibited a large fluctuation in the percent cover of sand. The percent cover of sand was 65.2% in Spring 2001, decreased to near zero in Fall 2001, and increased to 48.7% in Spring 2002. The decrease in sand in Fall 2001 corresponded to an increase in cover of low and high-relief substrate. Interestingly enough, values observed in Spring 2002 were similar to values observed in Spring 2001 suggesting that seasonal sand transport is very evident at BL-SS-2 (i.e., offshore during the winter period and onshore during the summer period).

BL-SS-3 is a site that has been monitored since 1997 for the Navy’s beach replenishment effort. During the surveys for the RBSP, the percent cover of the three substrate types has remained relatively constant (Figure 20). However, percent cover data since 1997 (Figure 21) suggests that the current pattern has existed since Spring 1999, but prior to Spring 1999 the percent cover of high-relief substrate decreased significantly to values currently observed. The decrease in high-relief substrate corresponded to an increase in low-relief substrate. The percent cover of sand has remained relatively constant since 1997.

**Biota**

Percent cover of surfgrass at BL-SS-2 and BL-SS-3 was similar with the exception of low percent cover in Spring 2001 at BL-SS-2 (Figure 22), and with the exception of this value are
significantly higher than the percent cover observed at BL-SS-1. The mean percent cover of surfgrass at BL-SS-1 was 0.7%, with values ranging from zero to 1.1%. The mean percent cover at BL-SS-2 was 38.7%, with values ranging from 11.2 to 56.6%. The mean percent cover at BL-SS-3 was 35.9%, with values ranging from 29.6 to 40.4%. With the exception of low percent cover at BL-SS-2 in Spring 2001, values at all monitoring locations have remained relatively constant.

Since 1997, the percent cover of surfgrass has fluctuated, with low coverage present in Fall 1998, and an increasing trend to Spring 2002 (Figure 23). Values observed in the last several years were observed during the initial survey in Fall 1997.

Surfgrass shoot density also exhibited a similar trend with two sites having similar values and trends (BL-SS-2 and BLSS-3), while little to no surfgrass was observed at BL-SS-1 (Figure 24). Shoot densities at BL-SS-2 ranged from 1.1 to 9.9 shoots per 0.0625 m² (mean = 5.4 per 0.0625 m²), while shoot densities at BL-SS-3 ranged from 3.8 to 6.5 shoots per 0.0625 m² (mean = 4.7 per 0.0625 m²).

Percent cover of feather boa kelp remained relatively stable at all sites, with very slight differences in coverage (Figure 25). The highest values were observed at BL-SS-3 with values ranging from 1.9 to 3.3% (mean = 2.9%). Coverage at BL-SS-2 was similar to BL-SS-3 with values ranging from 2.9 to 3.6% cover (mean = 2.9%). Very low coverage of feather boa kelp was observed at BL-SS-1 with values generally less than 1.9% (mean = 1.2%). Since 1997, coverage of feather boa kelp at BL-SS-3 has exhibited a very stable pattern with few fluctuations (Figure 23).

Abundance of sea palms remained stable at BL-SS-3 with values ranging from 0.5 to 0.7 per 10 m² (mean = 0.6 per 10 m²) (Figure 26). Abundance at BL-SS-2 exhibited an increasing trend with low abundance in Spring 2001 (0.06 per 10 m²) to higher abundance in Spring 2002 (2.28 per 10 m²). The lowest densities were observed at BL--SS-1 with values ranging from 0.0 to 0.05 per 10 m² (mean = 0.02 per 10 m²). Since 1997, sea palm densities at BL-SS-3 have remained relatively stable and low (less than 1 per 10m²) (Figure 27).

Sea fans have only been observed in low densities at BL-SS-1 with a mean density of 0.03 per 10 m² (Figure 28). Sea fans were recorded only in Fall 2001 at a density of 0.08 per 10 m².

No giant kelp has been observed at the monitoring locations at Batiquitos/Leucadia.

**MOONLIGHT BEACH**

Only one monitoring location (ML-SS-1) was established within the vicinity of the receiver site at Moonlight Beach. The monitoring location was placed at the closest reef area slightly upcoast of the receiver site as sediment transport modeling suggested that the sand may migrate upcoast and offshore (Figure 3).
Substrate

The monitoring location can be characterized as primarily low-relief substrate (mean = 51.9%) with moderate amounts of high-relief reef (mean = 22.5%) and sand (mean = 25%) (Figure 29). The coverage of low-relief reef remained relatively stable through Spring 2002, with the highest value in Spring 2001 (59.7%) and the lowest in Spring 2002 (41.3%). The was some fluctuation in high-relief substrate as the highest coverage was present in Fall 2001 (35.8%) and the lowest coverage was present in Spring 2001 (4.9%). Similar to BL-SS-2, there appeared to be a decline in sand coverage in Fall 2001. Values present during both spring surveys were similar with 33.4% cover in Spring 2001 and 32.1% cover in Spring 2002.

Biota

Percent cover of surfgrass has remained stable throughout the surveys (Figure 30). The lowest value was observed in Spring 2001 (35.3%) and the highest value observed in Fall 2001 (40.8%). The number of surfgrass shoots indicated an increasing trend, with the lowest value in Spring 2001 (2.1 per 0.0625 m²) and the highest value in Spring 2002 (7.8 per 0.0625 m²) (Figure 31).

Both feather boa kelp and sea palms displayed a similar pattern with the lowest values present in the spring and the highest value in the fall (Figures 32 and 33). Percent cover of feather boa kelp was 3.3% in Spring 2001, 5.6% in Fall 2001, and 2.5% in Spring 2002, while the number of sea palms was 0.9 per 10 m² in Spring 2001, 2.9 per 10 m² in Fall 2001, and 1.5 per 10 m² in Spring 2002.

No sea fans or giant kelp have been observed at the monitoring locations at Moonlight.

SWAMIS (CONTROL)

The monitoring locations at Swamis are considered control sites implying that this area will be unaffected by any replenishment activities. The monitoring locations were distributed on the upcoast and downcoast edges and in the center of the reef (Figure 4).

Substrate

Both SW-SS-1 and SW-SS-2 displayed similar patterns as BL-SS-2 and ML-SS-1, with a large decrease in the percent cover of sand in Fall 2001 (Figure 34). At SW-SS-1, the percent cover of sand was 76.3% in Spring 2001, 0.0% in Fall 2001, and 95% in Spring 2002. While at SW-SS-2, the percent cover of sand was 64.43% in Spring 2001, 8.8% in Fall 2001, and 55% in Spring 2002. The decrease in sand corresponded to an increase in low-relief reef and to a lesser degree, high-relief reef. At SW-SS-1, low-relief reef increased from 23.3% in Spring 2001 to 80.0% in Fall 2001, while at SW-SS-2, low-relief reef increased from 35.6% in Spring 2001 to 87.2% in Fall 2001. This further supports the concept of seasonal sand transport as this occurred prior to any beach replenishment activities. At SW-SS-3, there was high sand coverage in Spring 2001 (64.4%), a less dramatic decrease in Fall 2001 (48.6%), and similar levels in Spring 2002 (50.1%). There was relatively little high-relief reef present at the two downcoast monitoring locations, with values less than 8.8% cover.
Biota

Percent cover of surfgrass was similar at SW-SS-1 and SW-SS-3 with relatively low densities – mean percent cover was 6.9% at SW-SS-1 and 3.9% at SW-SS-3 (Figure 35). The lowest value was observed in Spring 2001 (35.3%) and the highest value observed in Fall 2001 (40.8%). There was a decreasing trend in surfgrass cover at SW-SS-2 with the highest cover present in Spring 2001 (6.4%) and the lowest in Spring 2002 (5.3%). The number of surfgrass shoots indicated a stable trend throughout the surveys, with SW-SS-2 having the highest shoot density (mean = 4.5 per 0.0625 m²), while SW-SS-1 and SW-SS-3 had much lower shoot densities (1.7 and 0.2 shoots per 0.0625 m², respectively) (Figure 36).

Feather boa kelp was more common at SW-SS-1 and SW-SS-2 in Spring 2001 and Fall 2001 (Figure 37). The percent cover was similar at the sites in Spring 2001 (approximately 16%); however, there was a decreasing trend at SW-SS-1 (14.3%) and an increasing trend at SW-SS-2 (21.7%) through Spring 2002. In Spring 2002, percent cover decreased at both sites (2.1% at SW-SS-1 and 9.3% at SW-SS-2). At SW-SS-3, the percent cover of feather boa kelp remained relatively low and stable with values ranging from 5.9% in Fall 2001 to 2.1% in Spring 2002.

Sea palms displayed a stable pattern at all sites with relatively low densities (less than 1 plant per 10 m²) (Figure 38).

Giant kelp was recorded at SW-SS-1 and SW-SS-2 although densities were low (less than 0.1 plants per 10 m²). At SW-SS-1, one adult plant was encountered during the survey, while at SW-SS-2, three adult plants were recorded during the surveys.

No sea fans were observed at the monitoring locations at Swamis.

CARDIFF

Only one monitoring location (CF-SS-1) was established at Cardiff within the vicinity of the receiver site. The monitoring location was placed at the closest reef area slightly upcoast of the receiver site as sediment transport modeling suggested that the sand may migrate upcoast and offshore (Figure 5).

Substrate

The percent cover of sand at CF-SS-1 revealed an opposite trend to BL-SS-2, SW-SS-1, SW-SS-2, and ML-SS-1 as it increased in Fall 2001 (Figure 39). Percent cover of sand was 3.0% in Spring 2001, increased to 75.9% in Fall 2001, and decreased to 29.3% in Spring 2002. This corresponded to a decrease in low-relief reef in Fall 2001, from 60.0% in Spring 2001 to 17.5% in Fall 2001. The percent cover of low-relief reef increased again in Spring 2002 to a level similar to the previous year (54.9%). The percent cover of high-relief reef remained similar throughout the surveys ranging from 6.7% in Fall 2001 to 15.3% in Spring 2002.
Biota

Percent cover of surfgrass was relatively stable with a slight decrease in Fall 2001. Percent cover was 9.7% in Spring 2001, decreased to 2.4% in Fall 2001, and increased to 15.2% in Spring 2002 (Figure 40). The number of shoots displayed a similar trend with a slight decline observed in Fall 2001. The number of shoots was 2.3 per 0.0625 m² in Spring 2001, decreased to 0.2 per 0.0625 m², and increased to 1.8 per 0.0625 m² (Figure 41).

Feather boa kelp displayed a decreasing trend throughout the surveys. The percent cover was 15.6% in Spring 2001, 9.4% in Fall 2001, and 6.5% in Spring 2002. (Figure 42). Sea palms exhibited a stable pattern throughout the surveys with densities of 1.0 per 10 m² in Spring 2001, 0.8 per 10 m² in Fall 2001, and 0.8 per m² in Spring 2002 (Figure 43).

Giant kelp was recorded during both spring surveys; however, the densities were very low (less than 0.02 plants per 10 m²).

No sea fans were observed at the monitoring location in Cardiff.

CARDIFF (CONTROL)

The monitoring locations at Cardiff (Seaside Reef) are considered control sites implying that this area will be unaffected by any replenishment activities. The monitoring locations were distributed on the upcoast and downcoast edges and in the center of the reef (Figure 5).

Substrate

Both CC-SS-1 and CC-SS-3 are similar in that they have relatively low sand coverage (Figure 44): the mean percent cover of sand at CC-SS-1 was 4.7% and 0.1% at CC-SS-3. At CC-SS-2, there was a relatively high amount of sand (mean = 51.6%). Despite the low coverage of sand, there appears to be some sand movement as the percentage of high and low-relief reef was variable (i.e., sand movement could have created low-relief reef in previous high-relief areas). At CC-SS-1, low-relief reef was the most common substrate in Spring 2001 (80.0%), but decreased to 52.7% in Fall 2001, and remained stable through Spring 2002 (53.6%). At CC-SS-3, high-relief reef has increased through the survey. The percent cover of high-relief reef was 18.0% in Spring 2001, 58.0% in Fall 2001, and 64.0% in Spring 2002. This corresponded to a decreasing trend in low-relief reef (from 82.0% in Spring 2001 to 36.0% in Spring 2002. The variability observed at these three sites appears to be a normal pattern as data from 1997 at CC-SS-2 suggests relatively large fluctuations in the percent cover of sand and reef habitat (Figure 45).

Biota

The percent cover of surfgrass at all the monitoring locations was similar throughout the surveys (Figure 46). There was a slight increase in cover exhibited during the Fall 2001 surveys; however, there was little variability between sites and surveys with values ranging between 20.9% and 35%. The mean percent cover was 23.5% at CC-SS-1, 25.4% at CC-SS-2, and 25.7%
at CC-SS-3. Data collected from 1997 at CC-SS-2 appears to indicate a similar trend with relatively mild fluctuations in percent cover of surfgrass (Figure 47).

Surfgrass shoot density was also similar between the sites from Spring 2001 to Spring 2002, with a slight decreasing trend (Figure 48). The highest densities were observed in Spring 2001 at CC-SS-1 (9.9 per 0.0625 m$^2$), while the lowest densities were observed at CC-SS-2 in Fall 2001 (2.3 per 0.0625 m$^2$).

The percent cover of feather boa kelp varied at each site between the surveys (Figure 49). CC-SS-1 displayed the most stable pattern with relatively similar cover throughout the surveys (6.1% in Spring 2001, 8.5% in Fall 2001, and 6.4% in Spring 2002). The percent cover of feather boa kelp at CC-SS-2 increased from 11.9% in Spring 2001 to 14.4% in Fall 2001, but decreased to 2.7% in Spring 2002. This variability has been observed at this site since 1997 (Figure 47). At CC-SS-3, the percent cover decreased from 11.9% in Spring 2001 to 4.3% in Fall 2001 to 2.2% in Spring 2002.

Sea palm abundance at CC-SS-1 and CC-SS-3 was very similar from Spring 2001 to Spring 2002 (Figure 50). At CC-SS-1, the mean number of sea palms was 2.2 per 10m$^2$ in Spring 2001, 2.5 per 10m$^2$ in Fall 2001, and 3.0 per 10m$^2$ in Spring 2002, while at CC-SS-3, the mean number of sea palms was 1.9 per 10m$^2$ in Spring 2001, 2.4 per 10m$^2$ in Fall 2001, and 2.9 per 10m$^2$ in Spring 2002. The abundance of sea palms at CC-SS-2 was lower than the other sites, with densities of 0.8 per 10m$^2$ in Spring 2001, 0.2 per 10m$^2$ in Fall 2001, and 0.8 per 10m$^2$ Spring 2002. There appears to be a fair amount of variability in sea palm abundance at CC-SS-2 since 1997 with values ranging from 2.4 per 10m$^2$ in Fall 2001 to near zero during several surveys (Figure 51).

Sea fans were only observed in Spring 2001 at CC-SS-1 at very low densities (0.04 per 10 m$^2$).

Giant kelp was observed primarily during the spring surveys. These plants were present in low densities (less than 0.1 per 10 m$^2$) at CC-SS-1 in Spring 2001 and Spring 2002. There was a single observation at CC-SS-3 in Spring 2001 (0.04 per 10 m$^2$)

**SOLANA BEACH**

At Solana Beach, sediment transport models suggested that the sand would be transported upcoast towards the reefs at Cardiff (Seaside Reef). One monitoring location was placed on available hard substrate upcoast of the receiver site (SB-SS-1), while the other two monitoring locations were established downcoast of the receiver site (SB-SS-2 and SB-SS-3) (Figure 5).

**Substrate**

Both SB-SS-1 and SB-SS-3 exhibited the same trend as CF-SS-1 with increasing sand in Fall 2001, although coverage returned to levels observed the prior spring (Figure 52). Sand was the most common substrate type at SB-SS-3 (mean = 58.4%) reaching a peak in Fall 2001 with a mean percent cover of 69.1%. Low-relief reef was present in moderate amounts, while high-relief reef was least common. At SB-SS-2, sand was the least common substrate type, with a
mean percent cover of 11.4%. This was due primarily to a higher occurrence of sand in Spring 2002 (26.3%). At SB-SS-1, low-relief reef was the most common substrate type (mean = 51.0%), although declines in Fall 2001 could be attributed to increasing sand cover (from 33.4% in Spring 2001 to 51.9% in Fall 2001). High-relief substrate was relatively stable during the surveys with a mean percent cover of 11.4%.

**Biota**

The percent cover of surfgrass did not vary between monitoring locations as the highest percent cover was observed at SB-SS-2 (mean = 219%), followed by SB-SS-1 (mean = 10.5%), and SB-SS-3 (mean = 3.0%). There was very little fluctuation in surfgrass density over the course of the surveys (Figure 53). Surfgrass shoot densities exhibited a similar trend as percent cover with the highest shoot density present at SB-SS-2 (mean = 4.7 per 0.0625 m²), followed by SB-SS-1 (mean = 1.9 per 0.0625 m²), and SB-SS-3 (mean = 0.4 per 0.0625 m²) (Figure 54).

The percent cover of feather boa kelp was relatively low at SB-SS-1 (mean = 0.5%) and SB-SS-3 (mean = 0.2%) (Figure 55). The mean percent cover of feather boa kelp at SB-SS-2 was 7.7%; however, it exhibit a decreasing trend with the highest percent cover present in Spring 2001 (15.6%), followed by 5.1% in Fall 2001, and 2.4% in Spring 2002.

The abundance of sea palm was similar to that of feather boa kelp, with the highest abundance present at SB-SS-2 (mean = 3.8 per 10 m²), followed by SB-SS-3 (mean = 0.5 per 10 m²), and SB-SS-1 (mean = 0.1 per 10 m²) (Figure 56). Densities stayed relatively stable throughout the sampling period.

Giant kelp was observed at low densities at SB-SS-2 throughout the surveys with densities of 0.2 per 10 m² in Spring 2001, 0.04 per 10 m² in Fall 2001, and 0.02 per 10 m² in Spring 2002. A single observation of giant kelp was made at SB-SS-1 in Fall 2001.

No sea fans were observed at Solana Beach.
DISCUSSION

The objective of the shallow subtidal monitoring is to evaluate whether beach replenishment operations result in any significant, long-term adverse impacts to sensitive marine resources in the vicinity of the beach replenishment sites. This report documents results of an on-going monitoring program scheduled through Spring 2005, and discusses preliminary results one year since completion of the RBSP.

It is apparent that these shallow subtidal habitats undergo temporal and spatial variation in sand movement. For some sensitive marine resources to exist, a firm substrate with little or no sand is required for initial settlement and growth. Eventually, these organisms may reach a size that will provide a refuge from sand burial; however, continual scour and/or burial could eventually cause mortality and variation in population structure (Foster and Schiel 1985). Natural variation in the abundance of the indicator species is expected and there are challenges in the determining causal relationships. While the presence of suitable substrate is an important factor, it is just one of many factors that may affect the presence of these indicator species (Foster and Schiel 1985).

In the shallow subtidal zone, sand movement influences substrate type and the presence of associated biota. Previous monitoring efforts for the Navy Homeporting beach replenishment project have documented at several areas the variability in natural sand transport. In areas where sand is constantly shifting, either moving on or offshore, or longshore, the presence of low- and high-relief substrate will vary. The loss of sand will expose previously covered rocky substrate creating habitat. Conversely, the influx of large amounts of sand can potentially cover these rocky areas. At all the study sites, the rocky areas are not continuous, but rather separated by sand channels that generally extend perpendicular from shore (Figure 57 – Picture of sand channel). These sand channels are created by constant scouring, provide avenues for sand movement, and can decrease the likelihood of impacts from scour or burial on the reef tops. Large fluctuations in sand cover observed at several sites (e.g., BL-SS-2, ML-SS-1, SW-SS-1, SW-SS-2) suggest that seasonal transport does occur. However, the increases in sand cover since completion of the RBSP (Spring 2002) are similar in magnitude to observations prior to implementation of the RBSP suggesting that this may be natural fluctuation. Another example of natural sand transport occurred at Cardiff. The percent cover of sand increased in spring 1999, while the percent cover of low-relief reef decreased. It appeared that sand movement occurred along several transects and covered some reef areas. This apparent influx of sand was also observed in the intertidal zone and documented during the rocky intertidal surveys (Engle 2000).

Sand scour and burial can also create substrate disturbance. The effects of the disturbance on organisms are directly related to reef elevation and can determine if the habitat is suitable for surfgrass, macroalgae, and sessile invertebrates (Daly and Mathieson 1977; Devinny and Volse 1978; Hirata 1991). High-relief reefs are exposed to less disturbance, which allows recruitment and persistence of organisms. Low-relief reefs are more exposed to disturbance and provide a less stable habitat (Dayton et al. 1984; Hirata 1986, 1991). If the habitat is highly disturbed, it becomes too unstable to support organisms. There is an elevation where disturbance from scour and burial is low enough to provide a refuge for perennial marine organisms. This is generally site specific and is determined by factors such as exposure to wave action and the amount of sand in the system.
The presence of sensitive marine resources can be directly related to the amount of available substrate (i.e., reefs). Sea palms, sea fans, and giant kelp are generally found on high-and low-relief reefs where sand is not present, which suggests that these species are less tolerant of sand movement and disturbance. In areas that are predominantly sand, no sensitive marine resources are present that are of concern to the resource agencies or commercial fisherman. On both high-and low-relief reefs, surfgrass, feather boa kelp, and sea palms are present, although their distribution is patchy. Surfgrass and feather boa kelp are also present on low-relief reefs with interspersed sand patches, suggesting that these species can tolerate moderate amounts of sand burial (Figure 58 — picture of species buried in sand). It also indicates that these reefs must undergo intermittent burial and removal of sand (i.e., ephemeral), as settlement and growth could not occur in the presence of sand (Foster and Schiel 1985).

An interesting note is the decrease in surfgrass abundance at BL-SS-3 in Fall 2000 (prior to the RBSP), which coincided with an increase in sand in several transects. The area along the transects where the increased sand was observed tended to be at the nearshore margin. A general transect profile usually consists of sand as the dominant substrate near the beach, followed by an area of rocky substrate that is heavily scoured and does not support sensitive marine organisms (“interface area”), followed by rocky substrate that is less scoured and can support a diverse assemblage of marine organisms. It is the boundary or interface area that is probably most affected by seasonal sand movement and disturbance. For example, if there is little sand on the beach, this interface area will move shoreward and may allow marine organisms to settle and grow in an area that was once too heavily disturbed to support organisms. The converse would also be true, as large amounts of sand would push this interface area further offshore and thereby reduce the amount of habitat available for recruitment and settlement of marine organisms.

Data collected from 1997 to 2001 indicate both general differences and similarities (e.g., BL-SS-2, ML-SS-1, SW-SS-1, and SW-SS-2 had large declines in sand in Fall 2001) in the mean percent cover of habitat types between treatment and control sites, suggesting that the distribution of substrata is different. This generally corresponded to observed differences in the mean percent cover of surfgrass and sea palms between treatment and control sites. However, differences were observed between treatment and control sites in the mean abundance of feather boa kelp, which suggests that site-specific variation does occur. Statistical comparisons or correlations could not be made with the sea fan and giant kelp data because they were infrequently encountered.

It is apparent that sand from the receiver sites has moved; however, observations and data from this monitoring program suggest that sand from the receiver sites does not appear to have migrated offshore onto the shallow subtidal reefs during the winter. This may be due in part to the relatively mild 2001/2002 winter as there were few large winter storms to push the sand offshore. It appears that the majority of the sand migrated downcoast of the receiver site as evident by sandy beaches downcoast of the receiver sites (Figure 59—picture of beach).

As stated earlier, this is the first year of a long-term monitoring program and subsequent surveys will further document any potential impacts associated with the RBSP. Data from other components of the monitoring program for the RBSP, primarily beach profile data would also
assist in documenting the degree to which sand transport occurs at specific areas and could also validate the observations of the biological monitoring. Based on results of the first year of sampling there appears to be no indication that sand from the receiver sites is impacting the shallow subtidal areas that are being monitored. However, several other beach replenishment projects have occurred in the North Carlsbad and Oceanside areas and may potentially affect the North Carlsbad monitoring locations. Also, maintenance dredging of Batiquitos Lagoon is conducted on a regular basis and may potentially affect the Batiquitos/Leucadia sites. There is potentially no way to disseminate between these different replenishment efforts and the RBSP, as well as, the cumulative effects of future beach replenishment effort.
LITERATURE CITED


FIGURES
North Carlsbad
Beach Replenishment Monitoring Sites

LEGEND

- SAND
- LOW RELIEF SCATTERED REEF
- HIGH RELIEF REEF
- Historical Maximum Kelp Bed Canopies 1978 to 1996
- Kelp Bed Canopy 1997
- Hard Substrate
- Receiver Site
- Modeled Deposition Area
- Monitoring Location

Oceanside Receiver Site
North Carlsbad Receiver Site

FIGURE 1
Figure 6. Percent cover of three substrate types at North Carlsbad.
Figure 7. Percent cover of three substrate types at NC-SS-2 since 1997.

Figure 8. Percent cover of surfgrass at North Carlsbad.
Figure 9. Percent cover of surfgrass and feather boa kelp at NC-SS-2 since 1997.

Figure 10. Mean shoot density of surfgrass per 0.0625 m² at North Carlsbad.
Figure 11. Percent cover of feather boa kelp at North Carlsbad.

Figure 12. Number of sea palms at North Carlsbad.
Figure 13. Number of sea palms and sea fans at NC-SS-2 since 1997.

Figure 14. Number of sea fans at North Carlsbad.
Figure 15. Percent cover of three substrate types at South Carlsbad.

Figure 16. Percent cover of surfgrass at South Carlsbad.
Figure 17. Mean shoot density of surfgrass per 0.0625 m² at South Carlsbad.

Figure 18. Percent cover of feather boa kelp at South Carlsbad.
Figure 19. Number of sea palms at South Carlsbad.
Figure 20. Percent cover of three substrate types at Batiquitos/Leucadia.
Figure 21. Percent cover of three substrate types at BL-SS-3 since 1997.

Figure 22. Percent cover of surfgrass at Batiquitos/Leucadia.
Figure 23. Percent cover of surfgrass and feather boa kelp at BL-SS-3 since 1997.

Figure 24. Mean shoot density of surfgrass per 0.0625 m² at Batiquitos/Leucadia.
Figure 25. Percent cover of feather boa kelp at Batiquitos/Leucadia.

Figure 26. Number of sea palms at Batiquitos/Leucadia.
Figure 27. Number of sea palms at BL-SS-3 since 1997.

Figure 28. Number of sea fans at Batiquitos/Leucadia.
Figure 29. Percent cover of three substrate types at Moonlight.

Figure 30. Percent cover of surfgrass at Moonlight.
Figure 31. Mean shoot density of surfgrass per 0.0625 m² at Moonlight.

Figure 32. Percent cover of feather boa kelp at Moonlight.
Figure 33. Number of sea palms at Moonlight.
Figure 34. Percent cover of three substrate types at Swamis.
Figure 35. Percent cover of surfgrass at Swamis.

Figure 36. Mean shoot density of surfgrass per 0.0625 m² at Swamis.
Figure 37. Percent cover of feather boa kelp at Swamis.

Figure 38. Number of sea palms at Swamis.
### Figure 39. Percent cover of three substrate types at Cardiff.

<table>
<thead>
<tr>
<th>Date</th>
<th>Percent Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar-01</td>
<td>0</td>
</tr>
<tr>
<td>Sep-01</td>
<td>60</td>
</tr>
<tr>
<td>Mar-02</td>
<td>20</td>
</tr>
</tbody>
</table>

### Figure 40. Percent cover of surfgrass at Cardiff.

<table>
<thead>
<tr>
<th>Date</th>
<th>Percent Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar-01</td>
<td>10</td>
</tr>
<tr>
<td>Sep-01</td>
<td>5</td>
</tr>
<tr>
<td>Mar-02</td>
<td>20</td>
</tr>
</tbody>
</table>
Figure 41. Mean shoot density of surfgrass per 0.0625 m² at Cardiff.

Figure 42. Percent cover of feather boa kelp at Cardiff.
Figure 43. Number of sea palms at Cardiff.
Figure 44. Percent cover of three substrate types at Cardiff (Control).
Figure 45. Percent cover of three substrate types at CC-SS-2 since 1997.

Figure 46. Percent cover of surfgrass at Cardiff (Control).
Figure 47. Percent cover of surfgrass and feather boa kelp at CC-SS-2 since 1997.

Figure 48. Mean shoot density of surfgrass per 0.0625 m$^2$ at Cardiff (Control).
Figure 49. Percent cover of feather boa kelp at Cardiff (Control).

Figure 50. Number of sea palms at Cardiff (Control).
Figure 51. Number of sea palms at CC-SS-2 since 1997.
Figure 52. Percent cover of three substrate types at Solana Beach.
Figure 53. Percent cover of surfgrass at Solana Beach.

Figure 54. Mean shoot density of surfgrass per 0.0625 m² at Solana Beach.
Figure 55. Percent cover of feather boa kelp at Solana Beach.

Figure 56. Number of sea palms at Solana Beach.
Figure 57. Picture of low-relief reef adjacent to sand channel.

Figure 58. Picture of surfgrass, coralline algae, and small kelps partially cover with sand.
Figure 59. Picture of South Carlsbad Receiver Site in December 2001 depicting sand migrating downcoast.
APPENDIX A
SUMMARY DATA
### SHALLOW SUBTIDAL SUMMARY DATA FOR RBSP
TRANSECT MEANS (N=10), PER LOCATION (N=5).

**SITE: NORTH CARLSBAD**

**LOCATION: SHALLOW SUBTIDAL-1 (NC-SS-1)**
DATE: 03/21/01

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
<th>SAND</th>
<th>SURFGRASS (2)</th>
<th>(# OF SHOOTS) per 0.0625 m²</th>
<th>EISNIA</th>
<th>MURICEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>0</td>
<td>53</td>
<td>47</td>
<td>2</td>
<td>4</td>
<td>0</td>
<td>98</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>0</td>
<td>60</td>
<td>40</td>
<td>8</td>
<td>7</td>
<td>0</td>
<td>92</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>0</td>
<td>42</td>
<td>58</td>
<td>9.2</td>
<td>5.3</td>
<td>0</td>
<td>90.8</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>5</td>
<td>35</td>
<td>60</td>
<td>15.5</td>
<td>4</td>
<td>0</td>
<td>84.5</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>5</td>
<td>40</td>
<td>55</td>
<td>5.5</td>
<td>3</td>
<td>0</td>
<td>94.5</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>2.0</td>
<td>46.0</td>
<td>52.0</td>
<td>8.0</td>
<td>4.7</td>
<td>0.0</td>
<td>92.0</td>
</tr>
<tr>
<td>SE</td>
<td>1.2</td>
<td>4.6</td>
<td>3.7</td>
<td>2.2</td>
<td>0.7</td>
<td>0.0</td>
<td>2.2</td>
</tr>
</tbody>
</table>

**LOCATION MEAN**
2.0 46.0 52.0 8.0 4.7 0.0 92.0 0.0 0.0

**SE**
1.2 4.6 3.7 2.2 0.7 0.0 2.2 0.0 0.0

**LOCATION: SHALLOW SUBTIDAL-2 (NC-SS-2)**
DATE: 03/21/01

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
<th>SAND</th>
<th>SURFGRASS (2)</th>
<th>(# OF SHOOTS) per 0.0625 m²</th>
<th>EISNIA</th>
<th>MURICEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>25</td>
<td>60</td>
<td>15</td>
<td>4.6</td>
<td>4</td>
<td>1.8</td>
<td>93.6</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>10</td>
<td>80</td>
<td>10</td>
<td>4.3</td>
<td>4</td>
<td>0.9</td>
<td>94.8</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>0</td>
<td>67</td>
<td>33</td>
<td>14.5</td>
<td>6</td>
<td>9.9</td>
<td>75.6</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>15</td>
<td>78</td>
<td>7</td>
<td>12.5</td>
<td>6</td>
<td>12.6</td>
<td>74.9</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>0</td>
<td>65</td>
<td>35</td>
<td>4.7</td>
<td>4</td>
<td>7.2</td>
<td>88.1</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>10.0</td>
<td>70.0</td>
<td>20.0</td>
<td>8.1</td>
<td>4.9</td>
<td>6.5</td>
<td>85.4</td>
</tr>
<tr>
<td>SE</td>
<td>4.7</td>
<td>3.9</td>
<td>5.9</td>
<td>2.2</td>
<td>0.5</td>
<td>2.3</td>
<td>4.3</td>
</tr>
</tbody>
</table>

**LOCATION MEAN**
10.0 70.0 20.0 8.1 4.9 6.5 85.4 1.8 0.0

**SE**
4.7 3.9 5.9 2.2 0.5 2.3 4.3 0.4 0.0

**LOCATION: SHALLOW SUBTIDAL-3 (NC-SS-3)**
DATE: 6/6/01

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
<th>SAND</th>
<th>SURFGRASS (2)</th>
<th>(# OF SHOOTS) per 0.0625 m²</th>
<th>EISNIA</th>
<th>MURICEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>15</td>
<td>75</td>
<td>10</td>
<td>34</td>
<td>8.6</td>
<td>9</td>
<td>57</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>5</td>
<td>85</td>
<td>10</td>
<td>47</td>
<td>11.5</td>
<td>7</td>
<td>46</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>25</td>
<td>30</td>
<td>45</td>
<td>42.5</td>
<td>16</td>
<td>1.5</td>
<td>56</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>15</td>
<td>55</td>
<td>30</td>
<td>56.2</td>
<td>12</td>
<td>1.7</td>
<td>42.1</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>15</td>
<td>65</td>
<td>20</td>
<td>33.5</td>
<td>9</td>
<td>8.2</td>
<td>58.3</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>15.0</td>
<td>62.0</td>
<td>23.0</td>
<td>42.6</td>
<td>11.4</td>
<td>5.5</td>
<td>51.9</td>
</tr>
<tr>
<td>SE</td>
<td>3.2</td>
<td>9.4</td>
<td>6.6</td>
<td>4.2</td>
<td>1.3</td>
<td>1.6</td>
<td>3.3</td>
</tr>
</tbody>
</table>

**LOCATION MEAN**
15.0 62.0 23.0 42.6 11.4 5.5 51.9 1.0 0.0

**SE**
3.2 9.4 6.6 4.2 1.3 1.6 3.3 0.2 0.0
**SHALLOW SUBTIDAL SUMMARY DATA FOR RBSP**  
**TRANSECT MEANS (N=10), PER LOCATION (N=5).**

**SITE: NORTH CARLSBAD**

**LOCATION: SHALLOW SUBTIDAL-1 (NC-SS-1)**  
**DATE: 9/14/2001**

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
<td>SAND</td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>7.0</td>
<td>62.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>1.0</td>
<td>49.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>0.0</td>
<td>32.5</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>28.3</td>
<td>33.3</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>5.0</td>
<td>23.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>8.3</td>
<td>40.0</td>
</tr>
<tr>
<td>SE</td>
<td>5.2</td>
<td>6.9</td>
</tr>
</tbody>
</table>

**LOCATION: SHALLOW SUBTIDAL-2 (NC-SS-2)**  
**DATE: 10/25/2001**

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
<td>SAND</td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>25.0</td>
<td>55.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>35.0</td>
<td>55.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>20.0</td>
<td>80.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>35.0</td>
<td>60.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>15.0</td>
<td>80.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>26.0</td>
<td>66.0</td>
</tr>
<tr>
<td>SE</td>
<td>24.0</td>
<td>67.0</td>
</tr>
</tbody>
</table>

**LOCATION: SHALLOW SUBTIDAL-3 (NC-SS-3)**  
**DATE: 10/25/2001**

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
<td>SAND</td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>68.3</td>
<td>3.3</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>57.0</td>
<td>25.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>25.0</td>
<td>70.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>5.0</td>
<td>95.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>10.0</td>
<td>85.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>33.1</td>
<td>55.7</td>
</tr>
<tr>
<td>SE</td>
<td>12.7</td>
<td>17.7</td>
</tr>
</tbody>
</table>
SHALLOW SUBTIDAL SUMMARY DATA FOR RBSP
TRANSECT MEANS (N=10), PER LOCATION (N=5).

SITE: NORTH CARLSBAD

LOCATION: SHALLOW SUBTIDAL-1 (NC-SS-1)
DATE: 4/11/02

<table>
<thead>
<tr>
<th>TRANSECT NO.</th>
<th>HIGH RELIEF</th>
<th>LOW RELIEF</th>
<th>SAND</th>
<th>SURFGRASS</th>
<th>(# OF SHOOTS) per 0.0625 m²</th>
<th>EGREGIA</th>
<th>BARE SPACE</th>
<th>EISENIA</th>
<th>MURICEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30.0</td>
<td>35.0</td>
<td>35.0</td>
<td>31.0</td>
<td>3.4</td>
<td>0.7</td>
<td>68.3</td>
<td>0.0</td>
<td>1.1</td>
</tr>
<tr>
<td>2</td>
<td>25.0</td>
<td>42.0</td>
<td>33.0</td>
<td>38.5</td>
<td>5.5</td>
<td>0.0</td>
<td>61.5</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>3</td>
<td>6.7</td>
<td>42.7</td>
<td>50.7</td>
<td>8.5</td>
<td>0.8</td>
<td>0.0</td>
<td>91.5</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>4</td>
<td>0.0</td>
<td>70.0</td>
<td>30.0</td>
<td>3.0</td>
<td>0.0</td>
<td>0.0</td>
<td>97.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>5</td>
<td>5.0</td>
<td>89.0</td>
<td>6.0</td>
<td>5.5</td>
<td>1.0</td>
<td>0.0</td>
<td>94.5</td>
<td>0.0</td>
<td>1.4</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>13.3</td>
<td>55.7</td>
<td>30.9</td>
<td>17.3</td>
<td>2.1</td>
<td>0.1</td>
<td>82.6</td>
<td>0.0</td>
<td>0.5</td>
</tr>
<tr>
<td>SE</td>
<td>5.9</td>
<td>10.2</td>
<td>7.2</td>
<td>7.3</td>
<td>1.0</td>
<td>0.1</td>
<td>7.3</td>
<td>0.0</td>
<td>0.3</td>
</tr>
</tbody>
</table>

LOCATION: SHALLOW SUBTIDAL-2 (NC-SS-2)
DATE: 4/11/02

<table>
<thead>
<tr>
<th>TRANSECT NO.</th>
<th>HIGH RELIEF</th>
<th>LOW RELIEF</th>
<th>SAND</th>
<th>SURFGRASS</th>
<th>(# OF SHOOTS) per 0.0625 m²</th>
<th>EGREGIA</th>
<th>BARE SPACE</th>
<th>EISENIA</th>
<th>MURICEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>48.3</td>
<td>18.3</td>
<td>33.3</td>
<td>31.0</td>
<td>3.6</td>
<td>7.7</td>
<td>61.3</td>
<td>4.2</td>
<td>0.0</td>
</tr>
<tr>
<td>2</td>
<td>34.7</td>
<td>56.7</td>
<td>8.7</td>
<td>9.0</td>
<td>0.0</td>
<td>0.6</td>
<td>90.4</td>
<td>2.5</td>
<td>0.0</td>
</tr>
<tr>
<td>3</td>
<td>10.0</td>
<td>70.0</td>
<td>20.0</td>
<td>53.5</td>
<td>9.9</td>
<td>9.9</td>
<td>36.6</td>
<td>2.2</td>
<td>0.0</td>
</tr>
<tr>
<td>4</td>
<td>0.0</td>
<td>67.0</td>
<td>33.0</td>
<td>44.0</td>
<td>13.5</td>
<td>13.4</td>
<td>42.6</td>
<td>1.8</td>
<td>0.0</td>
</tr>
<tr>
<td>5</td>
<td>0.0</td>
<td>70.0</td>
<td>30.0</td>
<td>45.0</td>
<td>8.5</td>
<td>18.5</td>
<td>36.5</td>
<td>0.9</td>
<td>0.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>18.6</td>
<td>56.4</td>
<td>25.0</td>
<td>36.5</td>
<td>7.1</td>
<td>10.0</td>
<td>53.5</td>
<td>2.3</td>
<td>0.0</td>
</tr>
<tr>
<td>SE</td>
<td>9.8</td>
<td>9.8</td>
<td>4.7</td>
<td>7.8</td>
<td>2.4</td>
<td>3.0</td>
<td>10.3</td>
<td>0.5</td>
<td>0.0</td>
</tr>
</tbody>
</table>

LOCATION: SHALLOW SUBTIDAL-3 (NC-SS-3)
DATE: 4/11/02

<table>
<thead>
<tr>
<th>TRANSECT NO.</th>
<th>HIGH RELIEF</th>
<th>LOW RELIEF</th>
<th>SAND</th>
<th>SURFGRASS</th>
<th>(# OF SHOOTS) per 0.0625 m²</th>
<th>EGREGIA</th>
<th>BARE SPACE</th>
<th>EISENIA</th>
<th>MURICEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>39.7</td>
<td>8.7</td>
<td>51.7</td>
<td>56.0</td>
<td>4.6</td>
<td>5.7</td>
<td>38.3</td>
<td>0.9</td>
<td>0.0</td>
</tr>
<tr>
<td>2</td>
<td>42.0</td>
<td>2.0</td>
<td>56.0</td>
<td>27.0</td>
<td>2.2</td>
<td>6.4</td>
<td>66.6</td>
<td>1.0</td>
<td>0.0</td>
</tr>
<tr>
<td>3</td>
<td>20.0</td>
<td>5.0</td>
<td>75.0</td>
<td>15.5</td>
<td>1.0</td>
<td>1.4</td>
<td>83.1</td>
<td>1.4</td>
<td>0.0</td>
</tr>
<tr>
<td>4</td>
<td>5.0</td>
<td>77.0</td>
<td>18.0</td>
<td>46.0</td>
<td>10.5</td>
<td>4.5</td>
<td>49.5</td>
<td>2.4</td>
<td>0.0</td>
</tr>
<tr>
<td>5</td>
<td>5.0</td>
<td>60.0</td>
<td>35.0</td>
<td>39.0</td>
<td>10.0</td>
<td>6.2</td>
<td>54.8</td>
<td>1.4</td>
<td>0.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>22.3</td>
<td>30.5</td>
<td>47.1</td>
<td>36.7</td>
<td>5.7</td>
<td>4.8</td>
<td>58.5</td>
<td>1.4</td>
<td>0.0</td>
</tr>
<tr>
<td>SE</td>
<td>8.0</td>
<td>15.8</td>
<td>9.7</td>
<td>7.1</td>
<td>2.9</td>
<td>0.9</td>
<td>7.7</td>
<td>0.3</td>
<td>0.0</td>
</tr>
<tr>
<td>HABITAT (% Cover / 10 m²)</td>
<td>% COVER / 10 m²</td>
<td>Number / 10 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----------------</td>
<td>---------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
<td>SAND</td>
<td>SURFGRASS</td>
<td>(# OF SHOOTS) per 0.0625 m²</td>
<td>EGERGIA</td>
<td>BARE SPACE</td>
<td>EISENIA</td>
<td>MURICEA</td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>0</td>
<td>12</td>
<td>88</td>
<td>2.5</td>
<td>0</td>
<td>0</td>
<td>97.5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>0</td>
<td>47.5</td>
<td>52.5</td>
<td>20.1</td>
<td>0</td>
<td>0</td>
<td>79.9</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>0</td>
<td>54</td>
<td>46</td>
<td>35</td>
<td>6.7</td>
<td>0</td>
<td>65</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>1</td>
<td>50</td>
<td>49</td>
<td>19.7</td>
<td>4</td>
<td>0.1</td>
<td>80.2</td>
<td>0.1</td>
<td>0</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>0</td>
<td>22</td>
<td>78</td>
<td>6.7</td>
<td>1</td>
<td>0</td>
<td>93.3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>0.2</td>
<td>37.1</td>
<td>62.7</td>
<td>16.8</td>
<td>2.3</td>
<td>0.0</td>
<td>83.2</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>SE</td>
<td>0.2</td>
<td>8.4</td>
<td>8.5</td>
<td>5.7</td>
<td>1.3</td>
<td>0.0</td>
<td>5.7</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>HABITAT (% Cover / 10 m²)</td>
<td>Number / 10 m²</td>
<td>% COVER / 10 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------------</td>
<td>-----------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
<td>SAND</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRANSECT NO: 1</td>
<td>33.3</td>
<td>23.3</td>
<td>43.3</td>
<td>13.0</td>
<td>0.0</td>
<td>0.0</td>
<td>87.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>TRANSECT NO: 2</td>
<td>26.7</td>
<td>33.7</td>
<td>39.7</td>
<td>11.0</td>
<td>0.0</td>
<td>0.5</td>
<td>88.5</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>TRANSECT NO: 3</td>
<td>0.0</td>
<td>75.0</td>
<td>25.0</td>
<td>6.5</td>
<td>1.5</td>
<td>0.7</td>
<td>92.8</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>TRANSECT NO: 4</td>
<td>5.0</td>
<td>60.0</td>
<td>35.0</td>
<td>9.7</td>
<td>1.0</td>
<td>1.6</td>
<td>88.7</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>TRANSECT NO: 5</td>
<td>3.3</td>
<td>43.3</td>
<td>53.3</td>
<td>31.2</td>
<td>5.0</td>
<td>0.6</td>
<td>88.2</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>13.7</td>
<td>47.1</td>
<td>39.3</td>
<td>14.3</td>
<td>1.5</td>
<td>0.7</td>
<td>85.0</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>SE</td>
<td>6.8</td>
<td>9.2</td>
<td>4.7</td>
<td>4.4</td>
<td>0.9</td>
<td>0.3</td>
<td>4.3</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>
### Shallow Subtidal Summary Data for RBSP

**TRANSECT MEANS (N=10), PER LOCATION (N=5).**

**SITE: South Carlsbad**

**LOCATION: Shallow Subtidal-1 (SC-SS-1)**

**DATE: 4/9/02**

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>0.0</td>
<td>7.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>0.0</td>
<td>12.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>0.0</td>
<td>6.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>0.0</td>
<td>5.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>0.0</td>
<td>6.0</td>
</tr>
<tr>
<td>SE</td>
<td>0.0</td>
<td>1.9</td>
</tr>
</tbody>
</table>
SHALLOW SUBTIDAL SUMMARY DATA FOR RBSP
TRANSECT MEANS (N=10), PER LOCATION (N=5).

SITE: BATICUITOS/LEUCADIA

LOCATION: SHALLOW SUBTIDAL-1 (BL-SS-1)
DATE: 03/22/01

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
<td>SAND</td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>0</td>
<td>55</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>37</td>
<td>44</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>9.4</td>
<td>23.8</td>
</tr>
<tr>
<td>SE</td>
<td>7.2</td>
<td>6.2</td>
</tr>
</tbody>
</table>

LOCATION MEAN 9.4 23.8 66.8 0.0 0.0 0.3 79.7 0.0 0.0
SE 7.2 10.9 15.4

LOCATION: SHALLOW SUBTIDAL-2 (BL-SS-2)
DATE: 03/22/01

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
<td>SAND</td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>0</td>
<td>27.5</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>0</td>
<td>58.5</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>0</td>
<td>33</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>0</td>
<td>23</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>0</td>
<td>32</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>0.0</td>
<td>34.8</td>
</tr>
<tr>
<td>SE</td>
<td>0.0</td>
<td>6.2</td>
</tr>
</tbody>
</table>

LOCATION MEAN 0.0 34.8 65.2 11.2 0.0 1.1 3.6 85.2 0.1 0.0
SE 0.0 6.2 6.2

LOCATION: SHALLOW SUBTIDAL-3 (BL-SS-3)
DATE: 03/22/01

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
<td>SAND</td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>4</td>
<td>71</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>5</td>
<td>75</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>5</td>
<td>90</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>20</td>
<td>75</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>6.8</td>
<td>82.2</td>
</tr>
<tr>
<td>SE</td>
<td>3.4</td>
<td>5.5</td>
</tr>
</tbody>
</table>

LOCATION MEAN 6.8 82.2 11.0 40.4 3.8 3.3 56.2 0.5 0.0
SE 3.4 5.5 4.8

Number / 10 m² 12 28 0.9 0 0 60 0 36 3 2.1 0 50.6 0 35 1 6.1 0.2 22.2 0 64 0.7 64 22.2 0 0.7 0 77.6 0.6 8.3 0.2 0.0.
### SHALLOW SUBTIDAL SUMMARY DATA FOR RBSP
TRANSECT MEANS (N=10), PER LOCATION (N=5).

**SITE: BATICQUITOS/LEUCADIA**

**LOCATION: SHALLOW SUBTIDAL-1 (BL-SS-1)**
DATE: 10/25/2001

<table>
<thead>
<tr>
<th>TRANSECT NO.</th>
<th>HIGH RELIEF</th>
<th>LOW RELIEF</th>
<th>SAND</th>
<th>SURFGRASS</th>
<th>(# OF SHOOTS) *100 per 0.0625 m²</th>
<th>EGREGIA</th>
<th>BARE SPACE</th>
<th>EISENIA</th>
<th>MURICEA</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.3</td>
<td>10.3</td>
<td>85.3</td>
<td>0.0</td>
<td>0.0</td>
<td>0.5</td>
<td>99.5</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>2</td>
<td>13.3</td>
<td>23.3</td>
<td>63.3</td>
<td>0.0</td>
<td>0.0</td>
<td>0.5</td>
<td>99.5</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>3</td>
<td>5.0</td>
<td>10.0</td>
<td>85.0</td>
<td>4.0</td>
<td>0.0</td>
<td>0.0</td>
<td>96.0</td>
<td>0.1</td>
<td>0.4</td>
<td>0.0</td>
</tr>
<tr>
<td>4</td>
<td>15.0</td>
<td>75.0</td>
<td>10.0</td>
<td>0.0</td>
<td>0.0</td>
<td>5.0</td>
<td>95.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>5</td>
<td>0.0</td>
<td>0.0</td>
<td>100.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>100.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>7.5</td>
<td>23.7</td>
<td>68.7</td>
<td>0.8</td>
<td>0.0</td>
<td>1.2</td>
<td>98.0</td>
<td>0.0</td>
<td>0.1</td>
<td>0.0</td>
</tr>
</tbody>
</table>

**SE**

<table>
<thead>
<tr>
<th>TRANSECT NO.</th>
<th>HIGH RELIEF</th>
<th>LOW RELIEF</th>
<th>SAND</th>
<th>SURFGRASS</th>
<th>(# OF SHOOTS) *100 per 0.0625 m²</th>
<th>EGREGIA</th>
<th>BARE SPACE</th>
<th>EISENIA</th>
<th>MURICEA</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.3</td>
<td>10.3</td>
<td>85.3</td>
<td>0.0</td>
<td>0.0</td>
<td>0.5</td>
<td>99.5</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>2</td>
<td>13.3</td>
<td>23.3</td>
<td>63.3</td>
<td>0.0</td>
<td>0.0</td>
<td>0.5</td>
<td>99.5</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>3</td>
<td>5.0</td>
<td>10.0</td>
<td>85.0</td>
<td>4.0</td>
<td>0.0</td>
<td>0.0</td>
<td>96.0</td>
<td>0.1</td>
<td>0.4</td>
<td>0.0</td>
</tr>
<tr>
<td>4</td>
<td>15.0</td>
<td>75.0</td>
<td>10.0</td>
<td>0.0</td>
<td>0.0</td>
<td>5.0</td>
<td>95.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>5</td>
<td>0.0</td>
<td>0.0</td>
<td>100.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>100.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>7.5</td>
<td>23.7</td>
<td>68.7</td>
<td>0.8</td>
<td>0.0</td>
<td>1.2</td>
<td>98.0</td>
<td>0.0</td>
<td>0.1</td>
<td>0.0</td>
</tr>
</tbody>
</table>

**SE**

### LOCATION: SHALLOW SUBTIDAL-2 (BL-SS-2)
DATE: 10/29/01

<table>
<thead>
<tr>
<th>TRANSECT NO.</th>
<th>HIGH RELIEF</th>
<th>LOW RELIEF</th>
<th>SAND</th>
<th>SURFGRASS</th>
<th>(# OF SHOOTS) *100 per 0.0625 m²</th>
<th>EGREGIA</th>
<th>BARE SPACE</th>
<th>EISENIA</th>
<th>MURICEA</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>45.0</td>
<td>55.0</td>
<td>0.0</td>
<td>78.0</td>
<td>0.0</td>
<td>0.0</td>
<td>22.0</td>
<td>1.4</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>2</td>
<td>35.0</td>
<td>65.0</td>
<td>0.0</td>
<td>78.0</td>
<td>0.0</td>
<td>1.0</td>
<td>21.0</td>
<td>1.1</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>3</td>
<td>20.0</td>
<td>80.0</td>
<td>0.0</td>
<td>42.0</td>
<td>11.0</td>
<td>3.5</td>
<td>54.5</td>
<td>2.9</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>4</td>
<td>0.0</td>
<td>100.0</td>
<td>0.0</td>
<td>55.0</td>
<td>8.7</td>
<td>0.5</td>
<td>44.5</td>
<td>2.1</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>5</td>
<td>5.0</td>
<td>95.0</td>
<td>0.0</td>
<td>30.0</td>
<td>6.0</td>
<td>9.7</td>
<td>60.3</td>
<td>2.7</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>21.0</td>
<td>79.0</td>
<td>0.0</td>
<td>56.6</td>
<td>5.1</td>
<td>2.9</td>
<td>40.5</td>
<td>2.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

**SE**

### LOCATION: SHALLOW SUBTIDAL-3 (BL-SS-3)
DATE: 10/29/01

<table>
<thead>
<tr>
<th>TRANSECT NO.</th>
<th>HIGH RELIEF</th>
<th>LOW RELIEF</th>
<th>SAND</th>
<th>SURFGRASS</th>
<th>(# OF SHOOTS) *100 per 0.0625 m²</th>
<th>EGREGIA</th>
<th>BARE SPACE</th>
<th>EISENIA</th>
<th>MURICEA</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20.0</td>
<td>60.0</td>
<td>20.0</td>
<td>16.5</td>
<td>0.0</td>
<td>8.5</td>
<td>75.0</td>
<td>0.1</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>2</td>
<td>0.0</td>
<td>100.0</td>
<td>0.0</td>
<td>24.0</td>
<td>6.5</td>
<td>3.7</td>
<td>72.3</td>
<td>0.4</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>3</td>
<td>15.0</td>
<td>85.0</td>
<td>0.0</td>
<td>43.0</td>
<td>6.5</td>
<td>0.5</td>
<td>56.5</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>4</td>
<td>0.0</td>
<td>100.0</td>
<td>0.0</td>
<td>31.5</td>
<td>5.4</td>
<td>0.0</td>
<td>68.5</td>
<td>1.5</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>5</td>
<td>39.0</td>
<td>42.0</td>
<td>19.0</td>
<td>33.0</td>
<td>0.0</td>
<td>4.0</td>
<td>63.0</td>
<td>1.4</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>14.8</td>
<td>77.4</td>
<td>7.8</td>
<td>29.6</td>
<td>3.7</td>
<td>3.3</td>
<td>67.1</td>
<td>0.7</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

**SE**
### SHALLOW SUBTIDAL SUMMARY DATA FOR RBSP
TRANSECT MEANS (N=10), PER LOCATION (N=5).

**SITE: BATIQUITOS/LEUCADIA**

**LOCATION: SHALLOW SUBTIDAL-1 (BL-SS-1)**
**DATE: 4/9/02**

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
<td>SAND</td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>60.0</td>
<td>10.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>70.0</td>
<td>0.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>58.7</td>
<td>8.7</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>0.0</td>
<td>47.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>37.7</td>
<td>12.7</td>
</tr>
<tr>
<td>SE</td>
<td>15.5</td>
<td>8.8</td>
</tr>
</tbody>
</table>

**LOCATION: SHALLOW SUBTIDAL-2 (BL-SS-2)**
**DATE: 03/22/01**

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
<td>SAND</td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>26.7</td>
<td>31.7</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>18.3</td>
<td>3.3</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>45.0</td>
<td>20.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>0.0</td>
<td>52.5</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>5.0</td>
<td>54.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>19.0</td>
<td>32.3</td>
</tr>
<tr>
<td>SE</td>
<td>8.0</td>
<td>9.7</td>
</tr>
</tbody>
</table>

**LOCATION: SHALLOW SUBTIDAL-3 (BL-SS-3)**
**DATE: 03/22/01**

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
<td>SAND</td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>21.7</td>
<td>56.7</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>45.0</td>
<td>40.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>25.0</td>
<td>45.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>15.0</td>
<td>70.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>5.0</td>
<td>80.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>22.3</td>
<td>58.3</td>
</tr>
<tr>
<td>SE</td>
<td>6.6</td>
<td>7.5</td>
</tr>
</tbody>
</table>
SHALLOW SUBTIDAL SUMMARY DATA FOR RBSP
TRANSECT MEANS (N=10), PER LOCATION (N=5).

SITE: MOONLIGHT

LOCATION: SHALLOW SUBTIDAL-1 (ML-SS-1)
DATE: 03/22/01

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>2</td>
<td>63</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>2.5</td>
<td>87.5</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>5</td>
<td>63</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>10</td>
<td>54</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>5</td>
<td>31</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>4.9</td>
<td>59.7</td>
</tr>
<tr>
<td>SE</td>
<td>1.4</td>
<td>9.1</td>
</tr>
</tbody>
</table>
### SHALLOW SUBTIDAL SUMMARY DATA FOR RBSP
TRANSECT MEANS (N=10), PER LOCATION (N=5).

**SITE:** MOONLIGHT

**LOCATION:** SHALLOW SUBTIDAL-1 (ML-SS-1)
**DATE:** 10/29/01

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
<td>SAND</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----------------</td>
<td>----------------</td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>20.0</td>
<td>80.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>10.0</td>
<td>90.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>38.0</td>
<td>61.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>96.0</td>
<td>3.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>15.0</td>
<td>40.0</td>
</tr>
</tbody>
</table>

**LOCATION MEAN**
35.8 54.8 9.4 40.8 3.1 5.6 53.5 2.9 0.0

**SE**
15.8 15.5 8.9 13.8 1.8 3.0 14.7 1.2 0.0
SHALLOW SUBTIDAL SUMMARY DATA FOR RBSP
TRANSECT MEANS (N=10), PER LOCATION (N=5).

SITE: MOONLIGHT
LOCATION: SHALLOW SUBTIDAL-1 (ML-SS-1)
DATE: 4/3/02

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
<td>SAND</td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>10.0</td>
<td>25.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>50.0</td>
<td>50.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>38.3</td>
<td>48.3</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>10.0</td>
<td>50.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>25.0</td>
<td>33.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>26.7</td>
<td>41.3</td>
</tr>
<tr>
<td>SE</td>
<td>7.9</td>
<td>5.2</td>
</tr>
<tr>
<td>HABITAT (% Cover / 10 m²)</td>
<td>Number / 10 m²</td>
<td>LOCATION: SHALLOW SUBTIDAL-1 (SW-SS-1)</td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------------</td>
<td>---------------------------------------</td>
</tr>
<tr>
<td>HIGH RELIEF</td>
<td>2</td>
<td>17</td>
</tr>
<tr>
<td>LOW RELIEF</td>
<td>0</td>
<td>81</td>
</tr>
<tr>
<td>SAND</td>
<td>7.2</td>
<td>0</td>
</tr>
<tr>
<td>SURFGRASS</td>
<td>34.5</td>
<td>34.5</td>
</tr>
<tr>
<td>EGREGIA</td>
<td>58.3</td>
<td>58.3</td>
</tr>
<tr>
<td>BARE SPACE</td>
<td>0.4</td>
<td>0</td>
</tr>
<tr>
<td>EISENIA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MURICEA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>0.4</td>
<td>23.3</td>
</tr>
<tr>
<td>SE</td>
<td>0.4</td>
<td>3.5</td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>0</td>
<td>70</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>0</td>
<td>35</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>0</td>
<td>44</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>0.0</td>
<td>35.6</td>
</tr>
<tr>
<td>SE</td>
<td>0.0</td>
<td>10.4</td>
</tr>
<tr>
<td>LOCATION: SHALLOW SUBTIDAL-2 (SW-SS-2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HIGH RELIEF</td>
<td>0</td>
<td>70</td>
</tr>
<tr>
<td>LOW RELIEF</td>
<td>0</td>
<td>35</td>
</tr>
<tr>
<td>SAND</td>
<td>36.1</td>
<td>17</td>
</tr>
<tr>
<td>SURFGRASS</td>
<td>5.3</td>
<td>1.4</td>
</tr>
<tr>
<td>EGREGIA</td>
<td>15</td>
<td>20.5</td>
</tr>
<tr>
<td>BARE SPACE</td>
<td>48.9</td>
<td>29.6</td>
</tr>
<tr>
<td>EISENIA</td>
<td>0.4</td>
<td>53.4</td>
</tr>
<tr>
<td>MURICEA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>0.0</td>
<td>35.6</td>
</tr>
<tr>
<td>SE</td>
<td>0.0</td>
<td>10.4</td>
</tr>
<tr>
<td>LOCATION: SHALLOW SUBTIDAL-3 (SW-SS-3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HIGH RELIEF</td>
<td>0</td>
<td>22</td>
</tr>
<tr>
<td>LOW RELIEF</td>
<td>0</td>
<td>45</td>
</tr>
<tr>
<td>SAND</td>
<td>0.5</td>
<td>0.1</td>
</tr>
<tr>
<td>SURFGRASS</td>
<td>0.2</td>
<td>0.1</td>
</tr>
<tr>
<td>EGREGIA</td>
<td>99.3</td>
<td>94.3</td>
</tr>
<tr>
<td>BARE SPACE</td>
<td>0.3</td>
<td>2.6</td>
</tr>
<tr>
<td>EISENIA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MURICEA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>0.0</td>
<td>22.4</td>
</tr>
<tr>
<td>SE</td>
<td>0.0</td>
<td>8.4</td>
</tr>
<tr>
<td>LOCATION: SHALLOW SUBTIDAL-1 (SW-SS-1)</td>
<td>HABITAT (% Cover / 10 m²) % COVER / 10 m²</td>
<td>Number / 10 m²</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>---------------------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>HIGH RELIEF</td>
<td>SAND</td>
<td>SURFGRASS</td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>50.0</td>
<td>50.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>40.0</td>
<td>60.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>0.0</td>
<td>100.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>0.0</td>
<td>100.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>10.0</td>
<td>90.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>20.0</td>
<td>80.0</td>
</tr>
<tr>
<td>SE</td>
<td>10.5</td>
<td>10.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LOCATION: SHALLOW SUBTIDAL-2 (SW-SS-2)</th>
<th>HABITAT (% Cover / 10 m²) % COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td>SAND</td>
<td>SURFGRASS</td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>5.0</td>
<td>71.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>15.0</td>
<td>75.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>0.0</td>
<td>100.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>0.0</td>
<td>90.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>0.0</td>
<td>100.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>4.0</td>
<td>87.2</td>
</tr>
<tr>
<td>SE</td>
<td>2.9</td>
<td>6.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LOCATION: SHALLOW SUBTIDAL-3 (SW-SS-3)</th>
<th>HABITAT (% Cover / 10 m²) % COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td>SAND</td>
<td>SURFGRASS</td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>0.0</td>
<td>50.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>17.0</td>
<td>45.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>0.0</td>
<td>85.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>8.3</td>
<td>48.3</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>5.0</td>
<td>14.5</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>6.1</td>
<td>48.6</td>
</tr>
<tr>
<td>SE</td>
<td>3.2</td>
<td>11.2</td>
</tr>
</tbody>
</table>
### SHALLOW SUBTIDAL SUMMARY DATA FOR RBSP

TRANSECT MEANS (N=10), PER LOCATION (N=5).

**SITE:** SWAMIS (CONTROL)

**LOCATION:** SHALLOW SUBTIDAL-1 (SW-SS-1)
**DATE:** 4/3/02

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOW RELIEF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAND</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SURFGRASS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(# OF SHOOTS) per 0.0625 m²</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EGREGIA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BARE SPACE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EISENIA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MURICEA</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TRANSECT NO.</th>
<th>0.0</th>
<th>5.0</th>
<th>95.0</th>
<th>8.5</th>
<th>1.0</th>
<th>4.4</th>
<th>87.1</th>
<th>0.5</th>
<th>0.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRANSECT NO.</td>
<td>0.0</td>
<td>10.0</td>
<td>90.0</td>
<td>7.0</td>
<td>0.0</td>
<td>1.5</td>
<td>91.5</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>TRANSECT NO.</td>
<td>0.0</td>
<td>5.0</td>
<td>95.0</td>
<td>4.0</td>
<td>1.0</td>
<td>0.7</td>
<td>95.3</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>TRANSECT NO.</td>
<td>0.0</td>
<td>5.0</td>
<td>95.0</td>
<td>8.0</td>
<td>0.0</td>
<td>3.5</td>
<td>88.5</td>
<td>0.3</td>
<td>0.0</td>
</tr>
<tr>
<td>TRANSECT NO.</td>
<td>0.0</td>
<td>0.0</td>
<td>100.0</td>
<td>11.5</td>
<td>0.0</td>
<td>0.5</td>
<td>88.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>0.0</td>
<td>5.0</td>
<td>95.0</td>
<td>7.8</td>
<td>0.4</td>
<td>2.1</td>
<td>90.1</td>
<td>0.2</td>
<td>0.0</td>
</tr>
<tr>
<td>SE</td>
<td>0.0</td>
<td>1.6</td>
<td>1.6</td>
<td>1.2</td>
<td>0.2</td>
<td>0.8</td>
<td>1.5</td>
<td>0.1</td>
<td>0.0</td>
</tr>
</tbody>
</table>

### LOCATION: SHALLOW SUBTIDAL-2 (SW-SS-2)
**DATE:** 4/3/02

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOW RELIEF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAND</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SURFGRASS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(# OF SHOOTS) per 0.0625 m²</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EGREGIA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BARE SPACE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EISENIA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MURICEA</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TRANSECT NO.</th>
<th>45.0</th>
<th>30.0</th>
<th>25.0</th>
<th>15.5</th>
<th>1.0</th>
<th>12.2</th>
<th>72.3</th>
<th>2.1</th>
<th>0.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRANSECT NO.</td>
<td>0.0</td>
<td>35.0</td>
<td>65.0</td>
<td>9.5</td>
<td>0.0</td>
<td>10.7</td>
<td>79.8</td>
<td>0.4</td>
<td>0.0</td>
</tr>
<tr>
<td>TRANSECT NO.</td>
<td>0.0</td>
<td>20.0</td>
<td>80.0</td>
<td>12.5</td>
<td>1.0</td>
<td>6.9</td>
<td>80.6</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>TRANSECT NO.</td>
<td>0.0</td>
<td>45.0</td>
<td>55.0</td>
<td>25.5</td>
<td>6.5</td>
<td>7.0</td>
<td>67.5</td>
<td>0.5</td>
<td>0.0</td>
</tr>
<tr>
<td>TRANSECT NO.</td>
<td>0.0</td>
<td>50.0</td>
<td>50.0</td>
<td>18.0</td>
<td>5.0</td>
<td>9.5</td>
<td>72.5</td>
<td>2.3</td>
<td>0.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>9.0</td>
<td>36.0</td>
<td>55.0</td>
<td>16.2</td>
<td>2.7</td>
<td>9.3</td>
<td>74.5</td>
<td>1.1</td>
<td>0.0</td>
</tr>
<tr>
<td>SE</td>
<td>9.0</td>
<td>5.3</td>
<td>9.1</td>
<td>2.7</td>
<td>1.3</td>
<td>1.0</td>
<td>2.5</td>
<td>0.5</td>
<td>0.0</td>
</tr>
</tbody>
</table>

### LOCATION: SHALLOW SUBTIDAL-3 (SW-SS-3)
**DATE:** 4/3/02

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOW RELIEF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAND</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SURFGRASS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(# OF SHOOTS) per 0.0625 m²</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EGREGIA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BARE SPACE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EISENIA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MURICEA</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TRANSECT NO.</th>
<th>0.0</th>
<th>50.0</th>
<th>50.0</th>
<th>3.4</th>
<th>0.0</th>
<th>2.7</th>
<th>93.9</th>
<th>1.6</th>
<th>0.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRANSECT NO.</td>
<td>18.3</td>
<td>35.3</td>
<td>46.3</td>
<td>3.0</td>
<td>0.0</td>
<td>0.8</td>
<td>96.2</td>
<td>2.1</td>
<td>0.0</td>
</tr>
<tr>
<td>TRANSECT NO.</td>
<td>0.0</td>
<td>30.0</td>
<td>70.0</td>
<td>0.0</td>
<td>0.0</td>
<td>2.5</td>
<td>97.5</td>
<td>0.6</td>
<td>0.0</td>
</tr>
<tr>
<td>TRANSECT NO.</td>
<td>0.0</td>
<td>25.0</td>
<td>75.0</td>
<td>1.1</td>
<td>0.0</td>
<td>0.2</td>
<td>98.7</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>TRANSECT NO.</td>
<td>0.0</td>
<td>91.0</td>
<td>9.0</td>
<td>10.7</td>
<td>1.5</td>
<td>4.5</td>
<td>84.8</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>3.7</td>
<td>46.3</td>
<td>50.1</td>
<td>3.6</td>
<td>0.3</td>
<td>2.1</td>
<td>94.2</td>
<td>0.9</td>
<td>0.0</td>
</tr>
<tr>
<td>SE</td>
<td>3.7</td>
<td>11.9</td>
<td>11.7</td>
<td>1.9</td>
<td>0.3</td>
<td>0.8</td>
<td>2.5</td>
<td>0.4</td>
<td>0.0</td>
</tr>
</tbody>
</table>
SHALLOW SUBTIDAL SUMMARY DATA FOR RBSP
TRANSECT MEANS (N=10), PER LOCATION (N=5).

SITE: CARDIFF

LOCATION: SHALLOW SUBTIDAL-1 (CF-SS-1)
DATE: 03/23/01

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
<td>SAND</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-----------------</td>
<td>-------------</td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>5</td>
<td>90</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>0</td>
<td>80</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>10</td>
<td>33</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>10</td>
<td>43</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>15</td>
<td>54</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>8.0</td>
<td>60.0</td>
</tr>
<tr>
<td>SE</td>
<td>2.5</td>
<td>10.8</td>
</tr>
</tbody>
</table>
SHALLOW SUBTIDAL SUMMARY DATA FOR RBSP
TRANSECT MEANS (N=10), PER LOCATION (N=5).

SITE: CARDIFF
LOCATION: SHALLOW SUBTIDAL-1 (CF-SS-1)
DATE: 10/30/01

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
<td>SAND</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----------------</td>
<td>----------------</td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>0.0</td>
<td>15.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>13.3</td>
<td>23.3</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>0.0</td>
<td>30.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>10.0</td>
<td>13.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>10.0</td>
<td>6.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>6.7</td>
<td>17.5</td>
</tr>
<tr>
<td>SE</td>
<td>2.8</td>
<td>4.2</td>
</tr>
</tbody>
</table>
### SHALLOW SUBTIDAL SUMMARY DATA FOR RBSP
TRANSECT MEANS (N=10), PER LOCATION (N=5).

**SITE: CARDIFF**

**LOCATION: SHALLOW SUBTIDAL-1 (CF-SS-1)**
**DATE: 4/3/02**

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
</tr>
<tr>
<td>Transect No.: 1</td>
<td>8.3</td>
<td>58.3</td>
</tr>
<tr>
<td>Transect No.: 2</td>
<td>30.0</td>
<td>20.0</td>
</tr>
<tr>
<td>Transect No.: 3</td>
<td>28.3</td>
<td>33.3</td>
</tr>
<tr>
<td>Transect No.: 4</td>
<td>10.0</td>
<td>87.0</td>
</tr>
<tr>
<td>Transect No.: 5</td>
<td>0.0</td>
<td>76.0</td>
</tr>
<tr>
<td>Location Mean</td>
<td>15.3</td>
<td>54.9</td>
</tr>
<tr>
<td>SE</td>
<td>5.9</td>
<td>12.6</td>
</tr>
</tbody>
</table>
**SHALLOW SUBTIDAL SUMMARY DATA FOR RBSP**

**TRANSECT MEANS (N=10), PER LOCATION (N=5).**

**SITE: CARDIFF (CONTROL)**

**LOCATION: SHALLOW SUBTIDAL-1 (CC-SS-1)**

**DATE: 5/8/01**

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HIGH RELIEF</strong></td>
<td><strong>LOW RELIEF</strong></td>
<td><strong>SAND</strong></td>
<td><strong>SURFGRASS</strong></td>
<td><strong>(# OF SHOOTS)</strong> per 0.0625 m²</td>
<td><strong>EGREGIA</strong></td>
<td><strong>BARE SPACE</strong></td>
<td><strong>EISENIA</strong></td>
<td><strong>MURICEA</strong></td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>20</td>
<td>80</td>
<td>0</td>
<td>31</td>
<td>18</td>
<td>5</td>
<td>64</td>
<td>6.1</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>15</td>
<td>85</td>
<td>0</td>
<td>32.5</td>
<td>22</td>
<td>9.5</td>
<td>58</td>
<td>0.8</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>5</td>
<td>95</td>
<td>0</td>
<td>43</td>
<td>9.4</td>
<td>4.5</td>
<td>52.5</td>
<td>1</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>15</td>
<td>85</td>
<td>0</td>
<td>2.8</td>
<td>0</td>
<td>9.7</td>
<td>87.5</td>
<td>1.7</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>30</td>
<td>55</td>
<td>15</td>
<td>6</td>
<td>0</td>
<td>1.7</td>
<td>93</td>
<td>1.6</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>17.0</td>
<td>80.0</td>
<td>3.0</td>
<td>23.1</td>
<td>9.9</td>
<td>6.1</td>
<td>71.0</td>
<td>2.2</td>
</tr>
<tr>
<td>SE</td>
<td>4.1</td>
<td>6.7</td>
<td>3.0</td>
<td>7.9</td>
<td>4.5</td>
<td>1.5</td>
<td>8.1</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**LOCATION: SHALLOW SUBTIDAL-2 (CC-SS-2)**

**DATE: 5/8/01**

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HIGH RELIEF</strong></td>
<td><strong>LOW RELIEF</strong></td>
<td><strong>SAND</strong></td>
<td><strong>SURFGRASS</strong></td>
<td><strong>(# OF SHOOTS)</strong> per 0.0625 m²</td>
<td><strong>EGREGIA</strong></td>
<td><strong>BARE SPACE</strong></td>
<td><strong>EISENIA</strong></td>
<td><strong>MURICEA</strong></td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>0</td>
<td>60</td>
<td>40</td>
<td>3.5</td>
<td>6</td>
<td>12.5</td>
<td>84</td>
<td>2.4</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>20</td>
<td>45</td>
<td>35</td>
<td>11.5</td>
<td>6</td>
<td>8</td>
<td>80.5</td>
<td>1.3</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>0</td>
<td>40</td>
<td>60</td>
<td>9</td>
<td>2.8</td>
<td>13.5</td>
<td>77.5</td>
<td>0</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>5</td>
<td>52</td>
<td>43</td>
<td>52</td>
<td>11.5</td>
<td>10.5</td>
<td>37.5</td>
<td>0</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>5</td>
<td>56</td>
<td>39</td>
<td>28.5</td>
<td>0</td>
<td>15</td>
<td>56.5</td>
<td>0.1</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>6.0</td>
<td>50.6</td>
<td>43.4</td>
<td>20.9</td>
<td>5.3</td>
<td>11.9</td>
<td>67.2</td>
<td>0.8</td>
</tr>
<tr>
<td>SE</td>
<td>3.7</td>
<td>3.6</td>
<td>4.3</td>
<td>8.8</td>
<td>1.9</td>
<td>1.2</td>
<td>8.8</td>
<td>0.5</td>
</tr>
</tbody>
</table>

**LOCATION: SHALLOW SUBTIDAL-3 (CC-SS-3)**

**DATE: 5/8/01**

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HIGH RELIEF</strong></td>
<td><strong>LOW RELIEF</strong></td>
<td><strong>SAND</strong></td>
<td><strong>SURFGRASS</strong></td>
<td><strong>(# OF SHOOTS)</strong> per 0.0625 m²</td>
<td><strong>EGREGIA</strong></td>
<td><strong>BARE SPACE</strong></td>
<td><strong>EISENIA</strong></td>
<td><strong>MURICEA</strong></td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>10</td>
<td>90</td>
<td>0</td>
<td>7.8</td>
<td>3</td>
<td>13.1</td>
<td>79.4</td>
<td>1.6</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>10</td>
<td>90</td>
<td>0</td>
<td>25.5</td>
<td>19.5</td>
<td>15</td>
<td>59.5</td>
<td>3.6</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>15</td>
<td>85</td>
<td>0</td>
<td>21</td>
<td>8.7</td>
<td>11.5</td>
<td>67.5</td>
<td>1.8</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>30</td>
<td>70</td>
<td>0</td>
<td>37.5</td>
<td>9.5</td>
<td>12.5</td>
<td>50</td>
<td>1.4</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>25</td>
<td>75</td>
<td>0</td>
<td>38.8</td>
<td>7</td>
<td>7.2</td>
<td>54</td>
<td>1.4</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>18.0</td>
<td>82.0</td>
<td>0.0</td>
<td>26.1</td>
<td>9.5</td>
<td>11.9</td>
<td>62.1</td>
<td>2.0</td>
</tr>
<tr>
<td>SE</td>
<td>4.1</td>
<td>4.1</td>
<td>0.0</td>
<td>5.7</td>
<td>2.7</td>
<td>1.3</td>
<td>5.2</td>
<td>0.4</td>
</tr>
</tbody>
</table>
SHALLOW SUBTIDAL SUMMARY DATA FOR RBSP
TRANSECT MEANS (N=10), PER LOCATION (N=5).

SITE: CARDIFF (CONTROL)

LOCATION: SHALLOW SUBTIDAL-1 (CC-SS-1)
DATE: 1/16/02

<table>
<thead>
<tr>
<th>HABITAT (%) Cover / 10 m²</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
<td>SAND</td>
</tr>
<tr>
<td>TRANSCECT NO.: 1</td>
<td>78.3</td>
<td>18.3</td>
</tr>
<tr>
<td>TRANSCECT NO.: 2</td>
<td>60.0</td>
<td>35.0</td>
</tr>
<tr>
<td>TRANSCECT NO.: 3</td>
<td>25.0</td>
<td>75.0</td>
</tr>
<tr>
<td>TRANSCECT NO.: 4</td>
<td>40.0</td>
<td>60.0</td>
</tr>
<tr>
<td>TRANSCECT NO.: 5</td>
<td>25.0</td>
<td>75.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>45.7</td>
<td>52.7</td>
</tr>
<tr>
<td>SE</td>
<td>10.4</td>
<td>11.3</td>
</tr>
</tbody>
</table>

LOCATION: SHALLOW SUBTIDAL-2 (CC-SS-2)
DATE: 1/16/02

<table>
<thead>
<tr>
<th>HABITAT (%) Cover / 10 m²</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
<td>SAND</td>
</tr>
<tr>
<td>TRANSCECT NO.: 1</td>
<td>20.0</td>
<td>20.0</td>
</tr>
<tr>
<td>TRANSCECT NO.: 2</td>
<td>25.0</td>
<td>40.0</td>
</tr>
<tr>
<td>TRANSCECT NO.: 3</td>
<td>10.0</td>
<td>62.0</td>
</tr>
<tr>
<td>TRANSCECT NO.: 4</td>
<td>8.3</td>
<td>52.3</td>
</tr>
<tr>
<td>TRANSCECT NO.: 5</td>
<td>37.0</td>
<td>27.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>20.1</td>
<td>40.3</td>
</tr>
<tr>
<td>SE</td>
<td>5.2</td>
<td>7.8</td>
</tr>
</tbody>
</table>

LOCATION: SHALLOW SUBTIDAL-3 (CC-SS-3)
DATE: 1/16/02

<table>
<thead>
<tr>
<th>HABITAT (%) Cover / 10 m²</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
<td>SAND</td>
</tr>
<tr>
<td>TRANSCECT NO.: 1</td>
<td>85.0</td>
<td>15.0</td>
</tr>
<tr>
<td>TRANSCECT NO.: 2</td>
<td>85.0</td>
<td>15.0</td>
</tr>
<tr>
<td>TRANSCECT NO.: 3</td>
<td>20.0</td>
<td>80.0</td>
</tr>
<tr>
<td>TRANSCECT NO.: 4</td>
<td>55.0</td>
<td>45.0</td>
</tr>
<tr>
<td>TRANSCECT NO.: 5</td>
<td>45.0</td>
<td>54.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>58.0</td>
<td>41.8</td>
</tr>
<tr>
<td>SE</td>
<td>12.4</td>
<td>12.4</td>
</tr>
</tbody>
</table>
**SHALLOW SUBTIDAL SUMMARY DATA FOR RBSP**
TRANSECT MEANS (N=10), PER LOCATION (N=5).

**SITE: CARDIFF (CONTROL)**

**LOCATION: SHALLOW SUBTIDAL-1 (CC-SS-1)**
**DATE: 4/2/02**

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HIGH RELIEF</strong></td>
<td><strong>LOW RELIEF</strong></td>
<td><strong>SAND</strong></td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>55.0</td>
<td>45.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>70.0</td>
<td>15.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>40.0</td>
<td>40.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>0.0</td>
<td>90.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>20.0</td>
<td>78.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>37.0</td>
<td>53.6</td>
</tr>
<tr>
<td>SE</td>
<td>12.4</td>
<td>13.5</td>
</tr>
</tbody>
</table>

**LOCATION: SHALLOW SUBTIDAL-2 (CC-SS-2)**
**DATE: 4/2/02**

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HIGH RELIEF</strong></td>
<td><strong>LOW RELIEF</strong></td>
<td><strong>SAND</strong></td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>21.7</td>
<td>16.7</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>3.3</td>
<td>13.3</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>0.0</td>
<td>15.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>0.0</td>
<td>35.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>5.0</td>
<td>56.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>6.0</td>
<td>27.2</td>
</tr>
<tr>
<td>SE</td>
<td>4.0</td>
<td>8.2</td>
</tr>
</tbody>
</table>

**LOCATION: SHALLOW SUBTIDAL-3 (CC-SS-3)**
**DATE: 4/2/02**

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HIGH RELIEF</strong></td>
<td><strong>LOW RELIEF</strong></td>
<td><strong>SAND</strong></td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>85.0</td>
<td>15.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>95.0</td>
<td>5.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>100.0</td>
<td>0.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>15.0</td>
<td>85.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>25.0</td>
<td>75.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>64.0</td>
<td>36.0</td>
</tr>
<tr>
<td>SE</td>
<td>18.2</td>
<td>18.2</td>
</tr>
</tbody>
</table>
### SHALLOW SUBTIDAL SUMMARY DATA FOR RBSP

#### TRANSECT MEANS (N=10), PER LOCATION (N=5).

**SITE:** SOLANA BEACH

**LOCATION:** SHALLOW SUBTIDAL-1 (SB-SS-1)

**DATE:** 5/9/01

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
<td>SAND</td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>0</td>
<td>50</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>15</td>
<td>40</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>10</td>
<td>58</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>15</td>
<td>50</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>0</td>
<td>95</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>8.0</td>
<td>58.6</td>
</tr>
<tr>
<td>SE</td>
<td>3.4</td>
<td>9.5</td>
</tr>
</tbody>
</table>

**LOCATION:** SHALLOW SUBTIDAL-2 (SB-SS-2)

**DATE:** 5/9/01

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
<td>SAND</td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>20</td>
<td>75</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>35</td>
<td>65</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>10</td>
<td>85</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>13.0</td>
<td>85.0</td>
</tr>
<tr>
<td>SE</td>
<td>6.6</td>
<td>6.9</td>
</tr>
</tbody>
</table>

**LOCATION:** SHALLOW SUBTIDAL-3 (SB-SS-3)

**DATE:** 5/9/01

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
<td>SAND</td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>0</td>
<td>19</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>0</td>
<td>45</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>0</td>
<td>80</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>0</td>
<td>47</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>0</td>
<td>43.5</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>0.0</td>
<td>46.9</td>
</tr>
<tr>
<td>SE</td>
<td>0.0</td>
<td>9.7</td>
</tr>
</tbody>
</table>
**SHALLOW SUBTIDAL SUMMARY DATA FOR RBSP**
**TRANSECT MEANS (N=10), PER LOCATION (N=5).**

**SITE: SOLANA BEACH**

**LOCATION: SHALLOW SUBTIDAL-1 (SB-SS-1)**
**DATE: 10/30/01**

<table>
<thead>
<tr>
<th>HABITAT (%) Cover / 10 m²</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
<td>SAND</td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>8.7</td>
<td>40.7</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>18.3</td>
<td>23.3</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>23.3</td>
<td>28.3</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>5.0</td>
<td>52.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>5.0</td>
<td>37.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>12.1</td>
<td>36.3</td>
</tr>
<tr>
<td>SE</td>
<td>3.7</td>
<td>5.0</td>
</tr>
</tbody>
</table>

**LOCATION: SHALLOW SUBTIDAL-2 (SB-SS-2)**
**DATE: 10/30/01**

<table>
<thead>
<tr>
<th>HABITAT (%) Cover / 10 m²</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
<td>SAND</td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>80.0</td>
<td>20.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>51.7</td>
<td>16.7</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>45.0</td>
<td>55.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>5.0</td>
<td>95.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>5.0</td>
<td>95.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>37.3</td>
<td>56.3</td>
</tr>
<tr>
<td>SE</td>
<td>14.4</td>
<td>17.2</td>
</tr>
</tbody>
</table>

**LOCATION: SHALLOW SUBTIDAL-3 (SB-SS-3)**
**DATE: 10/30/01**

<table>
<thead>
<tr>
<th>HABITAT (%) Cover / 10 m²</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
<td>SAND</td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>0.0</td>
<td>24.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>3.3</td>
<td>33.3</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>10.0</td>
<td>12.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>0.0</td>
<td>55.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>0.0</td>
<td>17.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>2.7</td>
<td>28.3</td>
</tr>
<tr>
<td>SE</td>
<td>1.9</td>
<td>7.6</td>
</tr>
</tbody>
</table>
**SHALLOW SUBTIDAL SUMMARY DATA FOR RBSP**
TRANSECT MEANS (N=10), PER LOCATION (N=5).

**SITE: SOLANA BEACH**

**LOCATION: SHALLOW SUBTIDAL-1 (SB-SS-1)**
**DATE: 4/2/02**

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
<td>SAND</td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>0.0</td>
<td>55.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>33.3</td>
<td>38.3</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>25.0</td>
<td>35.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>5.0</td>
<td>81.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>7.0</td>
<td>81.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>14.1</td>
<td>58.1</td>
</tr>
<tr>
<td>SE</td>
<td>6.4</td>
<td>10.0</td>
</tr>
</tbody>
</table>

**LOCATION: SHALLOW SUBTIDAL-2 (SB-SS-2)**
**DATE: 4/2/02**

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
<td>SAND</td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>76.7</td>
<td>11.7</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>15.0</td>
<td>50.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>25.0</td>
<td>40.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>15.0</td>
<td>48.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>0.0</td>
<td>88.5</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>26.3</td>
<td>47.6</td>
</tr>
<tr>
<td>SE</td>
<td>13.2</td>
<td>12.3</td>
</tr>
</tbody>
</table>

**LOCATION: SHALLOW SUBTIDAL-3 (SB-SS-3)**
**DATE: 4/2/02**

<table>
<thead>
<tr>
<th>HABITAT (% Cover / 10 m²)</th>
<th>% COVER / 10 m²</th>
<th>Number / 10 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH RELIEF</td>
<td>LOW RELIEF</td>
<td>SAND</td>
</tr>
<tr>
<td>TRANSECT NO.: 1</td>
<td>13.3</td>
<td>23.3</td>
</tr>
<tr>
<td>TRANSECT NO.: 2</td>
<td>39.0</td>
<td>10.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 3</td>
<td>18.3</td>
<td>23.3</td>
</tr>
<tr>
<td>TRANSECT NO.: 4</td>
<td>1.0</td>
<td>42.0</td>
</tr>
<tr>
<td>TRANSECT NO.: 5</td>
<td>0.0</td>
<td>65.0</td>
</tr>
<tr>
<td>LOCATION MEAN</td>
<td>14.3</td>
<td>32.7</td>
</tr>
<tr>
<td>SE</td>
<td>7.1</td>
<td>9.5</td>
</tr>
</tbody>
</table>
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>SECTION</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>METHODS</td>
<td>1</td>
</tr>
<tr>
<td>Study Sites</td>
<td>1</td>
</tr>
<tr>
<td>Methods for Biota Studies</td>
<td>1</td>
</tr>
<tr>
<td>Field Monitoring Periods</td>
<td>3</td>
</tr>
<tr>
<td>Data Analysis</td>
<td>4</td>
</tr>
<tr>
<td>RESULTS</td>
<td>4</td>
</tr>
<tr>
<td>Batiquitos/Leucadia</td>
<td>4</td>
</tr>
<tr>
<td>Substrate</td>
<td>4</td>
</tr>
<tr>
<td>Encinitas</td>
<td>4</td>
</tr>
<tr>
<td>Substrate</td>
<td>4</td>
</tr>
<tr>
<td>Swamis (Control)</td>
<td>5</td>
</tr>
<tr>
<td>Substrate</td>
<td>5</td>
</tr>
<tr>
<td>Cardiff</td>
<td>5</td>
</tr>
<tr>
<td>Substrate</td>
<td>5</td>
</tr>
<tr>
<td>Solana Beach</td>
<td>5</td>
</tr>
<tr>
<td>Substrate</td>
<td>6</td>
</tr>
<tr>
<td>Point Loma (Control)</td>
<td>6</td>
</tr>
<tr>
<td>Substrate</td>
<td>6</td>
</tr>
<tr>
<td>Distribution and Abundance of Target Taxa</td>
<td>6</td>
</tr>
<tr>
<td>Giant Kelp (Macrocystis pyrifera)</td>
<td>6</td>
</tr>
<tr>
<td>Understory Kelp</td>
<td>7</td>
</tr>
<tr>
<td>Brown Turf Algae</td>
<td>7</td>
</tr>
<tr>
<td>Red Turf Algae</td>
<td>7</td>
</tr>
<tr>
<td>Leafy Red Algae</td>
<td>7</td>
</tr>
<tr>
<td>Coralline Algae Turf</td>
<td>8</td>
</tr>
<tr>
<td>Crustose Red Algae</td>
<td>8</td>
</tr>
<tr>
<td>Parapholas Californica</td>
<td>8</td>
</tr>
<tr>
<td>Chacea Ovoidea</td>
<td>8</td>
</tr>
<tr>
<td>Muricea Californica</td>
<td>9</td>
</tr>
<tr>
<td>Diopatra Ornata</td>
<td>9</td>
</tr>
<tr>
<td>Kelletia Kelletii</td>
<td>9</td>
</tr>
<tr>
<td>Lithopoma Undosum</td>
<td>9</td>
</tr>
<tr>
<td>Sea Urchins</td>
<td>9</td>
</tr>
<tr>
<td>Sea Stars</td>
<td>10</td>
</tr>
<tr>
<td>Encrusting Invertebrates</td>
<td>10</td>
</tr>
<tr>
<td>DISCUSSION</td>
<td>11</td>
</tr>
<tr>
<td>LITERATURE CITED</td>
<td>15</td>
</tr>
<tr>
<td>FIGURE</td>
<td>DESCRIPTION</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
</tr>
<tr>
<td>1</td>
<td>Monitoring Locations at North Carlsbad...</td>
</tr>
<tr>
<td>2</td>
<td>Monitoring Locations at South Carlsbad and Batiquitos...</td>
</tr>
<tr>
<td>3</td>
<td>Monitoring Locations at Batiquitos and Leucadia...</td>
</tr>
<tr>
<td>4</td>
<td>Monitoring Locations at Moonlight Beach and Cardiff...</td>
</tr>
<tr>
<td>5</td>
<td>Monitoring Locations at Cardiff and Solana Beach...</td>
</tr>
<tr>
<td>6</td>
<td>Substrata at Batiquitos/Leucadia from 1997-2002...</td>
</tr>
<tr>
<td>7</td>
<td>Substrata at Encinitas from 2000-2002...</td>
</tr>
<tr>
<td>8</td>
<td>Substrata at Swamis from 1997-2002...</td>
</tr>
<tr>
<td>9</td>
<td>Substrata at Solana Beach from 1997-2001...</td>
</tr>
<tr>
<td>10</td>
<td>Substrata at Point Loma from 1997-2001...</td>
</tr>
<tr>
<td>11</td>
<td>Density of <em>Macrocystis pyrifera</em> Adults From Spring 2001 to Spring 2002...</td>
</tr>
<tr>
<td>12</td>
<td><em>Macrocystis pyrifera</em> Stipes Per Plant From Spring 2001 to Spring 2002...</td>
</tr>
<tr>
<td>13</td>
<td>Density of <em>Macrocystis pyrifera</em> Recruits From Spring 2001 to Spring 2002...</td>
</tr>
<tr>
<td>14</td>
<td>Density of <em>Macrocystis pyrifera</em> Juveniles From Spring 2001 to Spring 2002...</td>
</tr>
<tr>
<td>15</td>
<td>Density of <em>Macrocystis pyrifera</em> Sub-Adults From Spring 2001 to Spring 2002...</td>
</tr>
<tr>
<td>16</td>
<td>Density of <em>Cystoseira osmundacea</em> From Spring 2001 to Spring 2002...</td>
</tr>
<tr>
<td>17</td>
<td>Density of <em>Eisenia arborea</em> From Spring 2001 to Spring 2002...</td>
</tr>
<tr>
<td>18</td>
<td>Density of <em>Egregia menziesii</em> From Spring 2001 to Spring 2002...</td>
</tr>
<tr>
<td>19</td>
<td>Density of <em>Laminaria</em> sp. From Spring 2001 to Spring 2002...</td>
</tr>
<tr>
<td>20</td>
<td>Density of <em>Pterygophora californica</em> From Spring 2001 to Spring 2002...</td>
</tr>
<tr>
<td>21</td>
<td>Percent Cover of Red Turf Algae From Spring 2001 to Spring 2002...</td>
</tr>
<tr>
<td>22</td>
<td>Percent Cover of Leafy Red Algae From Spring 2001 to Spring 2002...</td>
</tr>
<tr>
<td>23</td>
<td>Percent Cover of Coralline Turf Algae From Spring 2001 to Spring 2002...</td>
</tr>
<tr>
<td>24</td>
<td>Percent Cover of <em>Muricea californica</em> From Spring 2001 to Spring 2002...</td>
</tr>
<tr>
<td>25</td>
<td>Percent Cover of <em>Parapholas californica</em> From Spring 2001 to Spring 2002...</td>
</tr>
<tr>
<td>26</td>
<td>Percent Cover of <em>Diopatra ornata</em> From Spring 2001 to Spring 2002...</td>
</tr>
<tr>
<td>27</td>
<td>Percent Cover of <em>Kelletia kelletii</em> From Spring 2001 to Spring 2002...</td>
</tr>
<tr>
<td>28</td>
<td>Density of <em>Lithopoma undosum</em> From Spring 2001 to Spring 2002...</td>
</tr>
<tr>
<td>29</td>
<td>Density of <em>Strongylocentrotus franciscanus</em> From Spring 2001 to Spring 2002...</td>
</tr>
<tr>
<td>30</td>
<td>Density of <em>Strongylocentrotus purpuratus</em> From Spring 2001 to Spring 2002...</td>
</tr>
<tr>
<td>31</td>
<td>Density of <em>Pisaster</em> sp. From Spring 2001 to Spring 2002...</td>
</tr>
<tr>
<td>32</td>
<td>Percent Cover of Sponges From Spring 2001 to Spring 2002...</td>
</tr>
<tr>
<td>33</td>
<td>Percent Cover of Ectoprocts From Spring 2001 to Spring 2002...</td>
</tr>
<tr>
<td>34</td>
<td>Percent Cover of Ascidians From Spring 2001 to Spring 2002...</td>
</tr>
</tbody>
</table>
LIST OF TABLES

<table>
<thead>
<tr>
<th>TABLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Positions of Shallow Subtidal and Kelp Forest Monitoring Locations (NAD83).......KF-2</td>
</tr>
<tr>
<td>2</td>
<td>Summary of Encrusting Invertebrate Taxa From 2001 to 2002...............................KF-11</td>
</tr>
</tbody>
</table>

LIST OF APPENDICES

<table>
<thead>
<tr>
<th>APPENDIX</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Summary Data ......................................................................................................KF-A-1</td>
</tr>
</tbody>
</table>
INTRODUCTION

Unlike the shallow subtidal habitat that may support giant kelp (*Macrocystis pyrifera*), kelp forest habitat is typically defined as the area further offshore where giant kelp is more persistent. Generally the water is deeper (depth of at least 10 meters [m]), thereby making it less susceptible to breaking waves and strong surge, which is a more conducive environment for giant kelp.

Stands of giant kelp provide a vertically structured habitat through the water column and provide nursery and feeding areas, and shelter for many other organisms (Foster and Schiel 1985). Kelp forests also support both commercially and recreationally important species, as well as providing aesthetic qualities, and similar to the shallow subtidal habitat, many of the indicator species present in the kelp forest habitat are perennial and require hard substrate for attachment. There is some overlap of species (i.e., organisms that may be found in both the shallow subtidal and kelp forest habitats); however, the kelp forest habitat can generally support a more diverse assemblage to organisms. Resource agencies and commercial fisherman were concerned that sand from the receiver sites may potentially move offshore and cover the substrate, thereby affecting the distribution and abundance of these resources. Therefore, the objective of the monitoring is to evaluate whether beach replenishment operations result in any significant, long-term adverse impact to kelp bed resources adjacent to nearshore discharge areas.

METHODS

STUDY SITES

Five sites along the San Diego County coastline have been monitored for the Navy's beach replenishment efforts: three test sites at Imperial Beach, Solana Beach, and Leucadia, and two control sites at Swami's and Point Loma Kelp Bed. Given the sand deposition patterns predicted for the RBSP all sites except for Imperial Beach would continue to be monitored. New test sites (with three replicate monitoring locations per site) were established off Encinitas and Cardiff (Restaurant Row), and replicate monitoring locations were added in Leucadia, Swamis, and Solana Beach to reflect project-specific, model-predicted sand deposition patterns. The monitoring locations are shown in Figures 1 through 5 (except for Point Loma), and the positions (latitude/longitude – NAD83) are shown in Table 1. The data are separated into shallow subtidal (SS) and kelp (K) monitoring locations. The monitoring locations were established in Spring 2001 prior to implementation of the RBSP.

METHODS FOR BIOTA STUDIES

Diving biologists, operating from a research vessel, sampled the kelp and reef biota within permanently established areas within the monitoring site. Three locations receiver site were non-randomly positioned at depths of approximately -30 ft MLLW within kelp habitat so biological information regarding kelp production and recruitment could be
TABLE 1. RBSP POST-CONSTRUCTION MONITORING LOCATIONS (NAD83).

<table>
<thead>
<tr>
<th>Location</th>
<th>Subtidal Location</th>
<th>Longitude</th>
<th>Latitude</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>North Carlsbad</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NC-SS-1</td>
<td>33  9.556</td>
<td>117 21.521</td>
<td></td>
</tr>
<tr>
<td>NC-SS-2</td>
<td>33  8.908</td>
<td>117 21.030</td>
<td></td>
</tr>
<tr>
<td>NC-SS-3</td>
<td>33  8.779</td>
<td>117 20.933</td>
<td></td>
</tr>
<tr>
<td><strong>South Carlsbad</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SC-SS-1</td>
<td>33  6.619</td>
<td>117 19.577</td>
<td></td>
</tr>
<tr>
<td><strong>Batiquitos/Leucadia</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BL-SS-1</td>
<td>33  4.744</td>
<td>117 18.868</td>
<td></td>
</tr>
<tr>
<td>BL-SS-2</td>
<td>33  4.363</td>
<td>117 18.722</td>
<td></td>
</tr>
<tr>
<td>BL-SS-3</td>
<td>33  3.944</td>
<td>117 18.541</td>
<td></td>
</tr>
<tr>
<td>SW-SS-1</td>
<td>33  2.186</td>
<td>117 17.960</td>
<td></td>
</tr>
<tr>
<td>SW-SS-2</td>
<td>33  2.039</td>
<td>117 17.857</td>
<td></td>
</tr>
<tr>
<td>SW-SS-3</td>
<td>33  1.935</td>
<td>117 17.718</td>
<td></td>
</tr>
<tr>
<td><strong>Moonlight</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ML-SS-1</td>
<td>33  3.487</td>
<td>117 18.344</td>
<td></td>
</tr>
<tr>
<td><strong>Swamis (Control)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SW-SS-1</td>
<td>33  2.186</td>
<td>117 17.960</td>
<td></td>
</tr>
<tr>
<td>SW-SS-2</td>
<td>33  2.039</td>
<td>117 17.857</td>
<td></td>
</tr>
<tr>
<td>SW-SS-3</td>
<td>33  1.935</td>
<td>117 17.718</td>
<td></td>
</tr>
<tr>
<td><strong>Cardiff</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CF-SS-1</td>
<td>33  0.822</td>
<td>117 17.113</td>
<td></td>
</tr>
<tr>
<td><strong>Cardiff (Control)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CC-SS-1</td>
<td>33  0.092</td>
<td>117 16.936</td>
<td></td>
</tr>
<tr>
<td>CC-SS-2</td>
<td>32  59.932</td>
<td>117 16.880</td>
<td></td>
</tr>
<tr>
<td>CC-SS-3</td>
<td>32  59.827</td>
<td>117 16.821</td>
<td></td>
</tr>
<tr>
<td><strong>Solana Beach</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SB-SS-1</td>
<td>32  59.544</td>
<td>117 16.730</td>
<td></td>
</tr>
<tr>
<td>SB-SS-2</td>
<td>32  58.940</td>
<td>117 16.623</td>
<td></td>
</tr>
<tr>
<td>SB-SS-3</td>
<td>32  58.750</td>
<td>117 16.581</td>
<td></td>
</tr>
</tbody>
</table>

* Navy Site

<table>
<thead>
<tr>
<th>Location</th>
<th>Subtidal Location</th>
<th>Longitude</th>
<th>Latitude</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Kelp Locations</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Batiquitos/Leucadia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BL-K-1</td>
<td>33  4.661</td>
<td>117 18.986</td>
<td></td>
</tr>
<tr>
<td>BL-K-2</td>
<td>33  4.368</td>
<td>117 18.852</td>
<td></td>
</tr>
<tr>
<td>BL-K-3</td>
<td>33  3.904</td>
<td>117 18.623</td>
<td></td>
</tr>
<tr>
<td>Encinitas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EN-K-1</td>
<td>33  3.774</td>
<td>117 18.587</td>
<td></td>
</tr>
<tr>
<td>EN-K-2</td>
<td>33  3.442</td>
<td>117 18.440</td>
<td></td>
</tr>
<tr>
<td>EN-K-3</td>
<td>33  2.932</td>
<td>117 18.260</td>
<td></td>
</tr>
<tr>
<td>Swamis (Control)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SW-K-1</td>
<td>33  2.24</td>
<td>117 18.069</td>
<td></td>
</tr>
<tr>
<td>SW-K-2</td>
<td>33  1.983</td>
<td>117 17.933</td>
<td></td>
</tr>
<tr>
<td>SW-K-3</td>
<td>33  1.825</td>
<td>117 17.730</td>
<td></td>
</tr>
<tr>
<td>Cardiff</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CF-K-1</td>
<td>33  0.969</td>
<td>117 17.247</td>
<td></td>
</tr>
<tr>
<td>CF-K-2</td>
<td>33  0.744</td>
<td>117 17.140</td>
<td></td>
</tr>
<tr>
<td>CF-K-3</td>
<td>33  0.181</td>
<td>117 17.045</td>
<td></td>
</tr>
<tr>
<td>Solana Beach</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SB-K-1*</td>
<td>32  59.499</td>
<td>117 16.951</td>
<td></td>
</tr>
<tr>
<td>SB-K-2</td>
<td>32  59.222</td>
<td>117 16.902</td>
<td></td>
</tr>
<tr>
<td>SB-K-3</td>
<td>32  58.870</td>
<td>117 16.752</td>
<td></td>
</tr>
<tr>
<td>Point Loma (Control)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PL-K-1*</td>
<td>32  42.025</td>
<td>117 15.856</td>
<td></td>
</tr>
<tr>
<td>PL-K-2</td>
<td>32  41.965</td>
<td>117 15.838</td>
<td></td>
</tr>
<tr>
<td>PL-K-3</td>
<td>32  41.892</td>
<td>117 15.838</td>
<td></td>
</tr>
</tbody>
</table>
assessed. A permanent, twenty-meter-long transect parallel to the shoreline was established, and along this permanent transect, 10 perpendicular quadrats/band transects were surveyed. The size of the quadrat/transect was dependent upon the resource being quantified.

In ten, five-meter-long by two-meter-wide bands transects (10 m²) the abundance of kelps (large brown algae) were counted. Observations included the number of kelp plants in each transect, the number of stipes at a height of one meter above the bottom, and the size of the individual plants. Four size categories were measured; newly recruited kelp plants (minimum size 2-10 cm), juveniles (10-40 cm in length), subadult (between 40 cm and 2 m) and adults (greater than 2 m in length). The characteristic color and wavy pattern of the blades allows biologists to readily identify even relatively small *Macrocystis* plants.

Biologists mapped substrate type to characterize the percentage of sand, rock, rock type, vertical relief, and depth of sand cover in ten, one-meter by one-meter quadrats (1 m²). Also, within the 1 m² quadrat, biologists documented the abundance of key indicator species of plants and invertebrates. The following list is based upon the results of prior reconnaissance dive surveys conducted by the Navy. Indicator species include the following species:

- giant kelp (*Macrocystis pyrifera*)
- red turf algae complex (*Corallina/Bossiella*)
- crustose red algal complex (*Lithothamnion/Lithophyllum*)
- understory kelp (*Pterygophora californica*)
- leafy red algal complex (*Rhodymenia/Gigartina*)
- red urchins (*Strongylocentrotus franciscanus*)
- purple urchins (*S. purpuratus*)
- ornate tube worms (*Diopatra ornata*)
- stalked tunicates (*Styela montereyensis*)
- brown gorgonian (*Muricea fruticosa*)
- Californian golden gorgonian (*M. californica*)
- Kellet's whelk (*Kelletia kelletii*)
- boring clams (*Parapholas californica*)

Species are monitored for abundances or percent cover. These organisms represent species that may be known to be sensitive to sand movement, and various trophic levels (primary producer, grazers, omnivores, and predators). The presence of other organisms will be noted in each replicate quadrat, but not quantified.

**FIELD MONITORING PERIODS**

Predisposal or baseline monitoring occurred in Spring 2001 prior to project initiation. Post-disposal monitoring has and will occur semi-annually in the spring and fall following sand replenishment activities, through Spring 2005. Spring and fall sampling is ideal because it will coincide with the natural onshore and offshore movement of sand, and natural variation in kelp densities, with generally lower densities in the spring and higher densities in the fall.
DATA ANALYSIS

At each site, species data obtained in each 1 m² replicate were entered into an Excel spreadsheet. Data, by species, were then summed to provide a total abundance value for each of the ten, 1 m² quadrats. Percent cover or density per 1 m² were then calculated for each species. Summary information includes arithmetic mean and standard error for each species. In addition, giant kelp production data (defined for this study as the mean number of kelp stipes per plant or per 10 m² of habitat) and kelp size class frequency distributions were also generated and summarized graphically for each monitoring site.

RESULTS

BATIQUITOS/LEUCADIA

One location at Batiquitos/Leucadia was part of Navy’s monitoring program (BL-K-2), while two other locations were established prior to start of construction. The monitoring locations were established on the shoreward portion of an existing kelp bed downcoast of the model predicted deposition area (Figure 3)

Substrate

Rocky reef was the most common substrate type at Batiquitos/Leucadia, although there have been several large influxes of sand (Figure 6). From 1997 to 2002, the percent cover of rocky substrate has fluctuated between 52.9% in Fall 1999 to 85.4% in Fall 1998. Since implementation of the RBSP, the percent cover of rocky reef has declined from 75% in Spring 2001 to 55.3% in Spring 2002. This corresponded to increases in sandy substrate (either with or without shell hash). The highest percentage of sand was documented in Fall 2001 (34.5%), which was just after completion of the Batiquitos and Leucadia receiver sites. This presumably was not due to the additional sand on the beach as the majority of the material remained on the beach until the winter. Similar sand cover (taking into account standard error) was present in Fall 1999 (17.0 ± 13.3%) suggesting that there episodes of sand movement are common in this area.

ENCINITAS

The Encinitas monitoring locations were established offshore and downcoast of the Leucadia receiver site on the shoreward edge of the existing kelp bed (Figure 3). Monitoring location EN-K-3 is also located upcoast of Moonlight Beach in the vicinity of the modeled predicted area of deposition for the Moonlight Beach receiver site.

Substrate

Encinitas was not included in the Navy’s monitoring program, therefore substrate data are available from Spring 2001 to Spring 2002 (Figure 7). Rocky reef was the most common substrate during all surveys, and similar to Batiquitos, an increase in sand cover was present in
Fall 2001. The percent cover of sand increased from 7.2% in Spring 2001 to 20.0% in Fall 2000, but decreased to 15.8% in Spring 2002. The Encinitas site is in close proximity to the Batiquitos/Leucadia site further suggesting that sediment transport occurs along this area of the coast.

**SWAMIS (CONTROL)**

Swamis was included in the Navy’s monitoring program (SW-K-2). The monitoring locations at Swamis are considered control sites implying that this area will be unaffected by any replenishment activities. The monitoring locations were distributed on the shoreward edge of the kelp bed; upcoast, downcoast, and in the middle of the kelp bed (Figure 4.).

**Substrate**

Rocky reef was the most common substrate type at Swamis, typically exceeding 80% cover during all surveys (Figure 8). Sand cover was highest in Fall 1998 (18%) prior to implementation of the RBSP. Since implementation of the RBSP, the percent cover of sand has increase from 3.5 % in Spring 2001 to 13.0% in Spring 2002.

**CARDIFF**

Two monitoring locations were placed at the closest kelp bed area upcoast of the receiver site as sediment transport modeling suggested that the sand may migrate upcoast and offshore (CF-K-1 and 2). One monitoring location was placed at the closest downcoast kelp bed as members of the CLTFA suggested that sediment transport was downcoast in the vicinity of the receiver site (CF-K-3) (Figure 5).

**Substrate**

Cardiff was not included in the Navy’s monitoring program, therefore substrate data are available from Spring 2001 to Spring 2002 (Figure 9). Rocky substrate has been the most common substrate, although there appears to be a decreasing trend albeit slight given the range about the average (10.9%). The highest percent cover of sand was observed in Fall 2001 soon after completion of the Cardiff receiver site, although it appears unlikely that sand from the receiver site contributed to this increase. The replenishment material from SO-6 was very distinct in color and grain size (i.e., very coarse and yellow-brown in color) and the material present at the monitoring location was fine to medium grained.

**SOLANA BEACH**

Solana Beach was included in the Navy’s monitoring program (SB-K-1). The monitoring locations were distributed on the shoreward edge of the kelp bed; upcoast, downcoast, and in the middle of the kelp bed offshore of the Fletcher Cover receiver site (Figure 5).
**Substrate**

Rocky reef was the most common substrate type at Solana Beach, typically exceeding 75% cover during all surveys, except for the Fall 1999 survey (Figure 10). In Fall 1999, the percent cover of rocky substrate declined to 56.3% and corresponded to an increase in sand cover. Sand cover in Fall 1999 was 41.3%, but declined to levels observed for the majority of the surveys. Since implementation of the RBSP, there has been little change in all substrate categories.

**Point Loma (Control)**

Point Loma was included in the Navy’s monitoring program. The monitoring locations at Point Loma are considered control sites implying that this area will be unaffected by any replenishment activities. The monitoring locations were distributed on the shoreward edge of the kelp bed; upcoast, downcoast, and in the middle of the kelp bed.

**Substrate**

The substrate at the Point Loma kelp bed is distinct different from that observed at the other monitoring locations. The substrate is generally flat, pavement-like sandstone, with scattered areas for sand. Rocky substrate is the most common substrate at Point Loma, generally exceeding 89% during most surveys (Figure 11). The highest percent cover of sand was observed in Fall 1997 (3.8%), while the zero percent cover of sand was observed in Fall 1999 and 2000.

**Distribution and Abundance of Target Taxa**

Target taxa distribution and abundance from Spring 2001 to Spring 2002 are graphically presented in Figures 12 through 40 to determine the relationships between treatment and reference sites, and relationships among all sampling sites. Note that the mean abundance and percent cover are relative to a 10 m² sampling area. See Appendix A for a summary of target species.

**Giant kelp (Macrocystis pyrifera)**

Giant kelp was present at each of the monitoring sites, although there were differences in the distribution of the life stages. Adult plants were observed at all sites and during all surveys (Figure 12). Point Loma consistently had the highest abundance, with densities exceeding 2 plants per 10 m² during all surveys. The kelp plants at Point Loma were also the largest plants as indicated by the highest mean number of stipes per plant (Figure 13). The other life stages were not present or were found at low densities in Spring 2001 through Fall 2001 (Figures 14 - 16). However, in Spring 2002, after implementation of the RBSP, densities of the various life stages increased at most of the sites. Typically recruitment of giant kelp occurs in the spring, although many of the recruits do not persist through the year. In areas where there are persistent stands of adult plants (e.g., Point Loma), recruitment is generally lower as adult plants typically outcompete the recruits for light and space. The data supports this as densities of earlier life stages was lowest at Point Loma.
**UNDERSTORY KELP**

Laminarians and fucoid phaeophytes can form dense, subsurface canopies approximately 0.5 to 2.5 m off of the seafloor (Foster and Schiel 1985) and can completely or partially exclude other species of large brown algae. *Cystoseira*, in shallow depths, can form surface canopies, but in offshore depths it attains an understory status in the community. *Pterygophora*, *Egregia*, and *Eisenia* have relatively long stipes and can create an understory canopy up to 2.5 m off the bottom, while *Desmarestia*, *Cystoseira*, and *Laminaria* are more prostrate and can cover the bottom.

Several species of large, understory kelp species were observed during the surveys including *Cystoseira osmundacea*, *Egregia menziesii*, *Eisenia arborea*, *Laminaria farlowii*, and *Pterygophora californica*. *Cystoseira*, *Egregia*, and *Eisenia* displayed the widest distributions, occurring at at least 5 of the 6 monitoring sites (Figures 17-19). Both *Cystoseira* and *Eisenia* were observed at all the sites, while *Egregia* was only absent from Point Loma. *Laminaria* was observed at three monitoring locations: Cardiff, Swamis, and Point Loma (Figure 20). *Pterygophora* was most common at Point Loma, although few individuals were observed at Solana Beach and Cardiff (Figure 21). *Desmarestia ligulata* is more of an ephemeral species and is unusually observed in areas that have been recently disturbed and cleared of other kelps. It was not observed during any of the surveys.

**BROWN TURF ALGAE**

Commonly occurring brown algae were combined into a brown turf algae complex that included such species as *Dictyopteris undulata*, *Dictyota binghamiae*, *Pachydictyon coriaceum*, and *Zonaria farlowii*). This complex, similar to the red turf complex, comprises a secondary layer of biological cover above encrusting algae and sessile invertebrates. Brown turf algae were not observed at any site.

**RED TURF ALGAE**

The red turf algae assemblage comprise filamentous, juvenile, and leafy turf growing associates, and forms a secondary canopy of benthic macrophytes that is susceptible to the movements of sediments. It can also act to protect kelp sporophytes from the grazing activities of fish and invertebrates grazers (Harris et al. 1984).

Red turf algae was observed at all the monitoring locations, with the highest percent cover observed at Encinitas (Figure 22). At the other monitoring locations, coverage was relatively lower and appeared to vary seasonally, with the higher coverage present during the spring surveys.

**LEAFY RED ALGAE**

Consisting of the more mature plants, leafy red algae >10 cm in height (e.g., *Acrosorium venulosum*, *Gracilariopsis* sp., *Rhodymenia californica*, and *Microcladia coulteri*) form a tertiary
layer of algae above the encrusting and turf algae. Leafy red algae were observed at all sites, with the highest percent cover observed at Encinitas in Fall 2001 (6.2%) (Figure 23). The majority of the sites appeared to have the highest percent cover of leafy red algae in Fall 2001. The percent cover of leafy red algae declined in Spring 2002 after implementation of the RBSP percent; however, the values were similar to those observed in Spring 2001.

CORALLINE ALGAE TURF

Coralline algae turf consists of species that have morphologically and physiologically adapted to the effects of abrasion and burial by possessing strong, calcified thalli (e.g., *Corallina officinalis*, *C. vancouverensis*, and *Bossiella* sp.). They were observed at all the monitoring locations, with the highest percent cover observed at Encinitas, Cardiff, and Point Loma (Figure 24). There were some slight fluctuation between surveys at several locations; however, given the variation during those surveys, the percent cover remained relatively stable.

CRUSTOSE RED ALGAE

This taxonomic complex (e.g., *Lithophyllum*/*Lithothamnion*) is common in subtidal zones (Foster and Schiel 1985) and may persist for long periods of time. However, the biology of these taxa is poorly known and may include the encrusting stages of articulated corallines. Like coralline turf, this complex is uniquely adapted to withstand sand burial and abrasion with its calcified thalli, and may exclude other forms of algae from settling. The percent cover of crustose red algae was relatively low at all monitoring locations, with the exception of Point Loma, where the percent cover generally exceeded 12% (Figure 25). At the other locations, percent cover rarely exceeded 1.0%.

PARAPHOLAS CALIFORNICA

The rock-boring pelecypod, *Parapholas californica*, commonly inhabits soft-shale reefs (Foster and Schiel 1985). Its hole is rarely deeper than 28 to 30-cm deep and it can live normally with sand cover of up to 15 cm (Morris et al. 1980). *Parapholas* was observed at all sites except for Solana Beach (Figure 26). The highest densities were consistently observed at Cardiff and Encinitas, although there appeared to be a large amount of variability at all sites. This may be due to their ability to retract their siphon into their hole when disturbed, making it difficult for biologist to document their presence.

CHACEIA OVOIDEA

*Chaceia ovoidea* is one of the largest pholads and can bore at least up to 60 cm. Haderlie et al. (1974) found few specimens of *Chaceia* living with a cover of sand, and attributed this to a settling preference that keeps it out of areas where periodic sand movement occurs. *Chaceia* was most common at Point Loma where densities ranged from 0.5 per 1 m² in Spring 2001 to 3.1 per 1 m² in Spring 2002 (Figure 27). At the other monitoring locations, *Chaceia* abundance was generally less than 0.2 per 1 m².
**Muricea californica**

*Muricea californica* is a frequently observed gorgonian on reefs in kelp forest habitats. It is susceptible to damage from storms, sediment burial, and abrasion, which are major causes of its mortality (Grigg 1975; Rosenthal et al. 1969). *Muricea* was observed at five of the six monitoring locations, with Point Loma being the only location where it was absent (Figure 28). The highest densities were observed at Encinitas, Cardiff, and Swamis, where densities were generally greater than 1.0 per 1 m². At Solana Beach and Batiquitos, densities were generally less than 1.0 per 1 m².

**Diopatra ornata**

Ornate tube worms form dense aggregations on sand-inundated reefs and in coarse, detrital-rich sands surrounding hard bottom habitat. A particulate feeder, this polychaete worm attaches fragments of algae and debris to its tube. These tubes can also serve as "refuges" for crustaceans, polychaete worms, and other micro-invertebrates. *Diopatra* was observed at all sites, with the highest abundance at Batiquitos (over 2.1 individuals per 1 m²), followed by Swami’s Reef (1.1 per 1 m²), Cardiff (1.1 per 1 m²), Solana Beach (1.1 per 1 m²), Encinitas (0.7 per 1 m²), and Point Loma (0.4 per 5 m²) (Figure 29).

**Kelletia kelletii**

The Kellet's whelk is one of the largest gastropods found intertidally and subtidally in southern California. It is commonly found to depths of 70 meters on rocky reefs and gravel bottoms, scavenging on dead or injured animals it finds on the seafloor, including other gastropods and mussels. Its food sources overlap with the giant sea star, *Pisaster giganteus*, which also is an occasional predator of *Kelletia*. *Kelletia* was present at the monitoring locations, although abundance varied, with highest abundance observed at Cardiff in Fall 2001 (1.4 per 1 m²; Figure 30). At the remaining locations, Kelletia abundance was low, with abundance less than 0.5 per 1 m². *Kelletia* is generally patchily distributed and during certain times of the year, primarily spring, can form dense mating aggregations, where densities can exceed 50 per 1 m².

**Lithopoma undosum**

The dietary habit of this species is not generally known, but it may be a grazer on lower stipes of kelp and sporophylls (Foster and Schiel 1985). This trochid snail was present at three of the six monitoring sites although it was observed infrequently except at Point Loma, where it was observed during all surveys and the highest abundance was 1.0 individual per 1 m² in Spring 2001 (Figure 31). At the other monitoring locations (Batiquitos and Swamis), abundance did not exceed 0.1 individuals per 1 m².

**Sea Urchins**

The red urchin, *Strongylocentrotus franciscanus*, is a significant grazer in the subtidal reef environment. Its grazing activity is known to influence the distribution and abundance of...
macrophytes and has been associated with the complete removal of kelp plants (Foster and Schiel 1985; Morris et al. 1980). The red sea urchin was present at four of the six sites, although not during every survey (Figure 32). Swamis was the only monitoring location where it was observed during every survey, and where abundance ranged from 0.3 to 0.9 individuals per 1 m². At Solana Beach, red urchins were recorded in Spring 2001 (0.1 per 1m²) and Fall 2001 (0.1 per 1 m²). At Encinitas and Point Loma, urchins were observed in Fall 2001 (0.1 per 1 m²) and Spring 2002 (0.1 per 1 m³), respectively.

Purple sea urchins, *Strongylocentrotus purpuratus*, consume a variety of brown and red algae, although *Macrocystis* is a preferred food item. It is preyed upon by sea stars (e.g., *Dermasterias imbricata* and *P. ochraceous*) and sheephead (*Semicossyphus pulcher*). The purple urchin was observed at three of the six monitoring locations (Figure 33). It was most common at Point Loma where it observed during all three surveys, with densities generally less than 1.0 individuals per 1 m². The other locations where it was observed, Encinitas and Solana Beach, densities were approximately 0.1 individuals per 1 m².

### SEA STARS

Predaceous sea stars (*Pisaster giganteus*, *P. ochraceous*, and *P. brevispinus*) feed on a range of mollusks, barnacles, and annelids, although its preferences vary with the available food resources (Morris et al. 1980). They are common predators in the low intertidal to depths of about 80 meters on rocky substrates, and occasionally are found in sandy habitats. They were present at four of the six sites, although not during every survey (Figure 34). Similar to purple urchins, sea stars were observed on every survey at Point Loma with densities generally less than 0.2 individuals per 1 m². At Batiquitos, Encinitas, and Solana Beach, sea stars were observed during two or fewer surveys with densities of approximately 0.1 individuals per 1 m².

### ENCRUSTING INVERTEBRATES

Sponges, ectoprocts (bryozoans), and colonial tunicates were assembled into a collective group of colonial and encrusting sessile suspension/filter feeding invertebrates; their mean percent cover is summarized in Table 5. Sponges (e.g., *Sigmadocia* and *Leucetta*), tunicates (e.g., *Didemnum* spp.), and ectoprocts (e.g., *Bugula californica*) were present at all six sites (Figures 35-37). Although it appears there was some seasonal variation (considering the standard error), the relative coverage was similar within each monitoring location. A comparison of all the monitoring locations indicates that Batiquitos has the lowest percent cover of encrusting invertebrates, while at the other locations, percent cover generally exceeded 3%, but ranged as high as 7.3% at Encinitas (Table 2).
Table 2. Summary of Encrusting Invertebrate Taxa From 2001 to 2002
(Mean Percent Cover/1 m² at Each Monitoring Site)

<table>
<thead>
<tr>
<th></th>
<th>BL</th>
<th>EN</th>
<th>CF</th>
<th>SW</th>
<th>SB</th>
<th>PK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poriferans</td>
<td>0.2</td>
<td>0.9</td>
<td>0.7</td>
<td>1.1</td>
<td>0.8</td>
<td>3.3</td>
</tr>
<tr>
<td>Ectoprocts</td>
<td>0.4</td>
<td>5.8</td>
<td>2.5</td>
<td>1.5</td>
<td>2.5</td>
<td>0.2</td>
</tr>
<tr>
<td>Tunicates</td>
<td>0.1</td>
<td>0.6</td>
<td>0.3</td>
<td>0.2</td>
<td>1.5</td>
<td>0.4</td>
</tr>
<tr>
<td>Total</td>
<td>0.7</td>
<td>7.3</td>
<td>3.5</td>
<td>2.8</td>
<td>4.8</td>
<td>3.9</td>
</tr>
</tbody>
</table>

BL = Batiquitos/Leucadia; EN = Encinitas; CF = Cardiff; SW = Swamis; SB = Solana Beach; PK = Point Loma

**DISCUSSION**

The objective of the monitoring program is to evaluate whether beach replenishment operations result in any significant, long-term adverse impacts to marine resources in the vicinity of the beach replenishment sites. Sediment can affect giant kelp forests by scouring or burying established populations or by affecting the survivorship of microscopic life history stages. However, other factors must also be considered when attempting to determine a relationship between beach replenishment operations from the RBSP and the persistence of a kelp forest community. For example, approximately 150,000 cubic yards of sand was placed on the beach at North Carlsbad in 1999, and periodic dredging of Batiquitos Lagoon and Oceanside Harbor has occurred within the last several years, contributing additional sand into the littoral cell.

The existence of a giant kelp forest depends upon physical and chemical conditions that favor the reproduction and growth of giant kelp, *Macrocystis pyrifera*, and generally these include hard substratum, cool water temperatures (<20°C), sufficient light intensities, nutrients, and protection from extreme water motion. Long-term studies of southern California kelp forests suggest that they are not stable over periods as short as several years (Schiel and Foster 1985). For example, studies at Point Loma kelp forest indicate that disturbance associated with the warm, nutrient-stressed 1982-1984 El Niño period resulted in poor *Macrocystis* growth, canopy formation, and survival. The decline in *Macrocystis* led to the persistence of understory kelps (Tegner et al. 1997). Once established, understory kelp have considerable resistance to invasion, and the increase in understory kelps led to declines in *Macrocystis* (Tegner et al. 1996). However, *Macrocystis* is competitively dominant over understory kelps, and excellent conditions during the cold, nutrient-rich, 1988-1989 La Niña event led to near extinction of understory kelps, although there was considerable site-to-site variation (Dayton et al. 1992). Recovery following large El Niño events also appears to vary. At the Point Loma kelp forest, there was significant recovery following the 1982-1984 El Niño, something that took over 5 years following the 1957-1959 El Niño (Tegner and Dayton 1991).

In kelp forests, sand movement influences substrate type and the presence of associated biota. In areas where sand is constantly shifting, either moving on or offshore or longshore, the biota would be indicative of sand tolerant organisms, whereas in areas that remain free of sand, the substrate would be available for colonization. The monitoring sites are generally composed of rocky reef
habitat with some sand. The amount of sand has remained relatively constant at most sites with the exception of Cardiff Reef, which increased in 1999.

The beginning of the Navy's monitoring program (1997) coincided with El Niño conditions, which were characterized by elevated water temperatures and intense storm activity. Giant kelp was present at all sites, although it was sparse at Point Loma and Cardiff Reef. The analysis of the size class information indicated that a large percentage of the kelp plants were recruits and juveniles, which corresponded to a general lack of canopy, and also indicated that kelp recruitment was occurring. Despite higher-than-average surface water temperatures during the survey (22.2 to 23.3°C), the bottom water temperatures were relatively cool (16.7 to 18.3°C) and were within the thermal tolerance ranges of kelp for the establishment and growth of young plants.

Kelp bed macrobiota exhibited very site-specific affinities during the 1997 monitoring effort. This trend was likely related to differences in the habitat types and the storm-generated waves that disturbed the bottom communities at the monitoring sites. Differences between the south and North County monitoring sites were defined by (1) different associations of understory kelp (*Desmarestia* and *Laminaria* in the south and *Pterygophora*, *Egregia*, *Eisenia*, and *Cystoseira* in the north); (2) greater cover of crustose coralline algae in the south; and (3) *Muricea* colonies, ectoprocts, sponges, and red urchins greater abundance at the North County sites. There was also a distinct difference in the distribution of the boring pholads, as both *Parapholus* and *Chaceia* were present north of Point Loma, possibly due to the more stable reef habitat. Several taxa were ubiquitous in 1997, such as red turf algae, coralline turf algae, leafy red algae, the whelk *Kelletia kelletii*, and the ornate tube worm *Diopatra ornata*.

The 1998 survey was conducted after a year of intense storms and higher-than-average temperatures. Seawater temperatures recorded during the 1998 surveys on the average declined 7.7°C on the surface and 4.3°C on the bottom, compared to the temperatures recorded in 1997. The waning elevated sea-surface temperatures in 1998 also produced a less-pronounced thermal gradient between the surface and bottom waters.

In 1998, all areas sampled appeared to be in a state of recovery from the previous winter’s storms and prolonged periods of elevated sea-surface temperatures. Algae and encrusting invertebrates were highly affected by red turf algae, leafy red algae, brown turf algae, sponge, tunicate, and ectoproct cover reduced in 1998. Reductions in the cover of these assemblages were concurrent with an increase in harder forms, such as coralline red algae. *Macrocystis* density at Imperial Beach, Swami’s Reef, and North Carlsbad decreased in 1998 compared to 1997, although recovery at Point Loma and Cardiff Reef appeared greater. Kelp cover, represented in the abundance of adult plants, as well as stipe production, were also lower in 1998 (as much as 60% overall). Understory kelps exhibited site-specific variation, such as *Desmarestia* (which was observed only at Imperial Beach), *Laminaria* at Point Loma, and *Eisenia* at Cardiff Reef.

Similar to the trend toward a decrease in algae and encrusting invertebrates, many of the motile and larger invertebrate target taxa also exhibited either a decrease in density or remained relatively constant. These species include the pholad clam, *Parapholus californica*, the whelk *Kelletia kelletii*, seastars (*Pisaster* sp.), and the trochid snail *Lithopoma*. Other taxa, such as the ornate tube worm
(Diopatra ornata), Chaceia ovoidea, the red sea urchin (Strongylocentrotus franciscanus), and Muricea californica had site-specific variations in abundance.

In 1999, substrate composition remained relatively stable with the exception of increases in sand at Cardiff Reef and North Carlsbad. This coincided with recovery of giant kelp at Imperial Beach, Point Loma, and Swami’s Reef, while there were declines at Cardiff Reef and North Carlsbad. The increases could not be attributed to the younger life stages as they were generally not observed, therefore the number of adult plants contributed to the overall increase. Although the number of plants was generally greater at the South County sites, stipe data suggests that the plants did not have as many stipes. Therefore, there were fewer, but larger, giant kelp plants in North County, and more, but smaller, plants in South County. There was also an increase in several understory kelps: Egregia, Pterygophora, and Eisenia at North County sites, and Laminaria at Point Loma. The low giant kelp recruitment may be a result of the increase in understory kelps as giant kelp reduces the available space and light.

Several algal taxa and sessile invertebrates increased at all sites in 1999, including red turf algae, leafy red algae, ornate tube worms (Diopatra ornata), sponges, tunicates, and ectoprocts, while others were site-specific. For example, pholads (e.g., Chaceia and Parapholas), leafy red algae, and Muricea exhibited higher densities or cover in North County, while coralline turf and crustose corallines exhibited higher cover in South County. Mobile invertebrates also exhibited site-specific variation, with sea stars, purple urchins, and Lithopoma increasing in South County, and red sea urchins increasing in North County.

In 2000, substrate composition returned to pre-1999 levels, with the dominant substrate consisting of rock/reef at most sites or cobble in the case of Imperial Beach. The large influx of sand at Cardiff Reef in 1999 was not present in 2000. Continuing with the apparent recovery observed in 1999, there was an increase in giant kelp at most sites. A surface canopy was present at all sites in 2000, and at both Swami’s Reef and North Carlsbad, all life stages were present, whereas Cardiff Reef, Point Loma, and Imperial Beach were dominated by adult plants. The size of the plants was similar among sites, with the exception of Cardiff Reef where the mean number of stipes was 20 per plant, compared to less than 10 stipes per plant at the other sites.

Several understory kelps increased in abundance although there were site-specific differences. Cystoseira and Eisenia increased at most sites, with larger changes observed at the North County sites. Egregia has consistently been more abundant at North Carlsbad, where its abundance increased significantly in 2000. Similarly, Laminaria abundance at Point Loma has steadily increased throughout the duration of the monitoring program. Pterygophora was the only understory kelp that experienced any marked decline in abundance in 2000, while Desmarestia abundance remained relatively low from 1999 to 2000. Other algal groups generally decreased from 1999 to 2000 at all sites, with the only exception being leafy red algae, which increased at all sites.

Invertebrates distribution and abundance exhibited site-specific variation, with no apparent pattern between north and South County sites. Most species generally declined in abundance from 1999 to 2000 including Parapholas, Chaceia, Muricea, Diopatra, Lithopoma, Strongylocentrotus.
*purpuratus*, and ascidians. *Kelletia* and *Pisaster* appeared to remain relatively constant in abundance, while *Strongylocentrotus franciscanus* and ectoprocts generally increased.

Prior to implementation of the RBSP (Spring 2001), substrate composition was stable at most locations, except for some declines in rocky substrate at Batiquitos/Leucadia which corresponded to an increase in sand cover. Sand cover at Batiquitos has remained at this level through Spring 2002; however, this increase in sand cover does not appear to affect the distribution and abundance patterns of key indicator species. Actually based on giant kelp data, it appears that giant kelp recruitment and persistence has increased since implementation of the RBSP. This does not imply that beach replenishment activities contributed to this increase, but that perhaps there were no negative impacts associated with the construction. Apparently oceanographic conditions during 2001-2002 have been conducive to kelp recruitment and persistence.

Factors that affect kelp forest communities were measured during this study and include recruitment periods (periods of high densities of *M. pyrifera* and unidentified Laminariales), amount of stable substrate available for attachment (percent reef), disturbance (percent sand), competition for space (density of other algae), herbivory (densities of sea urchin species), predation on herbivores (densities of sea stars), and the presence of characteristic biota. Subsequent monitoring will further document the variability associated with each site, and since other beach replenishment activities are being proposed, these data will provide a basis to document any potential effects from the RBSP.
LITERATURE CITED


Figure 6. Substrata at Batiquitos/Leucadia from 1997-2002.

Figure 7. Substrata at Encinitas from 2000-2002.
Figure 8. Substrata at Swamis from 1997-2002.

Figure 9. Substrata at Cardiff from 2001-2002.
Figure 10. Substrata at Solana Beach from 1997-2001.

Figure 11. Substrata at Point Loma from 1997-2001.
Figure 12. Density of *Macrocystis pyrifera* Adults From Spring 2001 to Spring 2002.

Figure 13. *Macrocystis pyrifera* Stipes Per Plant From Spring 2001 to Spring 2002.
Figure 14. Density of *Macrocystis pyrifera* Recruits From Spring 2001 to Spring 2002.

Figure 15. Density of *Macrocystis pyrifera* Juveniles From Spring 2001 to Spring 2002.
Figure 16. Density of *Macrocystis pyrifera* Sub-Adults From Spring 2001 to Spring 2002.

Figure 17. Density of *Cystoseira osmundacea* From Spring 2001 to Spring 2002.
Figure 18. Density of *Eisenia arborea* From Spring 2001 to Spring 2002.

Figure 19. Density of *Egregia menziesii* From Spring 2001 to Spring 2002.
Figure 20. Density of *Laminaria* sp. From Spring 2001 to Spring 2002.

Figure 21. Density of *Pterygophora californica* From Spring 2001 to Spring 2002.
Figure 22. Percent Cover of Red Turf Algae From Spring 2001 to Spring 2002.

Figure 23. Percent Cover of Leafy Red Algae From Spring 2001 to Spring 2002.
Figure 24. Percent Cover of Coralline Turf Algae From Spring 2001 to Spring 2002.

Figure 25. Percent Cover of Crustose Red Algae From Spring 2001 to Spring 2002.
Figure 26. Density of *Parapholas californica* From Spring 2001 to Spring 2002.

Figure 27. Density of *Chaceia ovoidea* From Spring 2001 to Spring 2002.
Figure 28. Density of *Muricea californica* From Spring 2001 to Spring 2002.

Figure 29. Density of *Diopatra ornata* From Spring 2001 to Spring 2002.
Figure 30. Density of *Kelletia kelletii* From Spring 2001 to Spring 2002.

Figure 31. Density of *Lithopoma undosum* From Spring 2001 to Spring 2002.
Figure 32. Density of *Strongylocentrotus franciscanus* From Spring 2001 to Spring 2002.

Figure 33. Density of *Strongylocentrotus purpuratus* From Spring 2001 to Spring 2002.
Figure 34. Density of *Pisaster* sp. From Spring 2001 to Spring 2002.

Figure 35. Percent Cover of Sponges From Spring 2001 to Spring 2002.
Figure 36. Percent Cover of Ectoprocts From Spring 2001 to Spring 2002.

Figure 37. Percent Cover of Ascidians From Spring 2001 to Spring 2002.
## SANDAG PRECONSTRUCTION DATA
**TRANSECT MEANS (N=10)**

### SITE: BATIQUITOS / LEUCADIA

**DATE:** 05/24/01

<table>
<thead>
<tr>
<th>LOCATION:</th>
<th>BL-K-1</th>
<th></th>
<th>BL-K-2</th>
<th></th>
<th>BL-K-3</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SE</td>
<td>Mean</td>
<td>SE</td>
<td>Mean</td>
<td>SE</td>
</tr>
<tr>
<td><strong>Substrata - % Cover / 1 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rock or Reef</td>
<td>83.0</td>
<td>11.4</td>
<td>82.0</td>
<td>5.3</td>
<td>60.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Rock w/ Rubble</td>
<td></td>
<td></td>
<td>5.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cobble</td>
<td></td>
<td></td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td>17.0</td>
<td>2.2</td>
<td>11.0</td>
<td>20.1</td>
<td>30.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Sand with Shell Hash</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Macrocystis - Count / 10 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recruits (&lt;10cm)</td>
<td>0.4</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Juveniles (10-40 cm)</td>
<td>0.4</td>
<td>0.2</td>
<td>0.3</td>
<td>0.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subadult (40 cm-2m)</td>
<td>0.1</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adults (&gt;2m)</td>
<td>1.4</td>
<td>0.4</td>
<td>0.6</td>
<td>0.0</td>
<td>1.0</td>
<td>0.5</td>
</tr>
<tr>
<td>Total # of Stipes</td>
<td>21.5</td>
<td>7.0</td>
<td>8.6</td>
<td>2.3</td>
<td>14.9</td>
<td>13.1</td>
</tr>
<tr>
<td>Avg. # of Stipes</td>
<td>11.7</td>
<td>4.0</td>
<td>8.6</td>
<td>2.3</td>
<td>3.9</td>
<td>1.9</td>
</tr>
<tr>
<td><strong>Understory Kelps - Count / 1 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pterygophora</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laminaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eisenia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cystospora/Halidrys</td>
<td>0.2</td>
<td>0.0</td>
<td>1.4</td>
<td>0.3</td>
<td>0.5</td>
<td>0.4</td>
</tr>
<tr>
<td>Eggregia</td>
<td>1.8</td>
<td>0.2</td>
<td>1.0</td>
<td>0.5</td>
<td>0.6</td>
<td>0.2</td>
</tr>
<tr>
<td>Desmaretia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.7</td>
<td>0.2</td>
</tr>
<tr>
<td><strong>Brown Turf Algae - % Cover / 1 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zonaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dicyota/Dicyopteris</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colpomenia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Red Algae - % Cover / 1 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Turf Algae</td>
<td>0.3</td>
<td>0.0</td>
<td>2.7</td>
<td>0.9</td>
<td>0.4</td>
<td>0.2</td>
</tr>
<tr>
<td>Leafy Red Algae</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encrusting Red Algae</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corallina Turf</td>
<td>0.3</td>
<td>0.0</td>
<td>1.3</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crustose Corallines</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Invertebrates - Count / 1 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parapholas californica</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chaceia ovoidea</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maxisca</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diopatra</td>
<td>4.8</td>
<td>0.7</td>
<td>1.0</td>
<td>0.2</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>Kelletia</td>
<td>0.5</td>
<td>0.2</td>
<td></td>
<td></td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>Lithopoma</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.2</td>
<td>0.0</td>
</tr>
<tr>
<td>Pisaster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. franciscanus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. purpuratus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Encrusting Inverts - % Cover / 1 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sponges</td>
<td>0.3</td>
<td>0.0</td>
<td>0.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ectoprocts</td>
<td></td>
<td></td>
<td>1.0</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ascidians</td>
<td></td>
<td></td>
<td>0.2</td>
<td>0.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## SANDAG POST-CONSTRUCTION DATA
### TRANSECT MEANS (N=10)

### SITE: BATIQUITOS / LEUCADIA
DATE: 1/17/02

<table>
<thead>
<tr>
<th>LOCATION:</th>
<th>BL-K-1</th>
<th></th>
<th>BL-K-2</th>
<th></th>
<th>BL-K-3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SE</td>
<td>Mean</td>
<td>SE</td>
<td>Mean</td>
</tr>
<tr>
<td>Substrata - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rock or Reef</td>
<td>32.0</td>
<td>6.8</td>
<td>80.5</td>
<td>7.8</td>
<td>74.0</td>
</tr>
<tr>
<td>Rock w/Rubble</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pebble</td>
<td>7.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td>69.0</td>
<td>7.5</td>
<td>8.5</td>
<td>4.1</td>
<td>26.0</td>
</tr>
<tr>
<td>Sand with Shell Hash</td>
<td>4.0</td>
<td>1.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Macrocytis - Count / 10 m³</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recruits (&lt;10cm)</td>
<td>2.6</td>
<td>1.6</td>
<td>0.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Juveniles (10-40 cm)</td>
<td>1.9</td>
<td>0.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subadult (40 cm-2m)</td>
<td>0.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adults (&gt;2m)</td>
<td>0.9</td>
<td>0.8</td>
<td>0.8</td>
<td>0.1</td>
<td>1.5</td>
</tr>
<tr>
<td>Total # of Stipes</td>
<td>8.8</td>
<td>8.7</td>
<td>6.9</td>
<td>1.4</td>
<td>10.7</td>
</tr>
<tr>
<td>Avg. # of Stipes</td>
<td>3.6</td>
<td>1.0</td>
<td>6.5</td>
<td>1.5</td>
<td>2.6</td>
</tr>
<tr>
<td>Understory Kelps - Count / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pterygophora</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laminaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eisenia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cystosera/Halidrya</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Egretias</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desmacraria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown Turf Algae - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zonaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dicyota/Dictyopteria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calpomenia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Algae - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Turf Algae</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leafy Red Algae</td>
<td>1.4</td>
<td>0.2</td>
<td>5.2</td>
<td>1.0</td>
<td>3.8</td>
</tr>
<tr>
<td>Encrusting Red Algae</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corallina Turf</td>
<td>0.1</td>
<td></td>
<td>5.1</td>
<td>1.2</td>
<td>6.3</td>
</tr>
<tr>
<td>Crustose Corallines</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Invertebrates - Count / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parapholas californica</td>
<td>0.2</td>
<td>1.6</td>
<td>0.1</td>
<td>0.3</td>
<td>0.9</td>
</tr>
<tr>
<td>Chaceia ovoida</td>
<td>1.6</td>
<td>0.4</td>
<td>0.1</td>
<td>0.3</td>
<td>0.9</td>
</tr>
<tr>
<td>Muraea</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diopatra</td>
<td>3.6</td>
<td>1.8</td>
<td>1.5</td>
<td>0.3</td>
<td>1.6</td>
</tr>
<tr>
<td>Kellesia</td>
<td>0.9</td>
<td>0.3</td>
<td>0.3</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Lithophora</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pisaster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. franciscanus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. purpuratus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encrusting Inverts - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sponges</td>
<td>0.1</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.1</td>
</tr>
<tr>
<td>Ectoprocts</td>
<td>0.2</td>
<td>1.6</td>
<td>1.2</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Ascidians</td>
<td>0.6</td>
<td>0.9</td>
<td>0.9</td>
<td>0.1</td>
<td></td>
</tr>
</tbody>
</table>
**SANDAG POST-CONSTRUCTION DATA**  
TRANSECT MEANS (N=10)  

**SITE: BATIQUITOS / LEUCADIA**  
DATE: 6/27/02

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>BL-K-1</th>
<th></th>
<th>BL-K-2</th>
<th></th>
<th>BL-K-3</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SE</td>
<td>Mean</td>
<td>SE</td>
<td>Mean</td>
<td>SE</td>
</tr>
<tr>
<td>Substrata - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rock or Reef</td>
<td>37.0</td>
<td>9.2</td>
<td>55.5</td>
<td>6.2</td>
<td>73.5</td>
<td>4.7</td>
</tr>
<tr>
<td>Rock w/ Rubble</td>
<td></td>
<td></td>
<td>6.0</td>
<td></td>
<td>4.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Cobble</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Sand</td>
<td>63.0</td>
<td>9.2</td>
<td>4.0</td>
<td>0.0</td>
<td>6.0</td>
<td>3.2</td>
</tr>
<tr>
<td>Sand with Shell Hash</td>
<td></td>
<td></td>
<td>32.5</td>
<td>6.6</td>
<td>16.5</td>
<td>11.6</td>
</tr>
<tr>
<td>Macrocystis - Count / 10 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recruits (&lt;10cm)</td>
<td>3.9</td>
<td>0.8</td>
<td>3.7</td>
<td>0.6</td>
<td>5.5</td>
<td>1.4</td>
</tr>
<tr>
<td>Juveniles (10-40 cm)</td>
<td>3.1</td>
<td>0.6</td>
<td>4.9</td>
<td>1.1</td>
<td>6.9</td>
<td>0.9</td>
</tr>
<tr>
<td>Subadult (40 cm-2m)</td>
<td>3.9</td>
<td>0.9</td>
<td>3.4</td>
<td>1.6</td>
<td>8.8</td>
<td>2.8</td>
</tr>
<tr>
<td>Adults (&gt;2m)</td>
<td>1.4</td>
<td>0.4</td>
<td>0.2</td>
<td>0.0</td>
<td>1.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Total # of Stipes</td>
<td>9.8</td>
<td>2.3</td>
<td>1.4</td>
<td>2.2</td>
<td>15.3</td>
<td>8.4</td>
</tr>
<tr>
<td>Avg. # of Stipes</td>
<td>6.9</td>
<td>2.7</td>
<td>1.4</td>
<td>2.2</td>
<td>5.0</td>
<td>1.4</td>
</tr>
<tr>
<td>Understory Kelps - Count / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pterygophora</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laminaria</td>
<td>0.3</td>
<td></td>
<td>2.7</td>
<td>0.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eisenia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cystospora/Halidrys</td>
<td>1.7</td>
<td>0.4</td>
<td>4.9</td>
<td>0.6</td>
<td>2.4</td>
<td>0.9</td>
</tr>
<tr>
<td>Egregia</td>
<td>2.9</td>
<td>0.5</td>
<td>4.0</td>
<td>1.1</td>
<td>3.3</td>
<td>1.2</td>
</tr>
<tr>
<td>Desmocysta</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown Turf Algae - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zonaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dicyota/Dictyopectis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colpomenia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Algae - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Turf Algae</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.8</td>
<td>0.7</td>
</tr>
<tr>
<td>Leafy Red Algae</td>
<td>2.6</td>
<td>0.4</td>
<td>7.5</td>
<td>1.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encrusting Red Algae</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corallina Turf</td>
<td>0.6</td>
<td>0.9</td>
<td>3.0</td>
<td>0.0</td>
<td>8.0</td>
<td>1.1</td>
</tr>
<tr>
<td>Crustose Corallines</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Invertebrates - Count / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parapholus californica</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.1</td>
<td>0.2</td>
</tr>
<tr>
<td>Chiocia ovoida</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muricea</td>
<td>0.1</td>
<td></td>
<td>0.8</td>
<td>0.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dicranota</td>
<td>0.1</td>
<td>0.1</td>
<td>2.1</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kellictea</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Lithopoma</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flabaster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. franciscanus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. purpuratus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encrusting Inverts - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sponges</td>
<td>0.3</td>
<td>0.2</td>
<td>0.3</td>
<td>0.0</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Ectoprocts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Ascidians</td>
<td>0.2</td>
<td></td>
<td>0.2</td>
<td></td>
<td>0.1</td>
<td></td>
</tr>
</tbody>
</table>
## SANDAG PRECONSTRUCTION DATA
### TRANSECT MEANS (N=10)

### SITE: ENCINITAS

**DATE:** 05/30/01

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Substrata - % Cover / 1 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rock or Reef</td>
<td>90.0</td>
<td>3.7</td>
<td>98.0</td>
<td>1.3</td>
<td>85.5</td>
<td>5.9</td>
</tr>
<tr>
<td>Rock w/ Rubble</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cobble</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td>5.0</td>
<td>2.2</td>
<td>2.0</td>
<td>0.0</td>
<td>14.5</td>
<td>5.0</td>
</tr>
<tr>
<td>Sand w/ Shell Hash</td>
<td>4.0</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Macroystis - Count / 10 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recruits (&lt;10cm)</td>
<td>0.3</td>
<td>0.2</td>
<td>0.1</td>
<td>0.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Juveniles (10-40 cm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.2</td>
<td>0.0</td>
</tr>
<tr>
<td>Subadult (40 cm-2m)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adults (&gt;2m)</td>
<td>1.4</td>
<td>0.6</td>
<td>2.9</td>
<td>0.5</td>
<td>1.2</td>
<td>0.3</td>
</tr>
<tr>
<td>Total # of Siphons</td>
<td>29.2</td>
<td>10.3</td>
<td>35.4</td>
<td>6.3</td>
<td>14.6</td>
<td>5.1</td>
</tr>
<tr>
<td>Avg. # of Siphons</td>
<td>13.4</td>
<td>1.8</td>
<td>13.1</td>
<td>1.6</td>
<td>7.0</td>
<td>2.1</td>
</tr>
<tr>
<td><strong>Understory Kelp - Count / 1 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pterygophora</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laminaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eisenia</td>
<td>1.9</td>
<td>1.2</td>
<td>1.9</td>
<td>0.4</td>
<td>0.3</td>
<td>0.0</td>
</tr>
<tr>
<td>Cystosira/Halidrys</td>
<td>5.5</td>
<td>2.9</td>
<td>0.9</td>
<td>1.1</td>
<td>0.3</td>
<td>0.2</td>
</tr>
<tr>
<td>Egregia</td>
<td>1.6</td>
<td>0.7</td>
<td>0.9</td>
<td>0.3</td>
<td>1.1</td>
<td>0.5</td>
</tr>
<tr>
<td>Desmarestia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Brown Turf Algae - % Cover / 1 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zonaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dicysta/Dicyopteris</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colpomenia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Red Algae - % Cover / 1 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Turf Algae</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leafy Red Algae</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encrusting Red Algae</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corallina Turf</td>
<td>14.2</td>
<td>2.8</td>
<td>1.2</td>
<td>0.5</td>
<td>0.5</td>
<td>0.0</td>
</tr>
<tr>
<td>Crustose Corallines</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td><strong>Invertebrates - Count / 1 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paraphalas californica</td>
<td>0.2</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1.3</td>
</tr>
<tr>
<td>Chaeoia oviedoae</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Murica</td>
<td>0.7</td>
<td>0.5</td>
<td>1.5</td>
<td>0.9</td>
<td>2.6</td>
<td>0.7</td>
</tr>
<tr>
<td>Diopatra</td>
<td>0.6</td>
<td>0.1</td>
<td>1.3</td>
<td>2.5</td>
<td>0.3</td>
<td>0.0</td>
</tr>
<tr>
<td>Kelletia</td>
<td>0.2</td>
<td>0.0</td>
<td>0.1</td>
<td></td>
<td>2.7</td>
<td>1.6</td>
</tr>
<tr>
<td>Lithopoma</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.2</td>
<td>0.0</td>
</tr>
<tr>
<td>Pisaster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. franciscanus</td>
<td>0.1</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. purpuratus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Encrusting Inverts - % Cover / 1 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sponges</td>
<td>0.5</td>
<td>0.2</td>
<td></td>
<td></td>
<td>2.1</td>
<td>1.6</td>
</tr>
<tr>
<td>Ectoprocts</td>
<td>2.5</td>
<td>0.5</td>
<td>1.4</td>
<td>0.6</td>
<td>27</td>
<td>4.4</td>
</tr>
<tr>
<td>Ascidiants</td>
<td>0.2</td>
<td>0.0</td>
<td></td>
<td></td>
<td>0.3</td>
<td>0.2</td>
</tr>
</tbody>
</table>
## SANDAG POST-CONSTRUCTION DATA

**TRANSECT MEANS (N=10)**

**SITE: ENCINITAS**

**DATE: 1/17/02**

<table>
<thead>
<tr>
<th>LOCATION:</th>
<th>EN-K-1</th>
<th></th>
<th>EN-K-2</th>
<th></th>
<th>EN-K-3</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SE</td>
<td>Mean</td>
<td>SE</td>
<td>Mean</td>
<td>SE</td>
</tr>
<tr>
<td>Substrata - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rock or Reef</td>
<td>60.0</td>
<td>13.8</td>
<td>96.0</td>
<td>2.7</td>
<td>80.0</td>
<td>8.2</td>
</tr>
<tr>
<td>Rock w/ Rubble</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cobble</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td>40.0</td>
<td>8.9</td>
<td></td>
<td></td>
<td></td>
<td>20.0</td>
</tr>
<tr>
<td>Sand with Shell Hash</td>
<td></td>
<td></td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Macrocystis - Count / 10 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recruits (&lt;10cm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Juveniles (10-40 cm)</td>
<td>0.2</td>
<td>0.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subadult (40 cm-2m)</td>
<td>0.1</td>
<td>0.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adults (&gt;2m)</td>
<td>0.8</td>
<td>0.4</td>
<td>2.8</td>
<td>0.4</td>
<td>1.0</td>
<td>0.4</td>
</tr>
<tr>
<td>Total # of Stipes</td>
<td>7.7</td>
<td>4.6</td>
<td>36</td>
<td>9.1</td>
<td>16.6</td>
<td>6.9</td>
</tr>
<tr>
<td>Avg. # of Stipes</td>
<td>4.0</td>
<td>1.9</td>
<td>10.8</td>
<td>1.3</td>
<td>9.3</td>
<td>1.8</td>
</tr>
<tr>
<td>Undertory Kelps - Count / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pterygophora</td>
<td>2.2</td>
<td>1.0</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.2</td>
</tr>
<tr>
<td>Laminaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eisenia</td>
<td></td>
<td></td>
<td>10.9</td>
<td>2.3</td>
<td></td>
<td>0.9</td>
</tr>
<tr>
<td>Cystoseira/Halidrys</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.5</td>
</tr>
<tr>
<td>Egregia</td>
<td>3.7</td>
<td>0.7</td>
<td></td>
<td></td>
<td></td>
<td>2.2</td>
</tr>
<tr>
<td>Desmarestia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.0</td>
</tr>
<tr>
<td>Brown Turf Algae - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zonaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dicyota Dictyopectris</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colpomenia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Algae - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Turf Algae</td>
<td>7.4</td>
<td>1.3</td>
<td>1.6</td>
<td>0.6</td>
<td>9.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Leafy Red Algae</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encrusting Red Algae</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corallina Turf</td>
<td>13.5</td>
<td>3.3</td>
<td>1.6</td>
<td>0.6</td>
<td>3.7</td>
<td>1.2</td>
</tr>
<tr>
<td>Crustose Corallines</td>
<td>0.5</td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
<td>1.5</td>
</tr>
<tr>
<td>Invertebrates - Count / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parapholas californica</td>
<td>0.3</td>
<td></td>
<td>1</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chacraea ovoida</td>
<td>0.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maricua</td>
<td>1.1</td>
<td>0.5</td>
<td>1.8</td>
<td>0.7</td>
<td>4.7</td>
<td>1.6</td>
</tr>
<tr>
<td>Diopatra</td>
<td>0.6</td>
<td>0.3</td>
<td>1.0</td>
<td>0.4</td>
<td>0.4</td>
<td>0.2</td>
</tr>
<tr>
<td>Kelletia</td>
<td>0.2</td>
<td></td>
<td>0.1</td>
<td></td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>Lithopoma</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.1</td>
</tr>
<tr>
<td>Pisaster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. franciscanus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.2</td>
</tr>
<tr>
<td>S. purpuratus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encrusting Inverts - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sponges</td>
<td>1.7</td>
<td>0.5</td>
<td>0.5</td>
<td></td>
<td>5.6</td>
<td>2.3</td>
</tr>
<tr>
<td>Ectoprocts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ascidians</td>
<td>0.2</td>
<td>0.2</td>
<td>0.8</td>
<td>0.7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## SANDAG POST-CONSTRUCTION DATA
### TRANSECT MEANS (N=10)

### SITE: ENCINITAS

**DATE: 6/26/02**

<table>
<thead>
<tr>
<th>LOCATION:</th>
<th>EN-K-1 Mean</th>
<th>SE</th>
<th>EN-K-2 Mean</th>
<th>SE</th>
<th>EN-K-3 Mean</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Substrata - % Cover / 1 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rock or Reef</td>
<td>81.0</td>
<td>5.9</td>
<td>87.5</td>
<td>2.6</td>
<td>65.5</td>
<td>10.7</td>
</tr>
<tr>
<td>Rock w/ Rubble</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cobble</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td>9.0</td>
<td>6.7</td>
<td>10.5</td>
<td>1.7</td>
<td>28.0</td>
<td>10.6</td>
</tr>
<tr>
<td>Sand w/ Shell Hash</td>
<td>10.0</td>
<td>2.5</td>
<td>2</td>
<td></td>
<td>6.5</td>
<td>3.6</td>
</tr>
<tr>
<td><strong>Macrocystis - Count / 10 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recruits (&lt;10cm)</td>
<td>2.6</td>
<td>0.4</td>
<td>2.5</td>
<td>0.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Juveniles (10-40 cm)</td>
<td>4.3</td>
<td>1.2</td>
<td>1.9</td>
<td>0.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subadult (40 cm-2m)</td>
<td>4.3</td>
<td>1.1</td>
<td>1.6</td>
<td>0.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adults (&gt;2m)</td>
<td>2.2</td>
<td>0.7</td>
<td>2.9</td>
<td>0.4</td>
<td>1.4</td>
<td>0.4</td>
</tr>
<tr>
<td>Total # of Stipes</td>
<td>31.7</td>
<td>11.6</td>
<td>55.2</td>
<td>8.9</td>
<td>30.9</td>
<td>14.2</td>
</tr>
<tr>
<td>Avg. # of Stipes</td>
<td>11.9</td>
<td>3.5</td>
<td>16.1</td>
<td>2.6</td>
<td>13.2</td>
<td>2.4</td>
</tr>
<tr>
<td><strong>Understory Keips - Count / 1 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ptyerygophera</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laminaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eisenia</td>
<td>2.1</td>
<td>1.0</td>
<td>1</td>
<td>0.4</td>
<td>0.9</td>
<td>0.4</td>
</tr>
<tr>
<td>Cystosera/Halidrys</td>
<td>7.5</td>
<td>1.3</td>
<td></td>
<td></td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Egregia</td>
<td>5.1</td>
<td>1.0</td>
<td></td>
<td></td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Desmarestia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Brown Turf Algae - % Cover / 1 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zonaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dicyota/Dicyopteris</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colpomenia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Red Algae - % Cover / 1 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Turf Algae</td>
<td>7.5</td>
<td>1.5</td>
<td>0.2</td>
<td>0.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leafy Red Algae</td>
<td>0.2</td>
<td>0.0</td>
<td>8</td>
<td>1.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encrusting Red Algae</td>
<td></td>
<td></td>
<td>0.4</td>
<td>0.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corallina Turf</td>
<td>19.9</td>
<td>6.0</td>
<td>0.4</td>
<td>0.0</td>
<td>4.7</td>
<td>1.0</td>
</tr>
<tr>
<td>Crustose Corallines</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Invertebrates - Count / 1 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parapholas californica</td>
<td>0.6</td>
<td>0.0</td>
<td>3.1</td>
<td>1.2</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>Chaetopterus ovoides</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muricea</td>
<td>1.1</td>
<td>0.5</td>
<td>0.8</td>
<td>0.5</td>
<td>6.1</td>
<td>1.4</td>
</tr>
<tr>
<td>Diopatra</td>
<td>0.2</td>
<td>1.0</td>
<td>0.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kelletia</td>
<td>0.2</td>
<td>0.0</td>
<td>0.1</td>
<td></td>
<td>0.4</td>
<td>0.0</td>
</tr>
<tr>
<td>Lithopoma</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pisaster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>S. franciscanum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>S. purpuratus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td><strong>Encrusting Inverts - % Cover / 1 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sponges</td>
<td>0.6</td>
<td>0.0</td>
<td>0.5</td>
<td>0.2</td>
<td>2.5</td>
<td>1.4</td>
</tr>
<tr>
<td>Ectoprocts</td>
<td>0.4</td>
<td>0.0</td>
<td>0.8</td>
<td>0.0</td>
<td>12</td>
<td>2.6</td>
</tr>
<tr>
<td>Ascidians</td>
<td>0.4</td>
<td>0.0</td>
<td>0.7</td>
<td>0.3</td>
<td>3</td>
<td>2.0</td>
</tr>
</tbody>
</table>
### SANDAG PRECONSTRUCTION DATA
TRANSECT MEANS (N=10)

#### SITE: SWAMIS (CONTROL)
DATE: 05/31/01

<table>
<thead>
<tr>
<th>LOCATION:</th>
<th>SW-K-1 Mean</th>
<th>SW-K-1 SE</th>
<th>SW-K-2 Mean</th>
<th>SW-K-2 SE</th>
<th>SW-K-3 Mean</th>
<th>SW-K-3 SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substrata - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rock or Reef</td>
<td>81.0</td>
<td>6.4</td>
<td>98.0</td>
<td>2.0</td>
<td>97.5</td>
<td>1.1</td>
</tr>
<tr>
<td>Rock w/Rubble</td>
<td>2.0</td>
<td>0.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cobble</td>
<td></td>
<td></td>
<td>2.0</td>
<td>0.0</td>
<td>2.5</td>
<td>0.8</td>
</tr>
<tr>
<td>Sand</td>
<td>6.0</td>
<td>8.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand with Shell Hash</td>
<td>11.0</td>
<td>3.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Macrocystis - Count / 10 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recruits (&lt;10cm)</td>
<td>0.1</td>
<td>0.0</td>
<td>0.2</td>
<td>0.0</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>Juveniles (10-40 cm)</td>
<td>0.2</td>
<td>0.0</td>
<td>0.2</td>
<td>0.0</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>Subadult (40 cm-2m)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adults (&gt;2m)</td>
<td>0.8</td>
<td>0.4</td>
<td>2.3</td>
<td>0.7</td>
<td>2.2</td>
<td>0.4</td>
</tr>
<tr>
<td>Total # of Stipes</td>
<td>10.9</td>
<td>8.0</td>
<td>35</td>
<td>9.0</td>
<td>56</td>
<td>15.9</td>
</tr>
<tr>
<td>Avg. # of Stipes</td>
<td>6.0</td>
<td>2.0</td>
<td>14.0</td>
<td>2.6</td>
<td>19.5</td>
<td>4.7</td>
</tr>
<tr>
<td>Undersoary Kelps - Count / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pterygophora</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laminaria</td>
<td>3.5</td>
<td>1.0</td>
<td>0.1</td>
<td>0.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eisenia</td>
<td>5.2</td>
<td>0.7</td>
<td>3.5</td>
<td>0.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cystoseira/Halidrys</td>
<td>2.1</td>
<td>0.8</td>
<td>0.4</td>
<td>0.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eggregia</td>
<td>4.7</td>
<td>1.2</td>
<td>1.4</td>
<td>1.1</td>
<td>0.3</td>
<td>0.2</td>
</tr>
<tr>
<td>Desmarestia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown Turf Algae - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zonaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dacyota/Dicyopteris</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colpomenia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Algae - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Turf Algae</td>
<td>6.0</td>
<td>2.2</td>
<td>2.1</td>
<td>1.2</td>
<td>1.9</td>
<td>1.2</td>
</tr>
<tr>
<td>Leafy Red Algae</td>
<td>7.7</td>
<td>4.0</td>
<td>0.6</td>
<td>0.1</td>
<td>0.3</td>
<td>0.2</td>
</tr>
<tr>
<td>Encrusting Red Algae</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corallina Turf</td>
<td>6.0</td>
<td>2.6</td>
<td>2.1</td>
<td>1.2</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>Coralline Corallines</td>
<td>0.3</td>
<td>0.0</td>
<td>0.1</td>
<td>0.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Invertebrates - Count / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parapholas californica</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chacella exoida</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Murica</td>
<td>1.0</td>
<td>0.3</td>
<td>0.8</td>
<td>0.3</td>
<td>1.2</td>
<td>0.7</td>
</tr>
<tr>
<td>Diopatra</td>
<td>1.0</td>
<td>0.9</td>
<td>0.6</td>
<td>0.4</td>
<td>0.4</td>
<td>0.2</td>
</tr>
<tr>
<td>Kelletia</td>
<td>0.4</td>
<td>0.2</td>
<td>1</td>
<td>0.4</td>
<td>0.8</td>
<td>0.3</td>
</tr>
<tr>
<td>Lithopoma</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pisaster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. franciscanus</td>
<td>0.3</td>
<td>0.2</td>
<td>0.6</td>
<td>0.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. purpuratus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encrusting Inverts - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sponges</td>
<td>0.4</td>
<td>0.0</td>
<td>1.1</td>
<td>0.5</td>
<td>0.8</td>
<td>0.1</td>
</tr>
<tr>
<td>Ectoprocts</td>
<td>3.0</td>
<td>1.2</td>
<td>1.2</td>
<td>0.4</td>
<td>1.6</td>
<td>0.4</td>
</tr>
<tr>
<td>Ascidians</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### SANDAG POST-CONSTRUCTION DATA

#### TRANSECT MEANS (N=10)

#### SITE: SWAMIS (CONTROL)

#### DATE: 1/17/02

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>SW-K-1 Mean</th>
<th>SW-K-1 SE</th>
<th>SW-K-2 Mean</th>
<th>SW-K-2 SE</th>
<th>SW-K-3 Mean</th>
<th>SW-K-3 SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strata - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rock or Reef</td>
<td>72.0</td>
<td>6.6</td>
<td>94.5</td>
<td>3.4</td>
<td>98.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Rock w/ Rubble</td>
<td>5.5</td>
<td>3.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cobble</td>
<td>22.5</td>
<td>6.2</td>
<td>3.0</td>
<td>0.0</td>
<td>2.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Sand</td>
<td>2.5</td>
<td>3.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand with Shell Hash</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Macrocystis - Count / 10 m²</td>
<td>0.8</td>
<td>0.1</td>
<td>1.0</td>
<td>0.1</td>
<td>1.0</td>
<td>0.1</td>
</tr>
<tr>
<td>Recruits (&lt;10cm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Juveniles (10-40 cm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subadult (40 cm-2m)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adults (&gt;2m)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total # of Stipes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg. # of Stipes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Understory Kelps - Count / 1 m²</td>
<td>4.5</td>
<td>0.6</td>
<td>5.2</td>
<td>1.0</td>
<td>1.7</td>
<td>0.5</td>
</tr>
<tr>
<td>Pterygophora</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laminaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eisenia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cystosceira/Halidrys</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Egregia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desmarestia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown Turf Algae - % Cover / 1 m²</td>
<td>4.5</td>
<td>0.6</td>
<td>5.2</td>
<td>1.0</td>
<td>1.7</td>
<td>0.5</td>
</tr>
<tr>
<td>Zonaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dicyota/Dictyopteris</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colpomenia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Algae - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Turf Algae</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leafy Red Algae</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encrusting Red Algae</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corallina Turf</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crustose Corallines</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Invertibrates - Count / 1 m²</td>
<td>0.6</td>
<td>0.5</td>
<td>0.7</td>
<td>0.2</td>
<td>0.6</td>
<td>0.3</td>
</tr>
<tr>
<td>Parapholas californica</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chaeodex ovoides</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moricea</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diopatra</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kelletia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lithopoponae</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fissaster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. franciscanus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. purpuratus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encrusting Inverts - % Cover / 1 m²</td>
<td>1.3</td>
<td>0.7</td>
<td>2.3</td>
<td>0.6</td>
<td>1.8</td>
<td>0.5</td>
</tr>
<tr>
<td>Sponges</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ectoprocts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ascidians</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## SANDAG POST-CONSTRUCTION DATA

TRANSECT MEANS (N=10)

**SITE: SWAMIS (CONTROL)**

**DATE: 6/26/02**

<table>
<thead>
<tr>
<th>LOCATION:</th>
<th>SW-K-1</th>
<th></th>
<th>SW-K-2</th>
<th></th>
<th>SW-K-3</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SE</td>
<td>Mean</td>
<td>SE</td>
<td>Mean</td>
<td>SE</td>
</tr>
<tr>
<td>Substrata - % Cover / 1 m²</td>
<td>66.0</td>
<td>10.1</td>
<td>81.5</td>
<td>8.6</td>
<td>94.5</td>
<td>2.2</td>
</tr>
<tr>
<td>Rock or Reef</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rock w/ Rubble</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cobble</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td>28.0</td>
<td>9.7</td>
<td>8.0</td>
<td></td>
<td>3.0</td>
<td>2.2</td>
</tr>
<tr>
<td>Sand with Shell Hash</td>
<td>6.0</td>
<td>1.8</td>
<td>10.5</td>
<td>5.4</td>
<td>2.5</td>
<td>0.9</td>
</tr>
<tr>
<td>Macrocystis - Count / 10 m²</td>
<td>1.6</td>
<td>1.0</td>
<td>0.1</td>
<td></td>
<td>7.1</td>
<td>1.4</td>
</tr>
<tr>
<td>Recruits (&lt;10cm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Juveniles (10-40 cm)</td>
<td>1.5</td>
<td>1.4</td>
<td></td>
<td></td>
<td>2.8</td>
<td>1.6</td>
</tr>
<tr>
<td>Subadult (40 cm-2m)</td>
<td>1.1</td>
<td>0.7</td>
<td></td>
<td></td>
<td>0.2</td>
<td>0.0</td>
</tr>
<tr>
<td>Adults (&gt;2m)</td>
<td>1.1</td>
<td>0.4</td>
<td>2.7</td>
<td>0.6</td>
<td>2.4</td>
<td>0.6</td>
</tr>
<tr>
<td>Total # of Stipes</td>
<td>18.8</td>
<td>3.1</td>
<td>76.6</td>
<td>21.5</td>
<td>71.2</td>
<td>20.9</td>
</tr>
<tr>
<td>Avg. # of Stipes</td>
<td>12.0</td>
<td>2.2</td>
<td>25.9</td>
<td>3.1</td>
<td>23.9</td>
<td>2.9</td>
</tr>
<tr>
<td>Understory Kelps - Count / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pterygophora</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laminaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eisenia</td>
<td>4.1</td>
<td>0.4</td>
<td>1.6</td>
<td>0.6</td>
<td>1.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Cystosira/Halidrys</td>
<td>2.2</td>
<td>0.4</td>
<td>0.1</td>
<td></td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Egregia</td>
<td>4.2</td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desmaretia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown Turf Algae - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zonaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dicyota/Dictyopteris</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colpomenia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Algae - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Turf Algae</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leafy Red Algae</td>
<td>9.4</td>
<td>2.0</td>
<td></td>
<td></td>
<td>3.5</td>
<td>1.1</td>
</tr>
<tr>
<td>Encrusting Red Algae</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coralina Turf</td>
<td>5.0</td>
<td>0.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crustose Corallines</td>
<td></td>
<td></td>
<td>0.6</td>
<td>0.1</td>
<td>0.4</td>
<td>0.0</td>
</tr>
<tr>
<td>Invertebrates - Count / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parapholas californica</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.8</td>
<td>0.2</td>
</tr>
<tr>
<td>Chaceia ovidea</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.7</td>
<td>0.4</td>
</tr>
<tr>
<td>Murica</td>
<td>1.2</td>
<td>0.6</td>
<td>1.3</td>
<td>0.2</td>
<td>1.0</td>
<td>0.4</td>
</tr>
<tr>
<td>Dinopatra</td>
<td>0.4</td>
<td>0.5</td>
<td>0.5</td>
<td>0.4</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Kellettia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lithopoma</td>
<td>0.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psaster</td>
<td>0.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. franciscanus</td>
<td>0.6</td>
<td>0.0</td>
<td>1.9</td>
<td>1.2</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>S. purpuratus</td>
<td>0.2</td>
<td>1.3</td>
<td></td>
<td>0.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encrusting Inverts - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sponges</td>
<td>1.5</td>
<td>1.2</td>
<td></td>
<td></td>
<td>0.9</td>
<td>0.1</td>
</tr>
<tr>
<td>Ectoprocts</td>
<td>2.0</td>
<td>0.9</td>
<td></td>
<td></td>
<td>1.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Ascidians</td>
<td>0.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### SANDAG PRECONSTRUCTION DATA
TRANSECT MEANS (N=10)

**SITE: CARDIFF**

**DATE: 05/31/01**

<table>
<thead>
<tr>
<th>LOCATION:</th>
<th>CF-K-1</th>
<th></th>
<th>CF-K-2</th>
<th></th>
<th>CF-K-3</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SE</td>
<td>Mean</td>
<td>SE</td>
<td>Mean</td>
<td>SE</td>
</tr>
<tr>
<td>Substrata - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rock or Reef</td>
<td>93.0</td>
<td>2.9</td>
<td>92.0</td>
<td>2.8</td>
<td>89.0</td>
<td>4.4</td>
</tr>
<tr>
<td>Rock w/ Rubble</td>
<td></td>
<td></td>
<td>4.5</td>
<td>7.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cobble</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td>7.0</td>
<td>2.6</td>
<td>8.0</td>
<td>2.7</td>
<td>6.5</td>
<td>2.7</td>
</tr>
<tr>
<td>Sand with Shell Hash</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Macrocystis - Count / 10 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>recruits (&lt;10cm)</td>
<td></td>
<td></td>
<td>0.7</td>
<td>0.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Juveniles (10-40 cm)</td>
<td>0.1</td>
<td>0.0</td>
<td>0.1</td>
<td>0.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subadult (40 cm-2m)</td>
<td>0.1</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adults (≥2m)</td>
<td>2.5</td>
<td>0.6</td>
<td>2.4</td>
<td>0.5</td>
<td>0.8</td>
<td>0.2</td>
</tr>
<tr>
<td>Total # of Stipes</td>
<td>63.8</td>
<td>23.9</td>
<td>31.1</td>
<td>11.9</td>
<td>10.5</td>
<td>5.0</td>
</tr>
<tr>
<td>Avg. # of Stipes</td>
<td>17.3</td>
<td>3.6</td>
<td>10.0</td>
<td>2.1</td>
<td>8.9</td>
<td>5.2</td>
</tr>
<tr>
<td>Understory Kelps - Count / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pterygophora</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laminaria</td>
<td>0.1</td>
<td>0.0</td>
<td>0.1</td>
<td>0.0</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>Eirenia</td>
<td>9.9</td>
<td>2.1</td>
<td>6.7</td>
<td>1.5</td>
<td>5.7</td>
<td>0.0</td>
</tr>
<tr>
<td>Cystoscella/Halidrys</td>
<td>5.5</td>
<td>1.1</td>
<td>2.5</td>
<td>1.0</td>
<td>5.1</td>
<td>1.6</td>
</tr>
<tr>
<td>Egregia</td>
<td>1.6</td>
<td>0.4</td>
<td>3.0</td>
<td>0.7</td>
<td>1.6</td>
<td>0.4</td>
</tr>
<tr>
<td>Desmaretia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown Turf Algae - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zonaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dicyota/Dicyopteris</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colpomenia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Algae - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Turf Algae</td>
<td>6.5</td>
<td>1.5</td>
<td>0.8</td>
<td>0.0</td>
<td>23.8</td>
<td>6.3</td>
</tr>
<tr>
<td>Leafy Red Algae</td>
<td>8.9</td>
<td>4.3</td>
<td>4.2</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encrusting Red Algae</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corallina Turf</td>
<td>15.7</td>
<td>7.6</td>
<td>4.8</td>
<td>1.8</td>
<td>4.7</td>
<td>1.1</td>
</tr>
<tr>
<td>Crustose Corallines</td>
<td>0.1</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Invertibrates - Count / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parophysalis californica</td>
<td>0.7</td>
<td>0.7</td>
<td>3.0</td>
<td>0.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chaceia ovoida</td>
<td>2.1</td>
<td>1.0</td>
<td>0.3</td>
<td>0.0</td>
<td>0.8</td>
<td>0.2</td>
</tr>
<tr>
<td>Muricea</td>
<td>0.2</td>
<td>0.0</td>
<td>0.3</td>
<td>0.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diopatra</td>
<td>0.1</td>
<td>0.0</td>
<td>0.1</td>
<td>0.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kelletia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lithopoma</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pisaster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. franciscanus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. purpuratus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encrusting Inverts - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sponges</td>
<td>1.2</td>
<td>0.2</td>
<td>1.0</td>
<td>0.5</td>
<td>1.0</td>
<td>0.2</td>
</tr>
<tr>
<td>Ectoprocts</td>
<td>4.8</td>
<td>1.6</td>
<td>3.9</td>
<td>2.1</td>
<td>1.9</td>
<td>1.1</td>
</tr>
<tr>
<td>Asciflans</td>
<td>0.1</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SANDAG POST-CONSTRUCTION DATA
TRANSECT MEANS (N=10)

SITE: CARDIFF
DATE: 1/16/02

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>CF-K1</th>
<th>SE</th>
<th>CF-K2</th>
<th>SE</th>
<th>CF-K3</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substrata - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rock or Reef</td>
<td>89.0</td>
<td>5.9</td>
<td>89.0</td>
<td>5.6</td>
<td>53.5</td>
<td>10.5</td>
</tr>
<tr>
<td>Rock w/ Rubble</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cobble</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td>7.0</td>
<td>7.3</td>
<td>10.0</td>
<td>7.1</td>
<td>34.5</td>
<td>10.3</td>
</tr>
<tr>
<td>Sand with Shell Hash</td>
<td>4.0</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Macrocystis - Count / 10 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recrifs (&lt;10cm)</td>
<td></td>
<td></td>
<td>0.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Juveniles (10-40 cm)</td>
<td></td>
<td></td>
<td>0.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subadult (40 cm-2m)</td>
<td>0.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adults (&gt;2m)</td>
<td>0.9</td>
<td>0.2</td>
<td>0.5</td>
<td>0.2</td>
<td>0.8</td>
<td>0.2</td>
</tr>
<tr>
<td>Total # of Stipes</td>
<td>6.3</td>
<td>2.0</td>
<td>4.7</td>
<td>3.2</td>
<td>14.5</td>
<td>4.4</td>
</tr>
<tr>
<td>Avg. # of Stipes</td>
<td>4.5</td>
<td>1.5</td>
<td>2.8</td>
<td>1.2</td>
<td>11.0</td>
<td>3.5</td>
</tr>
<tr>
<td>Undersory Kelps - Count / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pterygophora</td>
<td></td>
<td></td>
<td>0.4</td>
<td></td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Laminaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Ectenia</td>
<td>6.1</td>
<td>1.5</td>
<td>5.7</td>
<td>1.6</td>
<td>7.7</td>
<td>1.0</td>
</tr>
<tr>
<td>Cystoseira/Halidrys</td>
<td>7.2</td>
<td>1.6</td>
<td>1.3</td>
<td>0.4</td>
<td>4.4</td>
<td>1.0</td>
</tr>
<tr>
<td>Egregia</td>
<td>2.0</td>
<td>0.7</td>
<td>2.0</td>
<td>1.1</td>
<td>1.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Desmaretia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown Turf Algae - % Cover / 1 m³</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zonaria</td>
<td></td>
<td></td>
<td>0.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dicyota/Dictyopteris</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colponemia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Algae - % Cover / 1 m³</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Turf Algae</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leafy Red Algae</td>
<td>1.0</td>
<td></td>
<td>6.9</td>
<td>1.7</td>
<td>7.3</td>
<td>2.7</td>
</tr>
<tr>
<td>Encrusting Red Algae</td>
<td>17.0</td>
<td>4.9</td>
<td>10</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corallina Turf</td>
<td>8.5</td>
<td>1.7</td>
<td>6.7</td>
<td>1.6</td>
<td>6.7</td>
<td>1.7</td>
</tr>
<tr>
<td>Crustose Corallines</td>
<td>1.1</td>
<td>0.7</td>
<td>0.1</td>
<td></td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>Invertebrates - Count / 1 m³</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parapholas californica</td>
<td>4.3</td>
<td>0.9</td>
<td>2.9</td>
<td>0.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chaceia ovioidez</td>
<td>0.1</td>
<td></td>
<td>0.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maricola</td>
<td>2.9</td>
<td>1.2</td>
<td>1</td>
<td>0.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diopatra</td>
<td>0.2</td>
<td></td>
<td>1.0</td>
<td>0.8</td>
<td>2.1</td>
<td>0.5</td>
</tr>
<tr>
<td>Kelletia</td>
<td>0.7</td>
<td>0.3</td>
<td>3.6</td>
<td>0.9</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Lithopoma</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pisaster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. franciscanus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. purpuratus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encrusting Inverts - % Cover / 1 m³</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sponges</td>
<td>0.8</td>
<td>0.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ectoprocts</td>
<td>0.5</td>
<td>0.2</td>
<td>5.2</td>
<td>2.2</td>
<td>4.7</td>
<td>3.3</td>
</tr>
<tr>
<td>Ascidians</td>
<td>0.3</td>
<td>0.2</td>
<td>0.2</td>
<td></td>
<td>0.1</td>
<td></td>
</tr>
</tbody>
</table>
### SANDAG POST-CONSTRUCTION DATA
TRANSECT MEANS (N=10)

### SITE: CARDIFF
DATE: 6/26/02

| LOCATION: | CF-K-1 | | CF-K-2 | | CF-K-3 |
|-----------|--------|---|--------|---|--------|---|--------|---|--------|---|
|           | Mean   | SE | Mean   | SE | Mean   | SE |
| Substrata - % Cover / 1 m² | | | | | | |
| Rock or Reef | 53.0 | 12.4 | 88.0 | 3.6 | 72.5 | 6.0 |
| Rock w/ Rubble | | | | | | |
| Cobble | | | | | | |
| Sand | 8.0 | 6.6 | 0.0 | 0.0 | 8.5 | |
| Sand with Shell Hash | 38.0 | 11.1 | 10.0 | 0.0 | 2 | 2.2 |
| Macrocytis - Count / 10 m² | | | | | | |
| Recruits (<10cm) | 5.1 | 0.9 | 3.4 | 0.8 | |
| Juveniles (10-40 cm) | 0.8 | 0.2 | 5 | 0.7 | 2.3 | 0.8 |
| Subadult (40 cm-2m) | 2.3 | 0.5 | 4.9 | 0.7 | 0.8 | 0.4 |
| Adults (>2m) | 2.7 | 0.4 | 5.5 | 0.5 | 1.1 | 0.2 |
| Total # of Stipes | 19.4 | 3.7 | 41.8 | 8.7 | 23.4 | 7.6 |
| Avg. # of Stipes | 6.9 | 1.6 | 7.5 | 1.3 | 12.4 | 3.3 |
| Undestory Keips - Count / 1 m² | | | | | | |
| Pterygophora | | | | | | |
| Laminaria | | | | | | |
| Eisenia | 5.9 | 0.3 | 5.2 | 0.6 | 6 | 0.7 |
| Cystosiera/Halidrys | 4.0 | 0.7 | 0.2 | 0.2 | 4 | 1.1 |
| Egregia | 1.9 | 0.2 | 1.8 | 0.5 | 2.1 | 0.4 |
| Desmarestia | | | | | | |
| Brown Turf Algae - % Cover / 1 m² | | | | | | |
| Zonaria | | | | | | |
| Dicyota/Dictyopteris | | | | | | |
| Colpomonia | | | | | | |
| Red Algae - % Cover / 1 m² | | | | | | |
| Red Turf Algae | | | | | | |
| Leafy Red Algae | 14.0 | 0.7 | 1.5 | 1.1 | 2 | 0.0 |
| Encrusting Red Algae | | | | | | |
| Corallina Turf | | | | | | |
| Crustose Corallines | 6.0 | 1.4 | 6 | 0.7 | 7.2 | 1.2 |
| Invertebrates - Count / 1 m² | | | | | | |
| Paraphyllas californica | | | | | | |
| Chaceia ovosica | | | | | | |
| Maricia | | | | | | |
| Dipatra | | | | | | |
| Kelletia | | | | | | |
| Lithopoma | | | | | | |
| Piasiaert | | | | | | |
| S. franciscanus | | | | | | |
| S. purpuratus | | | | | | |
| Encrusting Inverts - % Cover / 1 m² | | | | | | |
| Sponges | 0.6 | 0.0 | 0.6 | 0.0 | 0.7 | 0.2 |
| Ectoprocts | 0.5 | 0.2 | 0.8 | 0.2 | 0.6 | 0.0 |
| Aecifidans | 0.1 | 0.8 | 0.7 | 1.3 | 0.4 |
**SANDAG PRECONSTRUCTION DATA**
TRANSECT MEANS (N=10)

**SITE: SOLANA BEACH**
DATE: 05/31/01

<table>
<thead>
<tr>
<th>LOCATION:</th>
<th>SB-K-1</th>
<th></th>
<th>SB-K-2</th>
<th></th>
<th>SB-K-3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SE</td>
<td>Mean</td>
<td>SE</td>
<td>Mean</td>
</tr>
<tr>
<td>Substrata - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rock or Reef</td>
<td>84.5</td>
<td>8.1</td>
<td>88.5</td>
<td>7.2</td>
<td>94.0</td>
</tr>
<tr>
<td>Rock w/ Rubble</td>
<td>1.0</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cobble</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td>15.5</td>
<td>9.3</td>
<td>11.5</td>
<td>8.7</td>
<td>5.0</td>
</tr>
<tr>
<td>Sand with Shell Hash</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Macrocystis - Count / 10 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recruits (&lt;10cm)</td>
<td></td>
<td></td>
<td>0.2</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Juveniles (10-40 cm)</td>
<td></td>
<td></td>
<td>0.6</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Subadult (40 cm-2m)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adults (&gt;2m)</td>
<td>1.5</td>
<td>0.4</td>
<td>2.6</td>
<td>0.4</td>
<td>1.1</td>
</tr>
<tr>
<td>Total # of Stipes</td>
<td>37.9</td>
<td>12.0</td>
<td>56.1</td>
<td>10.1</td>
<td>7.2</td>
</tr>
<tr>
<td>Avg. # of Stipes</td>
<td>17.7</td>
<td>3.1</td>
<td>18.0</td>
<td>2.2</td>
<td>5.0</td>
</tr>
<tr>
<td>Understory Kelps - Count / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ptyxyophyora</td>
<td>0.3</td>
<td>0.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laminaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eiseusia</td>
<td>0.2</td>
<td>0.0</td>
<td>0.2</td>
<td>0.0</td>
<td>0.2</td>
</tr>
<tr>
<td>Cystoseira/Halidrys</td>
<td>1.2</td>
<td>0.3</td>
<td></td>
<td></td>
<td>1.1</td>
</tr>
<tr>
<td>Egregia</td>
<td>1.4</td>
<td>0.1</td>
<td></td>
<td></td>
<td>0.3</td>
</tr>
<tr>
<td>Desmarestia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown Turf Algae - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zonaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dicyota/Dicryopteris</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colpomenia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Algae - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Turf Algae</td>
<td>0.7</td>
<td>0.7</td>
<td>2.5</td>
<td>2.5</td>
<td>1.2</td>
</tr>
<tr>
<td>Leafy Red Algae</td>
<td>0.7</td>
<td>0.2</td>
<td>2.5</td>
<td>2.9</td>
<td>1.2</td>
</tr>
<tr>
<td>Encrusting Red Algae</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corallina Turf</td>
<td>1.2</td>
<td>0.4</td>
<td>1.0</td>
<td>0.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Crustose Corallines</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Invertebrates - Count / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parapholas californica</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chaceia ovoida</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Murex</td>
<td>0.2</td>
<td>0.0</td>
<td></td>
<td></td>
<td>2.6</td>
</tr>
<tr>
<td>Diopatra</td>
<td>0.7</td>
<td>0.3</td>
<td>0.2</td>
<td>0.0</td>
<td>0.8</td>
</tr>
<tr>
<td>Kalloa</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lithopoma</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pinaster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.1</td>
</tr>
<tr>
<td>S. franciscanus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. purpuratus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encrusting Inverts - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sponges</td>
<td>0.8</td>
<td>0.2</td>
<td>0.7</td>
<td>0.1</td>
<td>1.0</td>
</tr>
<tr>
<td>Ectoprocts</td>
<td>1.8</td>
<td>0.6</td>
<td>0.4</td>
<td>0.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Ascidians</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.7</td>
</tr>
</tbody>
</table>
# SANDAG POST-CONSTRUCTION DATA

## TRANSECT MEANS (N=10)

## SITE: SOLANA BEACH

**DATE:** 1/16/02

<table>
<thead>
<tr>
<th>LOCATION:</th>
<th><strong>SB-K-1</strong></th>
<th></th>
<th><strong>SB-K-2</strong></th>
<th></th>
<th><strong>SB-K-3</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SE</td>
<td>Mean</td>
<td>SE</td>
<td>Mean</td>
</tr>
<tr>
<td>Substrata - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rock or Reef</td>
<td>84.0</td>
<td>4.3</td>
<td>80.0</td>
<td>7.6</td>
<td>63.0</td>
</tr>
<tr>
<td>Rock w/ Rubble</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cobble</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td>16.0</td>
<td>3.0</td>
<td>20.0</td>
<td>7.1</td>
<td>8.0</td>
</tr>
<tr>
<td>Sand with Shell Hash</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Macrocystis - Count / 10 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recruits (&lt;10cm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Juveniles (10-40 cm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subadult (40 cm-2m)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adults (&gt;2m)</td>
<td>1.5</td>
<td>0.5</td>
<td>2.0</td>
<td>0.4</td>
<td>1.1</td>
</tr>
<tr>
<td>Total # of Stipes</td>
<td>22.6</td>
<td>19.6</td>
<td>26.1</td>
<td>6.9</td>
<td>12.1</td>
</tr>
<tr>
<td>Avg. # of Stipes</td>
<td>9.8</td>
<td>2.1</td>
<td>9.8</td>
<td>1.6</td>
<td>6.5</td>
</tr>
<tr>
<td>Understory Kelps - Count / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pterygophora</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laminaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eisenia</td>
<td>0.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cystoseira/Halidrys</td>
<td>0.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Egregia</td>
<td>0.4</td>
<td>0.4</td>
<td>0.2</td>
<td></td>
<td>1.3</td>
</tr>
<tr>
<td>Desmarestia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown Turf Algae - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zonaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dicrateria/Dicyopectris</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colpomenia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Algae - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Turf Algae</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leafy Red Algae</td>
<td>1.3</td>
<td>1.6</td>
<td>4.1</td>
<td>1.6</td>
<td>6.4</td>
</tr>
<tr>
<td>Encrusting Red Algae</td>
<td>2.5</td>
<td>0.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corallina Turf</td>
<td>1.1</td>
<td>0.5</td>
<td>2.8</td>
<td>1.4</td>
<td>0.8</td>
</tr>
<tr>
<td>Crustose Corallines</td>
<td></td>
<td>0.5</td>
<td>0.2</td>
<td></td>
<td>0.2</td>
</tr>
<tr>
<td>Invertebrates - Count / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parapholas californica</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chaezea ovoida</td>
<td>0.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muricea</td>
<td>1.0</td>
<td>0.8</td>
<td></td>
<td></td>
<td>0.8</td>
</tr>
<tr>
<td>Didipatra</td>
<td>1.3</td>
<td>0.5</td>
<td>0.2</td>
<td></td>
<td>1.7</td>
</tr>
<tr>
<td>Kelletia</td>
<td>0.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lithopoma</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pisaster</td>
<td>0.1</td>
<td>0.1</td>
<td></td>
<td></td>
<td>0.1</td>
</tr>
<tr>
<td>S. franciscanus</td>
<td>0.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. purpuratus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encrusting Inverts - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sponges</td>
<td>1.2</td>
<td>0.7</td>
<td>1.3</td>
<td>1.6</td>
<td>1.3</td>
</tr>
<tr>
<td>Ectoprocts</td>
<td>2.9</td>
<td>2.7</td>
<td>4.5</td>
<td>2.1</td>
<td>8.3</td>
</tr>
<tr>
<td>Ascidians</td>
<td>6.6</td>
<td>3.2</td>
<td>1.2</td>
<td>1.8</td>
<td>2.8</td>
</tr>
</tbody>
</table>
### SAN DAG POST-CONSTRUCTION DATA
**TRANSECT MEANS (N=10)**

**SITE: SOLANA BEACH**
**DATE: 6/25/02**

<table>
<thead>
<tr>
<th>LOCATION:</th>
<th>MEAN</th>
<th>SE</th>
<th>MEAN</th>
<th>SE</th>
<th>MEAN</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Substrata - % Cover / 1 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rock or Reef</td>
<td>70.0</td>
<td>3.9</td>
<td>82.0</td>
<td>4.4</td>
<td>91.5</td>
<td>4.1</td>
</tr>
<tr>
<td>Rock w/ Rubble</td>
<td>5.0</td>
<td>1.6</td>
<td>17.0</td>
<td>3.6</td>
<td>5.5</td>
<td>6.0</td>
</tr>
<tr>
<td>Cobble</td>
<td>25.0</td>
<td>3.1</td>
<td>1.0</td>
<td>0.4</td>
<td>1.0</td>
<td>0.4</td>
</tr>
<tr>
<td>Sand</td>
<td>5.0</td>
<td>3.1</td>
<td>1.0</td>
<td>0.4</td>
<td>1.0</td>
<td>0.4</td>
</tr>
<tr>
<td>Sand w/ Shell Hash</td>
<td>5.0</td>
<td>3.1</td>
<td>1.0</td>
<td>0.4</td>
<td>1.0</td>
<td>0.4</td>
</tr>
<tr>
<td><strong>Macrocystis - Count / 10 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recruits (&lt;10cm)</td>
<td>13.6</td>
<td>2.2</td>
<td>3.3</td>
<td>0.7</td>
<td>4.0</td>
<td>0.8</td>
</tr>
<tr>
<td>Juveniles (10-40 cm)</td>
<td>9.3</td>
<td>2.4</td>
<td>10.5</td>
<td>3.6</td>
<td>3.9</td>
<td>1.1</td>
</tr>
<tr>
<td>Subadult (40 cm-2m)</td>
<td>0.2</td>
<td>0.2</td>
<td>0.1</td>
<td>0.2</td>
<td>0.1</td>
<td>0.2</td>
</tr>
<tr>
<td>Adults (&gt;2m)</td>
<td>1.1</td>
<td>0.4</td>
<td>1.6</td>
<td>0.3</td>
<td>1.0</td>
<td>0.3</td>
</tr>
<tr>
<td>Total # of Stipes</td>
<td>24.2</td>
<td>13.8</td>
<td>37.8</td>
<td>9.7</td>
<td>16.8</td>
<td>8.4</td>
</tr>
<tr>
<td>Avg. # of Stipes</td>
<td>12.6</td>
<td>3.1</td>
<td>19.5</td>
<td>3.4</td>
<td>9.6</td>
<td>2.5</td>
</tr>
<tr>
<td><strong>Understory Kelps - Count / 1 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pterygophora</td>
<td>0.1</td>
<td></td>
<td>2.6</td>
<td>0.6</td>
<td>4.1</td>
<td>1.0</td>
</tr>
<tr>
<td>Laminaria</td>
<td>0.1</td>
<td></td>
<td>2.6</td>
<td>0.6</td>
<td>4.1</td>
<td>1.0</td>
</tr>
<tr>
<td>Eisenia</td>
<td>0.7</td>
<td>0.3</td>
<td>4.1</td>
<td>1.0</td>
<td>4.1</td>
<td>1.0</td>
</tr>
<tr>
<td>Cystosira/Halidrys</td>
<td>0.5</td>
<td>0.2</td>
<td>4.1</td>
<td>1.0</td>
<td>4.1</td>
<td>1.0</td>
</tr>
<tr>
<td>Egrega</td>
<td>0.5</td>
<td>0.2</td>
<td>4.1</td>
<td>1.0</td>
<td>4.1</td>
<td>1.0</td>
</tr>
<tr>
<td>Desmarestia</td>
<td>0.5</td>
<td>0.2</td>
<td>4.1</td>
<td>1.0</td>
<td>4.1</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>Brown Turf Algae - % Cover / 1 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zonaria</td>
<td>0.1</td>
<td></td>
<td>2.6</td>
<td>0.6</td>
<td>4.1</td>
<td>1.0</td>
</tr>
<tr>
<td>Dicryota/Dictyopteris</td>
<td>0.1</td>
<td></td>
<td>2.6</td>
<td>0.6</td>
<td>4.1</td>
<td>1.0</td>
</tr>
<tr>
<td>Colpomenia</td>
<td>0.1</td>
<td></td>
<td>2.6</td>
<td>0.6</td>
<td>4.1</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>Red Algae - % Cover / 1 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Turf Algae</td>
<td>2.0</td>
<td>0.0</td>
<td>3.1</td>
<td>0.9</td>
<td>6.6</td>
<td>1.3</td>
</tr>
<tr>
<td>Leafy Red Algae</td>
<td>1.0</td>
<td>0.0</td>
<td>2.5</td>
<td>0.9</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Encrusting Red Algae</td>
<td>4.1</td>
<td>1.1</td>
<td>3.8</td>
<td>1.1</td>
<td>5.9</td>
<td>1.5</td>
</tr>
<tr>
<td><strong>Invertebrates - Count / 1 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parapholas californica</td>
<td>0.6</td>
<td>0.0</td>
<td>0.9</td>
<td>0.2</td>
<td>0.3</td>
<td>0.2</td>
</tr>
<tr>
<td>Chacea ovoida</td>
<td>0.6</td>
<td>0.0</td>
<td>0.9</td>
<td>0.2</td>
<td>0.3</td>
<td>0.2</td>
</tr>
<tr>
<td>Muricea</td>
<td>0.2</td>
<td></td>
<td>2.8</td>
<td>0.8</td>
<td>4.1</td>
<td>1.0</td>
</tr>
<tr>
<td>Diopatra</td>
<td>0.2</td>
<td></td>
<td>2.8</td>
<td>0.8</td>
<td>4.1</td>
<td>1.0</td>
</tr>
<tr>
<td>Kelletia</td>
<td>0.2</td>
<td></td>
<td>2.8</td>
<td>0.8</td>
<td>4.1</td>
<td>1.0</td>
</tr>
<tr>
<td>Lithopora</td>
<td>0.2</td>
<td></td>
<td>2.8</td>
<td>0.8</td>
<td>4.1</td>
<td>1.0</td>
</tr>
<tr>
<td>Pisaster</td>
<td>0.2</td>
<td></td>
<td>2.8</td>
<td>0.8</td>
<td>4.1</td>
<td>1.0</td>
</tr>
<tr>
<td>S. franciscamis</td>
<td>0.2</td>
<td></td>
<td>2.8</td>
<td>0.8</td>
<td>4.1</td>
<td>1.0</td>
</tr>
<tr>
<td>S. purpuratus</td>
<td>0.2</td>
<td></td>
<td>2.8</td>
<td>0.8</td>
<td>4.1</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>Encrusting Inverts - % Cover / 1 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sponges</td>
<td>0.1</td>
<td>0.6</td>
<td>0.9</td>
<td>0.5</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Ectoprocts</td>
<td>0.2</td>
<td>0.4</td>
<td>0.9</td>
<td>0.5</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Ascidians</td>
<td>0.3</td>
<td>0.2</td>
<td>0.1</td>
<td>0.3</td>
<td>0.2</td>
<td>0.2</td>
</tr>
</tbody>
</table>
### SANDAG PRECONSTRUCTION DATA
TRANSECT MEANS (n=10)

#### SITE: POINT LOMA (CONTROL)
DATE: 03/16/01

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SE</td>
<td>Mean</td>
<td>SE</td>
<td>Mean</td>
</tr>
<tr>
<td>Substrata - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rock or Reef</td>
<td>99.7</td>
<td>0.2</td>
<td>96.8</td>
<td>1.7</td>
<td>99.7</td>
</tr>
<tr>
<td>Rock w/ Rubble</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cobble</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td>0.3</td>
<td>0.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand with Shell Hash</td>
<td>3.2</td>
<td>1.8</td>
<td>0.3</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Macrocystis - Count / 10 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recruits (&lt;10cm)</td>
<td>0.2</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Juveniles (10-40 cm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subadult (40 cm-2m)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adults (&gt;2m)</td>
<td>1.9</td>
<td>0.3</td>
<td>1.7</td>
<td>0.3</td>
<td>2.8</td>
</tr>
<tr>
<td>Total # of Stipes</td>
<td>24.6</td>
<td>4.9</td>
<td>32.2</td>
<td>10.1</td>
<td>39.3</td>
</tr>
<tr>
<td>Avg. # of Stipes</td>
<td>11.5</td>
<td>1.2</td>
<td>13.3</td>
<td>2.6</td>
<td>15.1</td>
</tr>
<tr>
<td>Undersory Kelps - Count / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pterygophora</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laminaria</td>
<td>3.5</td>
<td>1.1</td>
<td>0.5</td>
<td>0.2</td>
<td>5.4</td>
</tr>
<tr>
<td>Eisenia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cystospora/Halidrys</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gregaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desmarestia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown Turf Algae - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zonaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dicyota/Dicyopectis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colpomenia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Algae - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Turf Algae</td>
<td>0.1</td>
<td>0.0</td>
<td>0.2</td>
<td>0.0</td>
<td>0.2</td>
</tr>
<tr>
<td>Leafy Red Algae</td>
<td>0.4</td>
<td>0.0</td>
<td>1.0</td>
<td>0.1</td>
<td>0.2</td>
</tr>
<tr>
<td>Encrusting Red Algae</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coralina Turf</td>
<td>3.6</td>
<td>2.1</td>
<td>14.1</td>
<td>6.5</td>
<td>2.3</td>
</tr>
<tr>
<td>Crustose Corallines</td>
<td>17.8</td>
<td>3.6</td>
<td>10.2</td>
<td>2.1</td>
<td>27.0</td>
</tr>
<tr>
<td>Invertebrates - Count / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parapholas californica</td>
<td>0.6</td>
<td>0.2</td>
<td>0.8</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Chaeaxia ovideae</td>
<td></td>
<td></td>
<td>0.1</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Muricea</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diopatra</td>
<td>0.9</td>
<td>0.0</td>
<td>0.3</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Kelletia</td>
<td>0.5</td>
<td>0.2</td>
<td>0.2</td>
<td>0.0</td>
<td>0.9</td>
</tr>
<tr>
<td>Lithopoma</td>
<td>0.8</td>
<td>0.2</td>
<td>1.0</td>
<td>0.3</td>
<td>1.1</td>
</tr>
<tr>
<td>Psaster</td>
<td></td>
<td></td>
<td>0.2</td>
<td>0.0</td>
<td>0.1</td>
</tr>
<tr>
<td>S. franciscanus</td>
<td>0.1</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. purpuratus</td>
<td>0.7</td>
<td>0.2</td>
<td>0.4</td>
<td>0.2</td>
<td>1.5</td>
</tr>
<tr>
<td>Encrusting Inverts - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sponges</td>
<td>2.9</td>
<td>0.9</td>
<td>0.8</td>
<td>0.1</td>
<td>0.6</td>
</tr>
<tr>
<td>Ectoprocts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ascidians</td>
<td>0.3</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## SANDAG POST-CONSTRUCTION DATA
TRANSECT MEANS (N=10)

### SITE: POINT LOMA (CONTROL)
DATE: 1/22/02

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SE</td>
<td>Mean</td>
<td>SE</td>
<td>Mean</td>
<td>SE</td>
</tr>
<tr>
<td><strong>Substrata - % Cover / 1 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rock or Reef</td>
<td>99.6</td>
<td>0.3</td>
<td>87.0</td>
<td>2.5</td>
<td>61.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Rock w/ Rubble</td>
<td></td>
<td></td>
<td>30.0</td>
<td>2.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cobble</td>
<td>3.0</td>
<td>2.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand with Shell Hash</td>
<td>0.4</td>
<td>13.0</td>
<td>2.2</td>
<td>6.0</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td><strong>Macrocystis - Count / 10 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recruits (&lt;10cm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Juveniles (10-40 cm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adults (&gt;2m)</td>
<td>3.6</td>
<td>0.2</td>
<td>1.4</td>
<td>0.3</td>
<td>3.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Total # of Stipes</td>
<td>70.8</td>
<td>11.7</td>
<td>23.8</td>
<td>9.2</td>
<td>74.6</td>
<td>12.9</td>
</tr>
<tr>
<td>Avg. # of Stipes</td>
<td>18.9</td>
<td>2.1</td>
<td>12.5</td>
<td>2.9</td>
<td>19.4</td>
<td>2.1</td>
</tr>
<tr>
<td><strong>Understory Kelps - Count / 1 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pterygophora</td>
<td>0.1</td>
<td>1.9</td>
<td>0.4</td>
<td>1.8</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>Laminaria</td>
<td>4.8</td>
<td>1.5</td>
<td>26.3</td>
<td>4.5</td>
<td>6.0</td>
<td>1.2</td>
</tr>
<tr>
<td>Eiteria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cystosoma/Halidrys</td>
<td>0.6</td>
<td>0.3</td>
<td></td>
<td></td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Egria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desmaretia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Brown Turf Algae - % Cover / 1 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zonaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dicicota/Dicystopteris</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colpomenia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Red Algae - % Cover / 1 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Turf Algae</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leafy Red Algae</td>
<td>1.4</td>
<td>0.6</td>
<td>14.9</td>
<td>3.5</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Encrusting Red Algae</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corallina Turf</td>
<td>4.0</td>
<td>0.4</td>
<td>11.0</td>
<td>2.1</td>
<td>3.5</td>
<td>0.6</td>
</tr>
<tr>
<td>Crustose Corallines</td>
<td>5.5</td>
<td>0.7</td>
<td>10.5</td>
<td>1.9</td>
<td>42.0</td>
<td>5.0</td>
</tr>
<tr>
<td><strong>Invertebrates - Count / 1 m²</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parapholas californica</td>
<td>4.3</td>
<td>0.9</td>
<td>2.0</td>
<td>0.2</td>
<td>3.0</td>
<td>0.4</td>
</tr>
<tr>
<td>Claxica ovoides</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muricea</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diopaster</td>
<td>0.4</td>
<td>0.4</td>
<td>0.2</td>
<td>0.2</td>
<td>0.7</td>
<td>0.5</td>
</tr>
<tr>
<td>Kelletia</td>
<td>0.3</td>
<td>0.2</td>
<td></td>
<td></td>
<td>0.7</td>
<td>0.2</td>
</tr>
<tr>
<td>Lithopoma</td>
<td>0.5</td>
<td>0.2</td>
<td></td>
<td></td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Psaster</td>
<td>0.3</td>
<td>0.2</td>
<td></td>
<td></td>
<td>0.5</td>
<td>0.2</td>
</tr>
<tr>
<td>S. franciscanus</td>
<td>0.5</td>
<td>0.4</td>
<td>0.9</td>
<td>0.4</td>
<td>0.5</td>
<td>0.2</td>
</tr>
<tr>
<td>S. purpuratus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Encrusting Inverts - % Cover / 1 m²</strong></td>
<td>7.1</td>
<td>1.4</td>
<td>2.9</td>
<td>0.5</td>
<td>1.9</td>
<td>0.5</td>
</tr>
<tr>
<td>Sponges</td>
<td></td>
<td></td>
<td></td>
<td>0.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ectoprocta</td>
<td>2.5</td>
<td>1.0</td>
<td>0.4</td>
<td>0.2</td>
<td>0.2</td>
<td></td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SE</td>
<td>Mean</td>
<td>SE</td>
<td>Mean</td>
<td>SE</td>
</tr>
<tr>
<td>Substrata - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rock or Reef</td>
<td>93.5</td>
<td>2.9</td>
<td>87.0</td>
<td>4.2</td>
<td>88.0</td>
<td>3.5</td>
</tr>
<tr>
<td>Rock w/ Rubble</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cobble</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td>6.5</td>
<td>2.0</td>
<td>13.0</td>
<td>2.9</td>
<td>12.0</td>
<td>1.7</td>
</tr>
<tr>
<td>Sand with Shell Hash</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Macrocytis - Count / 10 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recruits (&lt;10cm)</td>
<td>3.4</td>
<td>0.7</td>
<td>0.1</td>
<td>0.2</td>
<td>0.3</td>
<td>0.0</td>
</tr>
<tr>
<td>Juveniles (10-40 cm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subadult (40 cm-2m)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adults (&gt;2m)</td>
<td>87.6</td>
<td>24.9</td>
<td>20.0</td>
<td>5.6</td>
<td>79.2</td>
<td>13.5</td>
</tr>
<tr>
<td>Total # of Stipes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg. # of Stipes</td>
<td>22.0</td>
<td>3.9</td>
<td>19.0</td>
<td>6.0</td>
<td>26.8</td>
<td>3.9</td>
</tr>
<tr>
<td>Undersory Kelps - Count / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pterygophora</td>
<td>1.7</td>
<td>0.5</td>
<td>1.5</td>
<td>0.4</td>
<td>1.1</td>
<td>0.3</td>
</tr>
<tr>
<td>Laminaria</td>
<td>2.2</td>
<td>0.8</td>
<td>15.7</td>
<td>1.3</td>
<td>5.5</td>
<td>1.1</td>
</tr>
<tr>
<td>Eisenia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cystosia/Halidrys</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Egregia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demamaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown Turf Algae - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zonaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dicyota/Dictyopteris</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colopomenia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Algae - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Turf Algae</td>
<td>0.2</td>
<td>0.4</td>
<td>9.0</td>
<td>1.6</td>
<td>0.7</td>
<td>0.0</td>
</tr>
<tr>
<td>Leafy Red Algae</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encrusting Red Algae</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coralina Turf</td>
<td>4.8</td>
<td>1.0</td>
<td>13.0</td>
<td>2.0</td>
<td>7.5</td>
<td>1.1</td>
</tr>
<tr>
<td>Crustose Corallines</td>
<td>6.9</td>
<td>1.5</td>
<td>7.5</td>
<td>1.8</td>
<td>21.5</td>
<td>6.1</td>
</tr>
<tr>
<td>Invertebrates - Count / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paraphalalis californica</td>
<td>0.4</td>
<td>0.4</td>
<td>0.8</td>
<td>0.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chaccia ovoida</td>
<td>2.0</td>
<td>0.7</td>
<td>2.7</td>
<td>0.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muricea</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diopatra</td>
<td>0.2</td>
<td>0.0</td>
<td>0.2</td>
<td>0.3</td>
<td>0.1</td>
<td>0.2</td>
</tr>
<tr>
<td>Kelletia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lithopoma</td>
<td>0.4</td>
<td>0.2</td>
<td>0.4</td>
<td>0.0</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Pisaster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. franciscanus</td>
<td>0.3</td>
<td>0.1</td>
<td>0.4</td>
<td>0.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. purpuratus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encrusting Inverts - % Cover / 1 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sponges</td>
<td>7.1</td>
<td>2.5</td>
<td>3.9</td>
<td>0.8</td>
<td>2.1</td>
<td>0.5</td>
</tr>
<tr>
<td>Ectoprocts</td>
<td>1.0</td>
<td>0.0</td>
<td>0.2</td>
<td>0.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ascidians</td>
<td>0.6</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
LOBSTER MONITORING REPORT
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>SECTION</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>METHODS</td>
<td>2</td>
</tr>
<tr>
<td>STUDY SITES</td>
<td>2</td>
</tr>
<tr>
<td>METHODS FOR LOBSTER STUDIES</td>
<td>2</td>
</tr>
<tr>
<td>DATA ANALYSIS</td>
<td>3</td>
</tr>
<tr>
<td>FIELD MONITORING PERIODS</td>
<td>3</td>
</tr>
<tr>
<td>RESULTS</td>
<td>3</td>
</tr>
<tr>
<td>NORTH CARLSBAD</td>
<td>3</td>
</tr>
<tr>
<td>Lobster</td>
<td>3</td>
</tr>
<tr>
<td>SOUTH CARLSBAD</td>
<td>4</td>
</tr>
<tr>
<td>Lobster</td>
<td>4</td>
</tr>
<tr>
<td>BATIQUITOS/LEUCADIA</td>
<td>4</td>
</tr>
<tr>
<td>Substrate</td>
<td>4</td>
</tr>
<tr>
<td>Lobster</td>
<td>4</td>
</tr>
<tr>
<td>MOONLIGHT BEACH</td>
<td>4</td>
</tr>
<tr>
<td>Substrate</td>
<td>5</td>
</tr>
<tr>
<td>Lobster</td>
<td>5</td>
</tr>
<tr>
<td>SWAMIS (CONTROL)</td>
<td>5</td>
</tr>
<tr>
<td>Substrate</td>
<td>5</td>
</tr>
<tr>
<td>Lobster</td>
<td>5</td>
</tr>
<tr>
<td>CARDIFF</td>
<td>6</td>
</tr>
<tr>
<td>Substrate</td>
<td>6</td>
</tr>
<tr>
<td>Lobster</td>
<td>6</td>
</tr>
<tr>
<td>CARDIFF (CONTROL)</td>
<td>6</td>
</tr>
<tr>
<td>Lobster</td>
<td>6</td>
</tr>
<tr>
<td>SOLANA BEACH</td>
<td>6</td>
</tr>
<tr>
<td>Lobster</td>
<td>7</td>
</tr>
<tr>
<td>DISCUSSION</td>
<td>7</td>
</tr>
<tr>
<td>LITERATURE CITED</td>
<td>9</td>
</tr>
</tbody>
</table>

# LIST OF FIGURES

<table>
<thead>
<tr>
<th>FIGURE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Monitoring locations at North Carlsbad</td>
</tr>
<tr>
<td>2</td>
<td>Monitoring locations at South Carlsbad and Batiquitos</td>
</tr>
<tr>
<td>3</td>
<td>Monitoring locations at Batiquitos and Leucadia</td>
</tr>
</tbody>
</table>
4 Monitoring locations at Moonlight Beach and Cardiff ............................................. LB-13
5 Monitoring locations at Cardiff and Solana Beach .................................................. LB-14
6 Number of lobster at North Carlsbad ..................................................................... LB-15
7 Number of lobster at South Carlsbad ..................................................................... LB-15
8 Percent cover of three substrate types at BL-SS-2 .............................................. LB-16
9 Number of lobster Batiquitos/Leucadia ................................................................ LB-16
10 Percent cover of three substrate types at ML-SS-1 .............................................. LB-17
11 Number of lobster at Moonlight Beach ................................................................ LB-17
12 Percent cover of three substrate types at SW-SS-1 and SW-SS-2 ..................... LB-18
13 Number of lobster at Swamis ............................................................................ LB-18
14 Percent cover of three substrate types at CF-SS-1 .............................................. LB-19
15 Number of lobster at Cardiff ............................................................................. LB-20
16 Number of lobster at Cardiff (Control) ................................................................. LB-20
17 Number of lobster at Solana Beach .................................................................... LB-21
INTRODUCTION

California spiny lobsters (*Panulirus interruptus*) are found from Monterey Bay, California to Manzanillo, Mexico, primarily between Point Conception, California to Magdalena Bay, Baja California. Recruits and juvenile lobsters usually spend their first one to two years in nearshore (shallow subtidal) reef habitats that include surfgrass and eelgrass beds, providing a recruitment and nursery area. Adult lobsters are typically found in rocky areas from the intertidal zone to at least 240 feet residing in rocky habitats, though they will move onto sand in search of food. Local fishermen note that there is marked movement of adults between inshore and offshore areas. Most of the fishing for this species occurs in rocky coastal areas up to 120 feet in depth, although lobsters have been caught on any type of substrate. It takes approximately seven to eleven years for lobsters to reach legal size and is the commercial species of greatest value to the local fishing industry.

Shallow subtidal habitat is defined as the area of hard substrate (i.e., reef) closest to the shore or beach. It is a dynamic environment as this is the area where seasonal sand transport occurs and where wave energy is released (i.e., surf). It is also the area that would potentially be impacted first by migrating sand from the replenishment area(s). Generally these reefs are located approximately 200 meters (m) from the back beach in water ranging in depth from three to five meters. The reefs can be characterized as either high-relief (being greater than one meter high) or low-relief substrate primarily sandstone, separated by longitudinal sand channels, and are patchily distributed and scattered, meaning that they are not continuous along the coastline. Surveys have indicated surfgrass to be present on the reefs and are sensitive to varying degrees of sand scour or burial. For example, a relatively small amount of sand on, or falling on, the bottom can reduce the survivorship of microscopic life history stages (Devinny and Volse 1978; Littler et al. 1983; Foster and Schiel 1985). This habitat also supports both commercially and recreationally important species such as the California spiny lobster. For these reasons, many of the resource agencies have designated the reefs as sensitive marine resources.

During the EIR/EA process for the RBSP, fishermen expressed concerns about the impact of project-related turbidity may have on these nursery areas and its effect on juvenile lobster. The EIR/EA concluded that juvenile lobster appear capable of tolerating high turbidity and suspended sediments, that the project would affect areas relatively less important to the countywide fishermen, and that given the lack of long-term, adverse effects to their habitat from indirect sedimentation, there would be no significant impact to the fishery.

However, there is still concern regarding sedimentation of the nearshore surfgrass habitat. Therefore, the objective of the monitoring is to evaluate whether beach replenishment operations result in any significant, long-term adverse impacts to sensitive marine resources near the beach replenishment sites. Regarding spiny lobster, the objective was to evaluate whether sand encroachment on shallow subtidal reefs depletes habitat occupied by juvenile lobster.
METHODS

STUDY SITES

Under the Navy's monitoring program, two shallow subtidal reefs identified to support indicator species were established as test reefs (Leucadia and North Carlsbad) and a control reef was established at Cardiff. The control reef was located close enough to experience similar conditions, but far enough away from the receiver beaches to avoid any direct impacts from the replenishment activities.

Based on the results of modeled-predicted sand deposition, all three Navy sites were not predicted to have any sedimentation from the RBSP, therefore new sampling locations were established in areas of concern at North Carlsbad, South Carlsbad, Batiquitos/Leucadia, Moonlight Beach, Cardiff (Restaurant Row), and Solana Beach. The shallow subtidal monitoring locations are shown in Figures 1 through 5. The data are separated into shallow subtidal (SS) and kelp (K) monitoring locations. Unlike the Navy program which established single monitoring locations at key points, multiple sampling locations were established at most receiver sites (up to three monitoring locations per receiver site). Similarly, the monitoring locations were non-randomly selected and were established in areas of concern and/or in areas most likely to be impacted from sand deposition. This was based initially on the base map of existing conditions produced for the EIR/EA, and ground-truthed by reconnaissance surveys and communication with the CLTFA. The change in methodology was due to concern from lobster fisherman regarding the long-term movement of the sand.

The two general criteria used for determining the suitability of a monitoring location included: 1) that it was in the vicinity of the receiver site, either offshore or downcoast or in the area of modeled deposition, and 2) that it was approximately 250 m² in area, and contained a relatively high percentage of high and/or low-relief reef. This methodology provided greater spatial information regarding sediment transport and possible impacts from sand deposition. The Navy's site at North Carlsbad, Encinitas, Cardiff (i.e., Table Tops) would continue to be monitored. The Cardiff site still serves as a control site, and an additional control site was established at Swami's Reef. Based on existing information and reconnaissance surveys, several of the proposed locations (e.g., South Carlsbad, Moonlight, and Cardiff) did not support the necessary area to establish replicate monitoring locations. Therefore, only a single monitoring location was established at these areas.

METHODS FOR LOBSTER STUDIES

Because several sites were carried forward from the Navy program, diving biologists have mapped the habitat and associated biota within a permanently established study area at each of those sites. All the new study areas were established as follows. The offshore edge of each study area was positioned approximately 300 m from the back beach. A permanent, longitudinal transect (running parallel to shore) 40-m-long was established at this location. A minimum of five, 50-m-long by 2-m-wide band transects (total area = 100 m²), spaced at a minimum of ten meter intervals were established perpendicular to shore from the longitudinal transect. Lobster densities were determined by counting the number of lobster in each 100 m² band transect.
DATA ANALYSIS

All data were entered into an Excel spreadsheet and arithmetic mean and standard error were calculated and either graph.

FIELD MONITORING PERIODS

Predisposal or baseline monitoring occurred in Spring 2001 prior to project initiation. Post-disposal monitoring occurs semi-annually in the spring and fall following sand replenishment activities, through Spring 2005. Spring and fall sampling is ideal because it will coincide with the natural onshore and offshore movement of sand.

RESULTS

During the development of the monitoring plan, it was thought that having replicate monitoring locations would provide a more robust and powerful experimental design; however, the surveys have documented that there is a high amount of variability in measured factors. Therefore, the data are being presented at the monitoring location level (e.g., SW-SS-2) instead of at the site level (e.g., Swamis). This will provide more detail and insight to spatial differences within a given area.

Percent cover data of the different substrata are reported in the Shallow Subtidal Monitoring Report and therefore are not repeated here unless large changes in sand cover were documented. Since the loss of rocky substrate may potentially affect lobster recruitment and habitat, only those sites with significant sand fluxes were restated in this report. For example, a large decrease in the percent cover of sand was documented in Fall 2001 at BL-SS-2, ML-SS-1, SW-SS-1, and SW-SS-2 followed by a large increase in Spring 2002.

NORTH CARLSBAD

At North Carlsbad, sediment transport models suggested that the sand would be transported downcoast towards the jetty at the entrance to Agua Hedionda Lagoon. The monitoring locations were placed on hard substrate directly offshore of the receiver site (NC-SS-1) and downcoast of the receiver site (NC-SS-2 and 3) (Figure 1).

Lobster

At North Carlsbad, no lobsters were observed in Spring 2001 at all three monitoring locations, however, lobsters were present in Fall 2001 at both NC-SS-1 (2.0 per 100 m$^2$) and NC-SS-3 (1.2 per 100 m$^2$) (Figure 6). During Spring 2002, there was a similar abundance of lobsters at all three monitoring locations.
SOUTH CARLSBAD

Only one monitoring location (SC-SS-1) was established at South Carlsbad within the vicinity of the receiver site. The monitoring location was placed at the closest reef area downcoast of the receiver site (Figure 2).

Lobster

Lobster abundance at SC-SS-1 was low (between 0.8 and 1.2 lobsters per 100 m²) and relatively consistent throughout the sampling period (Figure 7).

BATIQUITOS/LEUCADIA

The Batiquitos and Leucadia receiver sites were located in close proximity to one another. The nearshore region offshore of these receiver sites contains a large area of low-relief substrate, with patchy high-relief substrate. Sediment transport models suggested that sand from Batiquitos would be transported directly offshore of the receiver site. One monitoring location (BL-SS-1) was placed on hard substrate directly offshore and downcoast of the Batiquitos receiver site, and the other two monitoring locations were established offshore (BL-SS-2) and downcoast (BL-SS-3) of the Leucadia receiver site (Figure 3).

Substrate

BL-SS-2 exhibited a large fluctuation in the percent cover of sand (Figure 8). The percent cover of sand was 65.2% in Spring 2001, decreased to near zero in Fall 2001, and increased to 48.7% in Spring 2002. The decrease in sand in Fall 2001 corresponded to an increase in cover of low and high-relief substrate. Interestingly enough, values observed in Spring 2002 were similar to values observed in Spring 2001 suggesting that seasonal sand transport is very evident at BL-SS-2 (i.e., offshore during the winter period and onshore during the summer period).

Lobster

Abundance of lobsters at BL-SS-1 exhibited an increasing trend with low abundance in Spring 2001 (1.2 per 100 m²) to higher abundance in Spring 2002 (4.6 per 100 m²). Lobsters were not observed at BL-SS-2 during Fall 2001, but did have 0.8 per 100 m² during Spring 2001 and 1.0 per 100 m² in Spring 2002. Regarding the decrease in sand cover (and corresponding increase in rocky habitat) at BL-SS-2 in Fall 2001, lobster were not observed during the survey. Abundance of lobster remained stable at BL-SS-3 with values ranging from 0.2 to 0.6 per 100 m² (mean = 0.4 per 100 m²) (Figure 9).

MOONLIGHT BEACH

Only one monitoring location (ML-SS-1) was established within the vicinity of the receiver site at Moonlight Beach. The monitoring location was placed at the closest reef area slightly upcoast of the receiver site as sediment transport modeling suggested that the sand may migrate upcoast and offshore (Figure 4).
Substrate

At ML-SS-1, there appeared to be a decline in sand coverage in Fall 2001, although values present during both spring surveys were similar with 33.4% cover in Spring 2001 and 32.1% cover in Spring 2002 (Figure 10).

Lobster

At ML-SS-1, the lowest abundance of lobsters was observed in Spring 2001 (0.2 per 100 m²), while the highest value was observed in the Fall 2001 (2.6 per 100 m²) (Figure 11). In Spring 2002, the mean number of lobster was 1.8 per 100 m², a value in between the other survey results. Unlike BL-SS-2, lobster abundance was highest at ML-SS-1 during Fall 2001, when the lowest percentage of sand cover was recorded. This could support the idea that the absence of sand provides more low and/or high-relief substrate for lobster.

Swamis (Control)

The monitoring locations at Swamis are considered control sites implying that this area will be unaffected by any replenishment activities. The monitoring locations were distributed on the upcoast and downcoast edges and in the center of the reef (Figure 4).

Substrate

Both SW-SS-1 and SW-SS-2 displayed similar patterns as BL-SS-2 and ML-SS-1, with a large decrease in the percent cover of sand in Fall 2001 (Figure 12). At SW-SS-1, the percent cover of sand was 76.3% in Spring 2001, 0.0% in Fall 2001, and 95% in Spring 2002. While at SW-SS-2, the percent cover of sand was 64.43% in Spring 2001, 8.8% in Fall 2001, and 55% in Spring 2002. The decrease in sand corresponded to an increase in low-relief reef and to a lesser degree, high-relief reef. At SW-SS-1, low-relief reef increased from 23.3% in Spring 2001 to 80.0% in Fall 2001, while at SW-SS-2, low-relief reef increased from 35.6% in Spring 2001 to 87.2% in Fall 2001. This further supports the concept of seasonal sand transport as this occurred prior to any beach replenishment activities.

Lobster

Lobsters were not recorded at any of the monitoring locations at Swamis during Spring 2001 (Figure 13). Both SW-SS-1 and SW-SS-2 had an increase in lobster densities in Fall 2001 with 2.0 per 100 m² and 1.4 per 100 m², respectively. Lobster abundance at both sites declined slightly in Spring 2002. This further supports the idea that a decrease in sand cover increases the amount of suitable lobster habitat. Lobster abundance at SW-SS-3 displayed a stable pattern with relatively low densities of 0.6 per 100 m² from Spring 2001 to Fall 2002.
CARDIFF

Only one monitoring location (CF-SS-1) was established at Cardiff within the vicinity of the receiver site. The monitoring location was placed at the closest reef area slightly upcoast of the receiver site as sediment transport modeling suggested that the sand may migrate upcoast and offshore (Figure 4).

Substrate

The percent cover of sand at CF-SS-1 revealed an opposite trend to BL-SS-2, SW-SS-1, SW-SS-2, and ML-SS-1 as it increased in Fall 2001. Percent cover of sand was 3.0% in Spring 2001, increased to 75.9% in Fall 2001, and decreased to 29.3% in Spring 2002. This corresponded to a decrease in low-relief reef in Fall 2001, from 60.0% in Spring 2001 to 17.5% in Fall 2001. The percent cover of low-relief reef increased again in Spring 2002 to a level similar to the previous year (54.9%). The percent cover of high-relief reef remained similar throughout the surveys ranging from 6.7% in Fall 2001 to 15.3% in Spring 2002.

Lobster

At CF-SS-1, lobsters were only recorded during the Spring 2002 survey and the density was very low (0.4 per 100 m²) (Figure 14).

CARDIFF (CONTROL)

The monitoring locations at Cardiff (Seaside Reef) are considered control sites implying that this area will be unaffected by any replenishment activities. The monitoring locations were distributed on the upcoast and downcoast edges and in the center of the reef (Figure 5).

Lobster

Lobster abundance at all three monitoring locations increased over time (Figure 15). At CC-SS-1, the mean number of lobster was 0.2 per 100 m² in Spring 2001, 3.0 per 100 m² in Fall 2001, and 5.8 per 100 m² in Spring 2002. The abundance of lobster at CC-SS-2 was lower than the other sites, with no lobsters recorded in Spring 2001, 0.6 per 100 m² in Fall 2001, and 2.4 per 100 m² Spring 2002. While at CC-SS-3, the mean number of lobster was 0.6 per 100 m² in Spring 2001, 1.6 per 100 m² in Fall 2001, and 2.6 per 100 m² in Spring 2002.

SOLANA BEACH

At Solana Beach, sediment transport models suggested that the sand would be transported upcoast towards the reefs at Cardiff (Seaside Reef). One monitoring location was placed on available hard substrate upcoast of the receiver site (SB-SS-1), while the other two monitoring locations were established downcoast of the receiver site (SB-SS-2 and SB-SS-3) (Figure 5).
Lobster abundance at all three monitoring locations increased over time (Figure 16). The abundance of lobster at SB-SS-1 was lower than the other sites, with no lobsters recorded in Spring 2001 or Fall 2001, and 1.8 per 100 m² in Spring 2002. At SB-SS-2, no lobsters were recorded in Spring 2001, and then 1.0 per 100 m² in Fall 2001, and 2.4 per 100 m² in Spring 2002. While the highest abundance of lobster was recorded at SB-SS-3, with the mean number of 2.6 per 100 m² in Fall 2001, and 5.8 per 100 m² in Spring 2002.

DISCUSSION

The objective of monitoring lobster abundance in the shallow subtidal reef area is to evaluate whether beach replenishment has any significant, long-term adverse impacts to an important fishery located in the vicinity of the beach replenishment sites. This report documents results of an on-going monitoring program scheduled through Spring 2005, and discusses preliminary results since completion of the RBSP.

In the shallow subtidal zone, sand movement influences substrate type and the presence of associated biota. In areas where sand is constantly shifting, either moving on or offshore, or longshore, the presence of low- and high-relief substrate will vary. The loss of sand will expose previously covered rocky substrate creating habitat. Conversely, the influx of large amounts of sand can potentially cover these rocky areas. At all the study sites, the rocky areas are not continuous, but rather separated by sand channels that generally extend perpendicular from shore. These sand channels are created by constant scouring, provide avenues for sand movement, and can decrease the likelihood of impacts from scour or burial on the reef tops. Large fluctuations in sand cover observed at several sites (e.g., BL-SS-2, ML-SS-1, SW-SS-1, SW-SS-2) suggest that seasonal transport does occur. However, the increases in sand cover since completion of the RBSP (Spring 2002) are similar in magnitude to observations prior to implementation of the RBSP suggesting that this may be natural fluctuation.

It is apparent that observations and data from this monitoring can not accurately determine whether the change in habitat availability has impacted the lobster population. Reasons are that seasonal transport of sand (nearshore to offshore and vice versa) is not fully displayed within this time frame, as well as abundance counts did not determine size classes of organisms (i.e., short lobster by Fish and Game standards). At a few of the monitoring locations (ML-SS-1, SW-SS-1, SW-SS-2) results could suggest that the absence of sand during Fall 2001 increased habitat therefore increasing lobster abundance. Although this was not true for BL-SS-2, and in addition there was not significant changes in the overall lobster population at the three sites mentioned above. It has been noted that lobsters will migrate during certain seasons as well as during certain weather conditions. It is not known if juvenile lobsters preferentially recruit and remain in the nearshore area and the current sampling design is not capable of documenting this concept.

Therefore, we will incorporate another sampling technique to be implemented in Fall 2002. After discussions with John Guth, president of the CLTFA, AMEC will attempt to target juvenile (sub-legal) lobsters within the monitoring locations. It is believed that juvenile lobsters are primarily found in the shallow subtidal areas. It is the juveniles that are of most concern to
sustain a future for the lobster fishery. The California Department of Fish and Game has granted a permit to deploy custom-made 1” mesh traps. The traps, having smaller mesh then the regulation 2” mesh traps will retain juvenile lobsters as well as adults. Quarterly surveys will be conducted at selected receiver sites to potentially document the distribution and abundance of the different size classes. The sampling will help to determine if there is a direct correlation between availability of suitable habitat (given temporal variations in sand cover) and lobster recruitment.
LITERATURE CITED


FIGURES
North Carlsbad Beach Replenishment Monitoring Sites

**Figure**

**North Carlsbad Beach Replenishment Monitoring Sites**

**Legend**
- SAND
- LOW RELIEF SCATTERED REEF
- HIGH RELIEF REEF
- Historical Maximum Kelp Bed Canopies 1978 to 1996
- Kelp Bed Canopy 1997
- Hard Substrate
- Receiver Site
- Modeled Deposition Area
- Monitoring Location

**North Carlsbad Receiver Site**

**Oceanside Receiver Site**

NET/TONGA/ROTA/BEACH/PILOTS/FIGURES/MONITOR2001.AML 08/23/01
Figure 6. Number of lobster at North Carlsbad.

Figure 7. Number of lobster at South Carlsbad.
Figure 8. Percent cover of three substrate types at BL-SS-2.

Figure 9. Number of lobster Batiquitos/Leucadia.
Figure 10. Percent cover of three substrate types at ML-SS-1.

Figure 11. Number of lobster at Moonlight Beach.
Figure 12. Percent cover of three substrate types at SW-SS-1 and SW-SS-2.
Figure 13. Number of lobster at Swamis.

Figure 14. Percent cover of three substrate types at CF-SS-1.
Figure 15. Number of lobster at Cardiff.

Figure 16. Number of lobster at Cardiff (Control).
Figure 17. Number of lobster at Solana Beach.