BROAD BEACH JUNE INTERTIDAL SAMPLING FOR THE BROAD BEACH SHORE PROTECTION PROJECT LOS ANGELES COUNTY, CALIFORNIA

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SECTION 1.0 – INTRODUCTION

Broad Beach is located in the City of Malibu in the northwestern portion of Los Angeles County (Figure 1). Since the 1970s, Broad Beach has gradually narrowed, exposing beachfront property to flooding and damage during winter storms and high tides (Moffatt & Nichol 2012). The public benefit of the historically wide beach also has diminished. In Broad Beach's current condition, only a narrow strip of sand to walk on at low tide is available to recreational users. In 2009, Broad Beach property owners hired Moffatt & Nichol to provide technical assistance in developing a long- term solution to restore the beach to its 1970s beach width and restore its former dune system. In 2010 severe winter storms threatened beachfront structures; and an emergency temporary revetment was constructed to protect residences, including septic systems and leach fields located seaward of the houses. The revetment was completed in the spring of 2010 and has provided temporary shore protection until a long-term restoration project can be implemented.

The purpose of the Broad Beach Restoration Project is to design, permit, and implement a long-term shoreline restoration program that balances erosion control, property protection, improved recreation and public access opportunities, aesthetics, and environmental stewardship (Moffatt & Nichol 2012). The proposed project would include validation and permitting of the existing emergency revetment, beach nourishment, and sand dune restoration. If approved, the revetment would remain in place and would be buried beneath a new system of sand dunes located at the landward edge of the widened, nourished beach. The revetment would serve as a last line of defense against future severe erosion during extreme storm events. The proposed project would place 600,000 cubic yards of sand on Broad Beach to create a wide, sandy beach backed by a system of sand dunes. The sand for beach nourishment would come from one or more inland stockpiles near Moorpark. The project also includes future efforts to maintain the enlarged beach, including annual or biennial backpassing of sand from the wider eastern reach to the narrower western reach of Broad Beach and one additional major renourishment event estimated to occur 10 years after completion of the initial nourishment.

Marine resources at Broad Beach include rocky intertidal habitat with surfgrass in the low intertidal, intertidal, and subtidal sand habitat and offshore kelp and eelgrass beds. These resources were previously described in *A Survey of Marine Biological Resources of Broad Beach, Malibu, California* (Chambers Group 2012a). That report also included an analysis of potential impacts of the Broad Beach Shore Protection Project on those resources. In October 2012, Chambers Group, Inc. (Chambers Group) sampled the intertidal biological communities at Broad Beach to obtain baseline information on intertidal organisms that may be affected by the Broad Beach Shore Protection Project. Chambers Group also conducted similar intertidal surveys at El Matador State Beach, upcoast of Broad Beach, as a control site (Chambers Group 2012b). To obtain information on intertidal resources under summer conditions, Chambers Group sampled the intertidal at Broad Beach and El Matador State Beach in June 2013. In addition, a downcoast sandy beach control site was added at the southeastern portion of Zuma Beach. This report discusses the June surveys.

Figure 1
Project Location

Chambers Group Inc.

Image Source

Sand and Invertebrate Transects

Kelp Survey 2009

N W E S

0 280 560 1,120

1:7,000 Feet

Figure 2
Location of Sampling Areas
Broad Beach

20252
Figure 4 Location of Sampling Areas.mxd
Version Date: 12/19/2012

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Sand and Invertebrate Transects

Kelp Survey 2009

N
W E
S

0 80 160 320

1:2,000 Feet

Figure 3
Location of Sampling Areas
El Matador State Beach

20252
Figure 5 Location of Sampling Areas.mxd
Version Date: 12/19/2012

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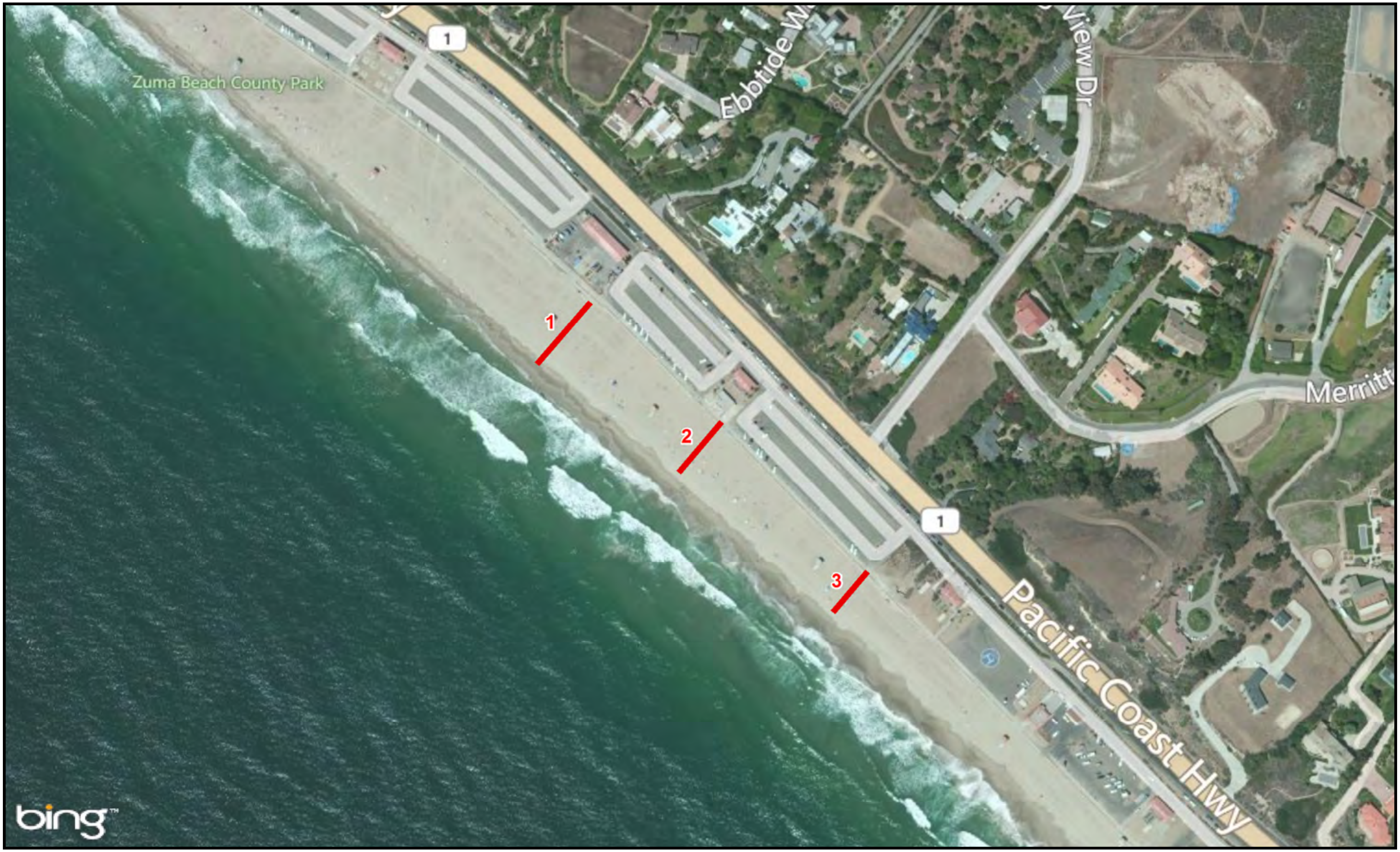

Sand and Invertebrate Transects

N
W E
S

0 160 320 640
1:4,000 Feet

Figure 4
Location of Sampling Areas
Zuma Beach

20252
20252 Figure 4 Location of Sampling Areas at Zuma Beach.mxd
Version Date: 7/29/2013

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SECTION 2.0 – METHODOLOGY

The Broad Beach intertidal was sampled on June 25, 2013, between 0530 and 1000. The tides were a low tide of -1.5 feet at 0540 and a high tide of 4.5 feet at 1210. The survey team consisted of Noel Davis (boulder field), Rick Ware of Coastal Resources Management (rocky intertidal), Steve Whitaker (rocky intertidal), Sean Vogt (boulder field), Mike Anghera (sand invertebrates, swash zone), Lisa Louie (sand invertebrates), and Corey Vane (birds, swash zone).

The rocky intertidal habitat in Lechuza Cove was surveyed by Rick Ware and Steve Whitaker. Figure 2 shows the location of the Lechuza Cove rocky intertidal. At each tidal level (high, mid, low) a 10-meter belt transect was laid out parallel to shore. Percent cover of substrate type was determined by using the line intercept method. At each meter on the line, the substrate type was scored. The percentage of each substrate type was determined by dividing the number of hits by the number of points. In addition, large, relatively uncommon organisms such as sea stars were counted within 1 meter of either side of the belt transect. One point on each transect was chosen by a random numbers table. At each of these points, the corner of a 0.25-square-meter quadrat was placed. The quadrat had a grid with 49 points. The number of points that touched each of a list of indicator organisms (Table 1) was scored. Percent cover of each indicator organism was determined by dividing the number of hits by 49. Four quadrats were sampled at each point for a total of 1 square meter at each point or 1 square meter for each transect. Two belt transects were done at each tidal level. The number of belt transects was limited by the amount of time that could be spent at each tidal level, so that the low intertidal was sampled during the lowest point in the tide, and the biologists were able to finish before the high tide washed onto the revetment.

Table 1: Quadrat Scoring Data Sheet

Quadrat Scoring Data Sheet										
Site:		**Sampling Season:**				**Date Sampled:**				
Person Scoring:		**Event Number:**				**Date Scored:**				
Recorder:						**Where Scored:**				
Assemblage										
Plot Number										
Bare Rock										
Sand										
Balanus/Chthamalus										
Other Barnacles										
Tetraclita rubescens										
Endocladia muricata										
Hesperophycus calif.										
Silvetia compressa										
Mytilus californianus										
Chondracanthus canalic.										
Gelidium/Pterocladiella										
Pollicipes polymerus										
Other Brown Algae										
Cladophora columbiana										
Coralline Crusts										
Endarachne/Petalonia										
Articulated Corallines										
Other Green Algae										
Mastocarpus papillatus										
Mazzaella affinis										
Non-Coralline Crust										
Porphyra spp.										
Other Red Algae										
Ulva/Enteromorpha										
Anthopleura spp.										
Chiton										
Limpet										
Lottia gigantea										
Other Invertebrate										
Phragmatopoma calif.										
Pisaster ochraceus										
Septifer/Brachydontes										
Tar										
Phyllospadix spp.										
Unidentified										
Unscorable										

Core Species in **Bold** must be scored if present. ***Egregia menziesii, Eisenia arborea, Gelidium/Pterocladiella, Halydrys/Cystoseira, Sargassum muticum, Scytosiphon sp***. Supplemental species in *italics* to be scored if present: *Gelidium spp.*, ***Fucus gardneri, Pelvetiopsis limitata, Postelsia palmeformis***

The boulder field downcoast from Lechuza Cove was sampled by Noel Davis and Sean Vogt. Figure 2 shows the location of the boulder field. The sampling methods were similar to those for Lechuza Cove. Because the boulder field had fewer rocky intertidal organisms, it was possible to do four 10-meter belt transects at each tidal level. Only one random point for quadrats was done on each belt transect for a total of sixteen 0.25-square-meter quadrats at each tidal level.

Three transects were established for the sandy beach invertebrate sampling. The transect locations were spaced to be representative of the sandy beach at Broad Beach. Figure 2 shows the sandy beach transect locations. The core samples were taken by Mike Anghera. On each transect a set of five replicate 10 centimeter (cm) diameter by 10 cm deep, handheld, sediment core samples were taken in the high, mid, and low intertidal. The high intertidal samples were taken at either the edge of the revetment or seawall. The mid intertidal samples were taken between the revetment and the water's edge. The low intertidal samples were taken between 0530 and 0640 when the tide was near its predicted low of -1.5 feet. Lisa Louie processed the samples on the beach by passing the materials through a 1-millimeter sieve. Materials retained on the sieve were fixed in a formaldehyde solution. Samples were processed under the direction of Tom Gerlinger. In the laboratory each sample was transferred to an alcohol solution. Organisms were separated from the debris, and each organism was identified to the lowest possible taxonomic level.

Swash zone samples were taken to collect larger sandy intertidal invertebrates that might not be well represented in the cores. The swash zone samples were taken by Mike Anghera and Corey Vane. The samples were collected at the water's edge at low tide. For each sample a 0.25-square-meter quadrat was excavated to a depth of about 18 inches. The sand was placed in a box sieve with 6-millimeter mesh. The organisms collected on the sieve were identified and returned to the ocean. Five swash zone samples were taken on each transect.

Corey Vane did the bird transects. He walked the length of Broad Beach from Lechuza Point to Trancas Creek and counted all marine birds that he saw on the beach. He also noted whether they were roosting or foraging. The bird transect at Broad Beach was done between 0720 and 0845.

El Matador State Beach, approximately 4,000 feet west of Broad Beach, was selected as a control site. El Matador was selected because it is close to Broad Beach and it is a bluff-backed beach that appears to have experienced erosion. Furthermore, it is a natural beach with no revetments or sea walls and thus provides a tool for separating changes caused by natural processes from the impacts of actions taken in the Broad Beach Shore Protection program. El Matador State Beach has more rocky habitat than Broad Beach, but El Matador State Beach does have areas of sandy intertidal. El Matador State Beach was sampled on June 26, 2013, between 0545 and 1030 by the same personnel who sampled Broad Beach. Rick Ware and Steve Whitaker did the rocky intertidal sampling. Noel Davis, Mike Anghera, Sean Voigt, and Lisa Louie did the sandy intertidal sampling. Corey Vane did the bird survey between 0615 and 0740. The tides were a low tide of -1.1 feet at 0630 and a high tide of 4.6 feet at 1300. El Matador State Beach has no boulder field; therefore, only the rocky intertidal was sampled. At El Matador State Beach, two belt transects were sampled at each tidal level, except three were done in the lower intertidal. Four 0.25-square-meter quadrats were done on each belt transect. Figure 3 shows the location of the rocky intertidal that was sampled. Because there were only two short areas of sandy beach, only two sandy intertidal transects were done. Figure 3 shows the location of the sandy intertidal transects.

Zuma Beach was sampled on June 27, 2013, between 0630 and 0930. Zuma Beach was not sampled in October, 2012, but was added as a downcoast control site for sandy intertidal organisms. The survey team at Zuma Beach was Noel Davis, Mike Anghera, Lisa Louie, and Corey Vane. Three transects were established at the downcoast end of Zuma Beach. Figure 4 shows the location of the Zuma Beach transects. The low intertidal samples and swash zone samples were taken at the water line during low tide. The high intertidal samples were taken at the wrack line left by the previous night's high tides. The mid intertidal samples were taken halfway between the low and high intertidal samples. The bird survey was done between 0805 and 0910. The tides on June 27 were a low of -0.6 feet at 0715 and a high of 4.7 feet at 1352.

SECTION 3.0 – RESULTS

3.1 OVERALL CONDITIONS OF BROAD BEACH, EL MATADOR STATE BEACH, AND ZUMA BEACH

The beach at Broad Beach was narrow at the time of the June 2013 survey. No wrack was observed during the survey. Drift kelp, carried in by the day's tide, was observed at the mid and low tide levels. This drift would be expected to be carried back into the ocean during the next high tide series. Figure 5 shows the western end of Broad Beach on June 25. The picture, taken from the boulder field at low tide, shows the narrow width of the beach and the lack of wrack on the upper beach. The survey was done in the early morning when few people were on the beach.

The beach at El Matador State Beach also was narrow at the time of the June survey. Along much of the beach, the high tide had reached the bluffs; however, wrack was deposited in coves along the bluff face (Figure 6). No beachgoers were present on El Matador State Beach during the survey because the parking lot does not open until 0800.

Zuma Beach is a wide sand beach. On June 27, a berm marked the edge of wave runup. Figure 7 shows the wrack line at the top of the berm. The gates at Zuma Beach open at 0600, and scattered beachgoers and surfers were present during the June 27 survey.

Figure 5: Low Tide at Broad Beach, June 2013

Figure 6: Wrack in El Matador High Intertidal

Figure 7: Berm and Wrack Line at Zuma Beach

3.2 ROCKY INTERTIDAL SAMPLING

3.2.1 Broad Beach

Lechuza Cove

Table 2 shows the substrate type as determined by the point intercept method on the belt transects.

Table 2: Percentage of Each Substrate Type on Lechuza Cove 10 Meter Belt Transects

Substrate Type	Low Intertidal			Mid Intertidal			High Intertidal		
	Rep 1	Rep2	Mean	Rep 1	Rep2	Mean	Rep 1	Rep2	Mean
Cobble	18.2	9.1	13.7	9.1	27.3	18.2	13.6	22.7	18.2
Boulder	9.1	50.0	29.6	45.5	45.5	45.5	86.4	68.2	77.3
Bedrock	27.3	9.1	18.2	0	0	0	0	0	0
Sand	27.3	31.8	29.6	45.5	36.4	41.0	0	9.1	4.6
Red algal turf	18.2	0	9.1	0	0	0	0	0	0
Phyllospadix	12.7	16.4	14.6	0	0	0	0	0	0
Egregia	1.8	0.4	1.1	0	0	0	0	0	0

Most of the bedrock was covered by a thin (0.5 to 1 cm) layer of sand, and the low intertidal had some deeper sand pockets. Figure 8 shows the low intertidal at Lechuza Cove in June 2013. Figure 9 shows the high intertidal. Compared to October 2012 more sand was observed in the low and mid intertidal but less sand in the high intertidal. In October 2012 sand cover was 10 percent in the low intertidal compared to 29.6 percent in June 2013 and 15 percent in the mid intertidal compared to 45.5 percent in June. In the high intertidal, by contrast, sand cover was 15 percent in October 2012 compared to 4.6 percent in June 2013. In addition, more surfgrass was recorded in June 2013 compared to October 2012. The greater amount of surfgrass may be because the tide was lower in June (-1.5 feet) than in October (-0.8 feet). Surfgrass is a species of the low intertidal to shallow subtidal.

Table 3 shows the density of large organisms counted on the belt transects. In the low intertidal, one kelp crab (*Pugettia product)* and one cancer crab (*Cancer antennarius*) were recorded on the transects. The mid intertidal supported striped shore crabs (*Pachygrapsus crassipes*) and ochre sea stars (*Pisaster ochraceus*). In addition, the mid intertidal was characterized by substantial numbers of aggregate anemones (*Anthopleura elegantissima*) and solitary anemones (*A. sola*). One striped shore crab was counted in the high intertidal. The high intertidal also was characterized by large numbers of black turban snails (*Tegula funebralis*) as well as hermit crabs (*Pagurus samuelis*).

Figure 8: Low Intertidal at Lechuza Cove, June 2013

Figure 9: High Intertidal in Lechuza Cove, June 2013

Table 3: Large Organisms (#/m2) on Lechuza Cove 10-Meter Belt Transects

Organism	Low Intertidal			Mid Intertidal			High Intertidal		
	Rep 1	Rep2	Mean	Rep 1	Rep2	Mean	Rep 1	Rep2	Mean
Pugettia producta	0	0.05	0.03	0	0	0	0	0	0
Cancer antennarius	0	0.05	0.03	0	0	0	0	0	0
Pachygrapsus crassipes	0	0	0	0	0.05	0.03	0.25	0	0.13
Pisaster ochraceus	0	0	0	0.25	0	0.13	0	0	0

Table 4 shows the results of the quadrat samples in the Lechuza Cove rocky intertidal.

Table 4: Percent Cover of Indicators in Lechuza Cove 0.25-Square-Meter Quadrats

QUADRAT SAMPLES IN LECHUZA COVER ROCKY INTERTIDAL									
HIGH INTERTIDAL									
Indicator	**Replicate**								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**MEAN**
Bare rock	18.4	22.4	8.2	20.4	42.9	61.2	45.0	51.0	33.7
Sand	0	0	4.1	0	0	0	2	6.1	1.5
Balanus/Chthamalus	69.4	2.0	0	40.8	45.0	22.4	26.5	28.6	29.3
Other red algae	10.2	16.3	45.0	10.2	4.1	6.1	18.4	14.3	15.6
Ulva/Enteromorpha	2.0	59.2	42.9	28.6	4.1	8.2	8.2	0	19.1
Anthopleura spp.	0	0	0	0	4.1	2.0	0	0	0.8
MID INTERTIDAL									
Indicator	**Replicate**								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**MEAN**
Bare rock	8.2	16.3	4.1	6.1	4.1	0	0	14.3	6.64
Sand	0	0	4.1	4.1	0	0	0	0	1.03
Balanus/Chthamalus	0	0	0	0	8.2	0	2.0	8.2	2.3
Enarachne/Petalona	0	0	0	0	0	0	0	6.1	0.76
Other red algae	83.7	55.1	83.7	77.6	18.4	79.6	59.2	14.3	58.95
Ulva/Enteromorpha	8.2	8.2	8.2	6.1	53.1	4.1	30.6	20.4	17.36
Articulated corallines	0	0	0	0	2.0	0	0	4.1	0.76
Anthopleura spp.	0	0	0	0	4.1	12.2	8.2	30.6	6.89
Other brown algae	0	20.4	0	6.1	4.1	4.1	0	0	4.34
Diatom	0	0	0	0	6.1	2.0	0	2.0	1.26

Table 4: Percent Cover of Indicators in Lechuza Cove 0.25-Square-Meter Quadrats

QUADRAT SAMPLES IN LECHUZA COVER ROCKY INTERTIDAL									
				LOW INTERTIDAL					
Indicator	**Replicate**								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Mean**
Bare rock	0	0	4.1	0	4.1	2.0	0	2.0	1.53
Sand	10.2	4.1	4.1	2.0	6.1	8.2	0	0	4.34
Phyllospadix	0	0	0	0	10.2	14.3	8.2	12.2	5.61
Articulated corallines	0	0	0	2.0	0	0	0	0	0.25
Other red algae	87.8	85.7	90.0	75.5	69.4	49.0	38.8	12.2	63.55
Ulva/Enteromorpha	2.0	10.2	2.0	20.4	0	2.0	0	0	4.58
Egregia	0	0	0	0	10.2	24.5	53.1	73.5	20.16

As was true in October 2012, bare rock and the barnacles *Chthamalus* and *Balanus* accounted for most of the percent cover in the high intertidal in June 2013; however, less bare rock (33.7 percent in June compared to 50.25 percent in October) was present and more other red algae and *Ulva/Enteromorpha* in June compared to October (15.6 and 19.1 percent respectively in June compared to 7.9 and 6.4 percent in October). In addition, sand cover in the high intertidal was less (1.5 percent) in June compared to October (4.8 percent).

In the mid intertidal, red algae accounted for most of the cover (59 percent). Red algae cover in June 2013 was similar to October 2012 when red algae accounted for 59.4 percent of the cover in the mid intertidal. Red algae that were abundant in the mid intertidal in June included *Gracilaria andersonii* and *Polysiphonia/Ceramium* sp. Bare rock decreased in June compared to October (6.6 percent in June compared to 17.1 percent in October). *Ulva/Enteromorpha* increased in June compared to October (17.4 in June compared to 10.2 in October). Sand, which did not occur in the quadrats in October, accounted for 1 percent cover in June.

In the low intertidal red algae (63.6 percent) and the feather boa kelp *Egregia menziesii* (20.2 percent) were dominant. Red algae and *Egregia* were also the dominant cover types in October 2012, but red algae cover (47.7 percent) was lower and *Egregia* cover higher in October compared to June. Red algae in the low intertidal in June included *Gracilaria andersoni* and *Sarcodiotheca furcata*. Bare rock decreased in June compared to October (1.5 percent in June compared to 3.8 percent in October), and sand increased (4.3 percent in June compared to 0 in October). Another noticeable difference was that surfgrass, which was not scored in the October quadrats, accounted for 5.6 percent of the cover in the June quadrats.

Figure 10 shows the boulder field on June 25, 2013. Table 5 shows the percent substrate type as determined by the point intercept method on the belt transects in the boulder field.

Figure 10: Broad Beach Boulder Field, June 2013

Table 5: Percentage of Each Substrate Type on Broad Beach Boulder Field 10-Meter Belt Transects

Percentage of Each Substrate Type on Broad Beach Boulder Field 10-Meter Transect					
HIGH					
	Rep 1	**Rep2**	**Rep 3**	**Rep 4**	**Mean**
Boulder	81.8	77.3	77.3	81.8	79.6
Sand	9.1	13.6	4.5	4.5	7.9
Porphyra	9.1	4.5	0	0	3.4
Green algae	0	0	4.5	4.5	2.3
Invertebrate (*Chthamalus*)	0	4.5	13.6	9.1	6.8
MID					
	Rep 1	**Rep2**	**Rep 3**	**Rep 4**	**Mean**
Sand	86.4	81.8	54.5	59.1	70.5
Invertebrate (*Anthopleura*)	9.1	0	4.5	13.6	6.8
Egregia	0	9.1	27.3	9.1	11.4
Fleshy red algae	4.5	0	4.5	4.5	3.4
Green algae	0	9.1	9.1	13.6	8.0
LOW					
	Rep 1	**Rep2**	**Rep 3**	**Rep 4**	**Mean**
Sand	40.9	59.1	27.3	63.6	47.7
Red algae turf	0	0	4.5	0	1.1
Egregia	0	0	45.5	4.5	12.5
Fleshy red algae	50.0	40.9	22.7	27.2	35.2
Phyllospadix	9.1	0	0	4.5	3.4

In October 2012, most of the boulder field was covered with a thin layer of sand. Sand also was one of the most pervasive cover types in June 2013, but less sand inundation was observed compared to October. In the high intertidal boulders accounted for 79.6 percent of the cover on the belt transects in June compared to 18.8 percent in October. Sand in the high intertidal in June was only 7.9 percent compared to 58.8 percent in October. The red alga *Porphyra* accounted for 3.4 percent of the cover on the belt transects in June but was not recorded in October. In the low and mid intertidal, sand was the dominant substrate type in June; but sand cover was less than in October. In the mid intertidal, sand cover was 70.5 percent in June compared to 86.3 percent in October. In the low intertidal, sand cover was 47.7 percent in June compared to 51.3 percent in October. The feather boa kelp *Egregia* accounted for 11.4 percent of cover in the mid intertidal in June and 12.5 percent in the low intertidal compared to 8.8 and 36.3 percent respectively in October. Red algae increased in the low intertidal in June (35.2 percent) compared to October (7.5 percent). Surfgrass percent cover in the low intertidal in June was 3.4 percent, which was similar to the 3.8 percent recorded for surfgrass in October.

A total of 18 ochre sea stars (*Pisaster ochraceus)* was counted on the 4 belt transects for a mean density of 0.23 per square meter. In the low intertidal, eight ochre sea stars were counted on the four belt transects for a mean density of 0.1 per square meter. In addition, one giant spined sea star (*P. giganteus*) was recorded in the low intertidal.

Table 6 shows the results of the quadrat samples in the Broad Beach boulder field.

Table 6: Percent Cover of Indicators in Broad Beach Boulder Field 0.25-Square-Meter Quadrats

Percent Cover of Indicators in Broad Beach Boulder Field 0.25-Square-Meter Quadrats																	
	HIGH INTERTIDAL																
Indicator	**Replicate**																
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**Mean**
Bare rock	20.4	65.3	18.4	36.7	89.8	98.0	89.8	79.6	40.8	93.9	67.3	42.9	95.9	87.8	100	75.5	68.9
Sand	79.6	28.6	79.6	63.3	0	0	4.1	0	0	0	0	10.2	0	0	0	0	16.6
Balanus/ Chthamalus	0	0	0	0	2.0	0	0	6.1	0	0	14.3	12.2	4.1	0	0	22.4	3.8
Ulva/ Enteromorpha	0	0	0	0	0	0	0	0	40.8	0	6.1	4.1	0	10.2	0	0	3.8
Porphyra	0	0	0	0	0	0	0	4.1	6.1	0	0	14.3	0	0	0	0	1.5
Limpet	0	4.1	0	0	2.0	0	2.0	2.0	0	0	0	0	0	0	0	0	0.6
Anthopleura	0	0	0	0	2.0	2.0	4.1	8.2	0	0	6.1	0	0	0	0	0	1.0
Other invertebrate	0	2.0	2.0	0	4.1	0	0	0	12.2	6.2	6.1	16.3	0	2.0	0	2.0	3.3
	MID INTERTIDAL																
Indicator	**Replicate**																
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**Mean**
Bare Rock	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.1	0	0.4
Sand	100	100	100	100	69.4	49.0	46.9	61.2	4.1	20.4	40.8	22.4	98.0	95.9	55.1	93.9	66.1
Egregia	0	0	0	0	14.3	14.3	16.3	6.1	95.9	67.3	32.6	73.5	0	0	0	0	20.0
Ulva/ Enteromorpha	0	0	0	0	14.3	8.2	10.2	30.6	0	8.2	6.1	2.0	0	2.0	16.3	4.1	6.4
Other red algae	0	0	0	0	2.0	26.5	22.4	2.0	0	4.1	12.2	0	2.0	2.0	6.1	0	5.0
Anthopleura	0	0	0	0	0	2.0	4.1	0	0	0	8.2	2.0	0	0	12.2	2.0	1.9
Other invertebrate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4.1	0	0.3

Table 6: Percent Cover of Indicators in Broad Beach Boulder Field 0.25-Square-Meter Quadrats

Percent Cover of Indicators in Broad Beach Boulder Field 0.25-Square-Meter Quadrats																	
	LOW INTERTIDAL																
Indicator	**Replicate**																
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**Mean**
Sand	0	0	0	0	89.8	100	40.8	49.0	79.6	42.9	42.9	12.2	69.4	93.9	65.3	67.3	47.1
Egregia	0	8.2	8.2	0	2.0	0	4.1	6.1	0	0	28.6	38.8	0	0	0	4.1	6.3
Chondracanthus canaliculata	0	6.1	8.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0.9
Other Invertebrate	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0.1
Anthopleura	0	0	2	2	0	0	0	0	0	0	0	2.0	0	0	0	0	0.4
Articulated corallines	4.1	16.3	8.2	10.2	0	0	0	0	0	0	0	0	0	0	0	0	2.4
Mastocarpus papillatus	34.7	51.0	55.1	63.2	0	0	0	0	2	0	0	0	0	0	0	0	12.9
Other red algae	61.2	16.3	18.4	24.5	8.2	0	55.1	44.9	18.4	57.1	28.6	38.8	26.5	4.1	20.4	24.5	27.9
Ulva/ Enteromorpha	0	0	0	0	0	0	0	0	0	0	0	4.1	0	0	0	0	0.3
Phyllospadix	0	2.0	0	0	0	0	0	0	0	0	0	0	4.1	0	0	4.1	0.6
Porphyra	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0.1
Fabric	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14.3	0	0.9
Pisaster ochraceus	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0.1

On October 16, 2012, the percent cover in the boulder field was primarily sand in the high and mid intertidal. In June 2013, sand cover in these zones decreased. Sand cover in the high intertidal was 16.6 percent in June compared to 87.9 percent in October. Bare rock in the high intertidal increased from 5.4 percent in October to 68.9 percent in June, indicating that rocks became exposed as sand moved out of the area. In the mid intertidal, sand cover was 66.1 percent in June compared to 97.3 percent in October. Rocks in the mid intertidal in June generally were not bare but were covered by *Egregia, Ulva/Enteromorpha,* and red algae. The anemone *Anthopleura* was also fairly common. *Anthopleura* can survive sand burial and probably became exposed as sand moved out of the area. In contrast to the decrease in sand cover in the high and mid intertidal, in the low intertidal sand cover actually increased from 20.3 percent in October to 47.1 percent in June. Red algae were the dominant cover on the rocks. *Phyllospadix* had a mean percent cover of only 0.9 percent in the June quadrats compared to 15.1 percent in October, reflecting the patchiness of surfgrass in the boulder field area.

3.2.2 El Matador State Beach

Figure 11 shows the rocky intertidal at El Matador State Beach on June 26, 2012. Table 7 shows the substrate type as determined by the point intercept method on the belt transects.

Table 7: Percentage of Each Substrate Type on El Matador 10-Meter Belt Transects

Percentage of Each Substrate Type on El Matador 10-Meter Belt Transects				
High				
	Rep 1	**Rep2**	**Rep 3**	**Mean**
Rock	63.6	63.6	N/A	63.6
Sand	36.4	36.4	N/A	36.4
Mid				
	Rep 1	**Rep2**	**Rep 3**	**Mean**
Rock	63.6	63.6	N/A	63.6
Sand	36.4	36.4	N/A	36.4
Low				
	Rep 1	**Rep2**	**Rep 3**	**Mean**
Rock	30.8	27.3	54.5	37.5
Sand	58.3	72.7	45.5	58.8
Phyllospadix	10.8	0	0	3.6

The substrate in the rocky intertidal at El Matador State Beach in June 2013 was a mixture of rock and sand. In the high and mid intertidal, the percentage of rock increased in June compared to October 2012. In June, rock was 63.6 percent in both the high and mid intertidal compared to 13.3 percent and 18.3 percent respectively in October. Conversely, in the low intertidal the percentage of rock substrate in June was 37.5, which was comparable to the 40 percent documented in October.

Figure 11: Rocky Intertidal at El Matador State Beach, June 2013

Common large invertebrates in the high intertidal at El Matador included the black turban snail *Tegula funebralis* and the anemone *Anthopleura* spp. *Tegula* and *Anthopleura* also were common in the mid intertidal. Other common large invertebrates in the mid intertidal were *Pisaster ochraceus* (density on belt transects = 0.08 per square meter), chitons (*Mopalia muscosa* and *Nuttallina* sp.), and limpets (*Lottia gigantea* and *Fissurella volcano*). Common large invertebrates in the low intertidal included *Tegula, Anthopleura*, *Fissurella,* the limpet *Notoacmea*, hermit crabs (*Pagurus samuelis*), the crab *Cancer antennarius* (one counted on three belt transects), and *Pisaster ochraceus* (0.07 per square meter). Mussels (*Mytilus californianus*) grew on the higher relief boulders.

Table 8 shows the results of the quadrat samples in the El Matador State Beach rocky intertidal.

Table 8: Percent Cover of Indicators in El Matador 0.25-Square-Meter Quadrats

Percent Cover of Indicators I El Matador 0.25-Square-Meter Quadrats													
High Intertidal													
Indicator	**Replicate**												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Mean**
Bare rock	73.5	61.2	65.3	85.7	75.5	89.8	12.2	20.4	N/A	N/A	N/A	N/A	60.5
Sand	0	0	0	0	16.3	2.0	85.7	71.4	N/A	N/A	N/A	N/A	21.9
Balanus/Chthamalus	26.5	38.8	34.7	14.3	2.0	2.0	0	6.1	N/A	N/A	N/A	N/A	15.6
Anthopleura	0	0	0	0	0	2.0	0	0	N/A	N/A	N/A	N/A	0.3
Ulva/Enteromorpha	0	0	0	0	2.0	4.1	2.0	2.0	N/A	N/A	N/A	N/A	1.3
Limpet	0	0	0	0	4.1	0	0	0	N/A	N/A	N/A	N/A	0.5
Mid Intertidal													
Indicator	**Replicate**												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Mean**
Bare rock	57.1	38.8	22.4	14.3	46.9	57.1	55.1	85.7	N/A	N/A	N/A	N/A	47.2
Sand	0	20.4	30.6	16.3	6.1	16.3	22.4	0	N/A	N/A	N/A	N/A	14.0
Balanus/Chthamalus	30.6	18.4	14.3	24.5	6.1	8.2	0	6.1	N/A	N/A	N/A	N/A	13.5
Chondracanthus canaliculata	0	0	0	0	2.0	0	0	0	N/A	N/A	N/A	N/A	0.3
Articulated corallines	0	2.0	0	0	0	0	0	0	N/A	N/A	N/A	N/A	0.3
Non-coralline crust	0	0	0	2.0	0	2.0	0	0	N/A	N/A	N/A	N/A	0.5
Other red algae	0	0	0	0	0	2.0	0	0	N/A	N/A	N/A	N/A	0.3
Anthopleura spp.	10.2	14.3	0	2.0	32.7	4.1	4.1	4.1	N/A	N/A	N/A	N/A	8.9
Limpet	2.0	0	0	4.1	2.0	4.1	4.1	2.0	N/A	N/A	N/A	N/A	2.3
Phragmatopoma californica	0	6.1	32.7	36.7	4.1	6.1	2.0	2.0	N/A	N/A	N/A	N/A	11.2

Table 8: Percent Cover of Indicators in El Matador 0.25-Square-Meter Quadrats

Percent Cover of Indicators I El Matador 0.25-Square-Meter Quadrats													
Low Intertidal													
Indicator	**Replicate**												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Mean**
Bare rock	0	0	0	0	0	0	0	0	8.2	2.0	2.0	6.1	1.50
Sand	44.9	6.1	67.3	51.0	100	100	100	100	0	0	0	0	47.40
Anthopleura	0	2.0	0	2.0	0	0	0	0	14.3	12.2	6.1	6.1	3.60
Chondracanthus canaliculata	42.9	59.2	32.7	28.6	0	0	0	0	36.7	38.8	57.1	44.9	28.40
Gelidium/ Pterocladiella	0	2.0	0	0	0	0	0	0	0	0	0	0	0.02
Coralline crust	0	0	0	0	0	0	0	0	0	10.2	0	0	0.09
Articulated corallines	0	4.1	0	0	0	0	0	0	28.6	26.5	24.5	26.5	9.20
Mastocarpus papillatus	0	0	0	2.0	0	0	0	0	0	0	0	0	0.02
Mazzaella affinis	0	0	0	0	0	0	0	0	6.1	0	2.0	2.0	0.08
Other red algae	12.2	0	0	4.1	0	0	0	0	2.0	2.0	0	4.1	2.00
Limpet	0	0	0	0	0	0	0	2	2.0	0	0	0	0.03
Phragmatopoma californica	0	0	0	12.2	0	0	0	0	2.0	8.2	6.1	10.2	3.20
Egregia	0	0	0	0	0	0	0	0	0	0	2.0	0	0.02
Phyllospadix spp.	0	26.5	0	0	0	0	0	0	0	0	0	0	2.2

Bare rock accounted for the largest percentage of cover in the high intertidal (rock = 60.5 percent) and mid intertidal (47.2 percent) quadrats in June. Apparently some of the sand that had been covering rocks in October 2012 moved out of the area by June 2013. The percentage of sand in the El Matador quadrats decreased from 70.1 percent in the high intertidal in October to 21.9 percent in June. In the mid intertidal the percentage of sand decreased from 80.8 percent in October to 14 percent in June. The percentage of barnacles (*Balanus/Chthamalus*) in the high and mid intertidal also increased in June (15.6 percent in the high intertidal and 13.5 percent in the mid intertidal) compared to October (3.4 and 0.6 percent, respectively). The barnacles probably survived the seasonal sand burial. In the low intertidal, sand cover actually increased slightly to 47.4 percent in June compared to 43.1 percent in October.

3.3 SWASH ZONE SAMPLES

3.3.1 Broad Beach

Table 9 shows the results of the swash zone samples at Broad Beach.

Table 9: Organisms in Broad Beach Swash Zone Samples

Organisms in Broad Beach Swash Zone Samples						
	Transect 1					
	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Mean
Blepharipoda occidentalis	3	0	0	0	0	0.6
Nephtys sp.	1	1	1	2	1	1.2
Emerita analoga	0	2	1	0	0	0.6
	Transect 2					
	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Mean
Blepharipoda occidentalis	1	0	0	0	0	0.2
Nephtys sp.	0	1	2	0	2	0.6
Emerita analoga	0	0	0	0	1	0.2
Euzonus	0	0	0	0	1	0.2
Tivela stultorum	0	1	0	0	0	0.2
	Transect 3					
	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Mean
Euzonus	0	0	2	1	1	0.8
Nephtys sp.	0	2	1	0	2	1.0
Emerita analoga	0	0	0	0	2	0.4
Olivella	0	0	0	1	0	0.2

Six taxa were collected in the swash zone samples at Broad Beach in June 2013. The polychaete worm *Nephtys* sp. was the most abundant taxon. Sand crab (*Blepharipoda occidentalis* and *Emerita analoga*) abundance was down in June compared to October 2012 when sand crabs were the most abundant taxa. As was true in October, one Pismo clam (*Tivela stultorum*) was collected in the Broad Beach swash zone samples in June. In both seasons the Pismo clam was collected on Transect 2. The presence of the

Pismo clam is noteworthy because Pismo clams were common at Broad Beach and Zuma Beach prior to the 1982/83 El Niño but have become rare.

3.3.2 El Matador State Beach

Table 10 shows the results of the swash zone samples at El Matador State Beach.

Table 10: Organisms in El Matador State Beach Swash Zone Samples

Organisms in El Matador State Beach Swash Zone Samples						
	Transect 1					
	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Mean
Emerita analoga	9	14	9	16	11	11.8
Nephtys	0	0	1	1	1	0.6
	Transect 2					
	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Mean
Nephtys sp.	1	0	1	0	0	0.4
Emerita analoga	51	73	23	46	64	51.4

As was true in October 2012, the swash zone samples at El Matador State Beach were dominated by the sand crab *Emerita analoga.* Large numbers of this species were collected in the samples on Transect 2. Very high numbers of *Emerita* were also collected on Transect 2 in October. Five *Nephtys* were collected on the swash zone transects in June.

3.3.3 Zuma Beach

Table 11 shows the results of the swash zone samples at Zuma Beach.

Table 11: Organisms in Zuma Beach Swash Zone Samples

Organisms in Zuma Beach Swash Zone Samples						
	Transect 1					
	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Mean
Blepharipoda occidentalis	1	0	2	3	2	1.6
Nephtys sp.	0	0	1	2	2	1.0
Emerita analoga	10	5	6	8	4	6.6
	Transect 2					
	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Mean
Blepharipoda occidentalis	0	4	3	3	1	2.2
Nephtys sp.	0	2	1	1	0	0.8
Emerita analoga	2	2	2	2	3	2.2
Euzonus	0	0	0	2	0	0.4
	Transect 3					

Table 11: Organisms in Zuma Beach Swash Zone Samples

Organisms in Zuma Beach Swash Zone Samples						
	Rep 1	**Rep 2**	**Rep 3**	**Rep 4**	**Rep 5**	**Mean**
Euzonus	0	0	1	1	0	0.4
Nephtys sp.	0	0	0	2	0	0.4
Emerita analoga	7	4	11	11	5	7.6
Blepheripoda occidentalis	0	2	3	0	0	1.0

A total of four taxa was collected in the Zuma Beach swash zone samples. The sand crab *Emerita analoga* was the most abundant species.

3.4 BIRD TRANSECTS

3.4.1 Broad Beach

Table 12 shows the birds counted on the bird transect at Broad Beach on June 25, 2013.

Table 12: Birds Counted on Transect at Broad Beach

Common Name	Scientific Name	F	R	FO	O	Total
western gull	*Larus occidentalis*	0	7	12	0	19
northern rough-winged swallow	*Stelgidopteryx serripennis*	5	0	0	0	5
cliff swallow	*Petrochelidon pyrrhonota*	1	0	0	0	1
Heermann's gull	*Larus heermanni*	1	0	1	0	2
double-crested cormorant	*Phalacrocorax auritus*	0	3	2	0	5
Brandt's cormorant	*Phalacrocorax pencillatus*	0	0	1	0	1
brown pelican	*Pelecanus occidentalis*	0	0	14	0	14
parrot	*Amazona* sp.	0	0	5	0	5
black phoebe	*Sayornis nigricans*	1	4	0	0	5
black-crowned night heron	*Nycticorax nycticorax*	2	0	0	0	2
western grebe	*Aechmophorus occidentalis*	0	0	0	3	3
American crow	*Corvus brachyrhynchos*	4	0	0	0	4
unidentified gull	*Larus* sp.	0	0	0	4	4

F = Foraging
R = Roosting
FO = Flyover
O = Offshore

Four water bird species were observed on Broad Beach during the bird transect. An additional four species were observed offshore or flying over the site. Five typically terrestrial birds were found flying over or foraging on the beach. The most abundant species was western gull, followed by brown pelicans. No shorebirds were observed. In June, most shorebirds are on their northern breeding grounds.

3.4.2 El Matador State Beach

Table 13 shows the birds counted on the bird transect at El Matador State Beach on June 26, 2013.

Table 13: Birds Counted on Transect at El Matador State Beach

Common Name	Scientific Name	F	R	FO	O	Total
western gull	*Larus occidentalis*	1	0	11	0	12
Heermann's gull	*Larus heermanni*	18	3	0	0	21
double-crested cormorant	*Phalacrocorax auritus*	0	3	0	0	3
Brandt's cormorant	*Phalacrocorax pencillatus*	0	17	0	0	17
brown pelican	*Pelecanus occidentalis*	0	0	1	0	1
great egret	*Casmerodius albus*	1	0	0	0	1
parrot	*Amazona* sp.	0	0	7	0	7
American crow	*Corvus brachyrhynchos*	5	0	0	6	11
black phoebe	*Sayornis nigricans*	2	2	0	0	4

F = Foraging
R = Roosting
FO = Flyover
O = Offshore

A total of 9 bird taxa was observed on the El Matador State Beach transects. Six of the taxa were waterbirds. Heermann's gulls were the most numerous bird species observed during the survey followed closely by Brandt's cormorants. The gulls were foraging on the beach or roosting. Most of the cormorants were roosting on the tall rock outcrops.

3.4.3 Zuma Beach

Table 14 shows the birds counted on the bird transect at Zuma Beach on June 27, 2013.

Table 14: Birds Counted on Transect at Zuma Beach

Common Name	Scientific Name	F	R	FO	O	Total
western gull	*Larus occidentalis*	0	9	9	0	18
Heermann's gull	*Larus heermanni*	0	18	1	0	19
rock pigeon	*Columba livia*	0	0	2	0	2
American crow	*Corvus brachyrhynchos*	5	0	0	0	5
black phoebe	*Sayornis nigricans*	1	0	0	0	1

F = Foraging
R = Roosting
FO = Flyover
O = Offshore

Five bird taxa were observed on the Zuma Beach transects, but only two species are considered marine species. Heermann's gulls were the most numerous bird species observed during the survey, followed closely by western gulls. The gulls were mainly roosting on the beach, but some birds were observed to forage during the transect count.

3.5 MACROINVERTEBRATE SAMPLES

3.5.1 Broad Beach

Table 15 shows the macroinvertebrates collected in the sandy intertidal core samples at Broad Beach.

Table 15: Macroinvertebrates in Core Samples at Broad Beach

TRANSECT 1						
	High Intertidal					
	1	**2**	**3**	**4**	**5**	**Mean**
Emerita analoga	5	11	0	7	2	5
	Mid Intertidal					
	1	**2**	**3**	**4**	**5**	**Mean**
Americhelidium shoemakeri	1	1	1	0	0	0.6
Donax californiensis	0	0	1	0	0	0.2
Emerita analoga	0	2	0	0	1	0.6
Copepod	0	2	0	0	1	0.6
Total	**1**	**5**	**2**	**0**	**2**	**1.8**
	Low Intertidal					
	1	**2**	**3**	**4**	**5**	**Mean**
Nephtys californiensis	0	1	0	0	0	0.2
Emerita analoga	0	0	0	1	0	0.2
Copepod	0	0	0	1	0	0.2
Total	**0**	**1**	**0**	**2**	**0**	**0.6**
TRANSECT 2						
	High Intertidal					
	1	**2**	**3**	**4**	**5**	**Mean**
Scolelepis bullibranchia	0	0	0	0	1	0.2
Emerita analoga	35	24	37	22	48	33.2
Total	**35**	**24**	**37**	**22**	**49**	**33.4**
	Mid Intertidal					
	1	**2**	**3**	**4**	**5**	**Mean**
Scoloplos acmeceps	0	0	1	0	0	0.2
Nemertea	0	0	0	0	1	0.2
Emerita analoga	0	0	0	1	0	0.2
Copepod	1	0	0	0	0	0.2
Total	**1**	**0**	**1**	**1**	**1**	**0.8**

Table 15: Macroinvertebrates in Core Samples at Broad Beach

	Low Intertidal					
	1	**2**	**3**	**4**	**5**	**Mean**
Emerita analoga	0	1	0	1	0	0.2
TRANSECT 3						
	High Intertidal					
	1	**2**	**3**	**4**	**5**	**Mean**
Nemertea	0	0	1	0	0	0.2
Scolelepis bullibranchia	0	0	1	0	0	0.2
Emerita analoga	5	7	20	10	20	12.4
Copepod	0	0	2	0	1	0.6
Total	**5**	**7**	**24**	**10**	**21**	**13.4**
	Mid Intertidal					
	1	**2**	**3**	**4**	**5**	**Mean**
Scolelepis bullibranchia	0	1	0	0	0	0.2
Americhelidium shoemakeri	0	1	0	0	0	0.2
Emerita analoga	0	1	0	0	1	0.4
Total	**0**	**3**	**0**	**0**	**1**	**0.8**
	Low Intertidal					
	1	**2**	**3**	**4**	**5**	**Mean**
Eulithidium sp.	0	0	0	1	0	0.2
Copepod	0	1	0	0	0	0.2
Scolelepis bullibranchia	0	1	0	0	0	0.2
Nephtys ferruginea	0	1	0	0	0	0.2
Total	**0**	**3**	**0**	**1**	**0**	**0.8**

A total of 286 macroinvertebrates comprised of 10 taxa was collected in the 45 Broad Beach core samples in June 2013. The number of organisms collected in the June samples was much greater than the 66 organisms collected in the 45 core samples taken in October 2012. The high abundance in the June cores was because large numbers of small sand crabs *Emerita analoga* were collected in the high intertidal. The abundance of small sand crabs likely reflects the start of the summer recruitment period. The large numbers were seen in the high intertidal samples. *Emerita* is a characteristic species of the mid and low intertidal zone of sand beaches. Because of the narrow beach width at Broad Beach, a true high intertidal zone is lacking.

3.5.2 <u>El Matador State Beach</u>

Table 16 shows the macroinvertebrates collected in the sand intertidal core samples at El Matador State Beach.

Table 16: Macroinvertebrates in Core Samples at El Matador State Beach

TRANSECT 1						
	High Intertidal					
	1	**2**	**3**	**4**	**5**	**Mean**
Protohyale frequins	0	1	0	0	0	0.2
Insect larvae	0	2	0	0	0	0.4
Muscidae	0	1	0	0	0	0.2
Staphylinidae	0	0	1	0	0	0.2
Total	**0**	**4**	**1**	**0**	**0**	**1.0**
	Mid Intertidal					
	1	**2**	**3**	**4**	**5**	**Mean**
Emerita analoga	3	0	4	1	1	1.8
	Low Intertidal					
	1	**2**	**3**	**4**	**5**	**Mean**
Emerita analoga	7	19	8	15	10	11.8
Eohaustorius sawyeri	0	0	0	0	1	0.2
Protohyale frequens	0	0	1	1	0	0.4
Total	**7**	**19**	**9**	**16**	**11**	**12.4**
TRANSECT 2						
	High Intertidal					
	1	**2**	**3**	**4**	**5**	**Mean**
Tylos punctatus	2	0	1	0	1	0.8
Staphylinidae	0	0	0	0	1	0.2
Total	**2**	**0**	**1**	**0**	**2**	**1.0**
	Mid Intertidal					
	1	**2**	**3**	**4**	**5**	**Mean**
Emeriti analoga	6	26	21	20	22	19.0
Tylos punctatus	0	0	0	0	1	0.2
Total	**6**	**26**	**21**	**20**	**23**	**19.2**
	Low Intertidal					
	1	**2**	**3**	**4**	**5**	**Mean**
Emerita analoga	23	32	29	37	24	29.0
Scolelepis bullibranchia	0	0	0	1	0	0.2
Paraonides platybranchia	0	0	0	0	1	0.2
Byrrhidae	0	2	1	1	0	0.8
Total	**23**	**34**	**30**	**39**	**25**	**30.2**

A total of 328 macroinvertebrates comprised of 10 taxa was collected in the 30 macroinvertebrate samples at El Matador State Beach. As was true in October 2012, the sand crab *Emerita analoga* was by far the most abundant species. The total number of sand crabs in the June samples was 308 compared to 125 in October. Therefore, the sand crab recruitment observed at Broad Beach also occurred at El Matador, but the sand crabs recruited in greater numbers at El Matador. In addition, at El Matador the sand crabs were collected in the mid and low intertidal; but at Broad Beach sand crabs were collected in the high intertidal as well. The presence of sand crabs in samples taken as high as possible on Broad Beach indicates that the beach is truncated by erosion and no true high intertidal exists. In contrast, the high intertidal samples at El Matador were taken at the visible wrack line; and insects, which associate with wrack, were collected.

3.5.3 Zuma Beach

Table 17 shows the macroinvertebrates collected in the core samples at Zuma Beach.

Table 17: Macroinvertebrates in Core Samples at Zuma Beach

TRANSECT 1						
	High Intertidal					
	1	**2**	**3**	**4**	**5**	**Mean**
No animals	0	0	0	0	0	0
	Mid Intertidal					
	1	**2**	**3**	**4**	**5**	**Mean**
Scolelepis bullibranchia	1	0	0	0	0	0.2
	Low Intertidal					
	1	**2**	**3**	**4**	**5**	**Mean**
Emerita analoga	0	6	0	0	0	1.2
TRANSECT 2						
	High Intertidal					
	1	**2**	**3**	**4**	**5**	**Mean**
Oligochaete	1	0	0	0	0	0.2
Insect larvae	3	1	1	0	1	1.2
Insect pupa	0	0	1	0	0	0.2
Curcilionidae	0	0	0	1	0	0.2
Fly	0	0	0	0	1	0.2
Total	**4**	**1**	**2**	**1**	**2**	**2.0**
	Mid Intertidal					
	1	**2**	**3**	**4**	**5**	**Mean**
Cirolana harfordi	0	1	0	0	0	0.2
Oligochaete	0	0	0	1	0	0.2
Total	**0**	**1**	**0**	**1**	**0**	**0.4**

Table 17: Macroinvertebrates in Core Samples at Zuma Beach

	Low Intertidal					
	1	**2**	**3**	**4**	**5**	**Mean**
Emerita analoga	0	1	0	0	0	0.2
TRANSECT 3						
	High Intertidal					
	1	**2**	**3**	**4**	**5**	**Mean**
Oligochaete	0	0	1	0	0	0.2
	Mid Intertidal					
	1	**2**	**3**	**4**	**5**	**Mean**
Nemertea	0	0	1	1	0	0.4
Emerita analoga	0	0	2	2	3	1.4
Total	**0**	**0**	**3**	**3**	**3**	**1.8**
	Low Intertidal					
	1	**2**	**3**	**4**	**5**	**Mean**
Emerita analoga	2	1	0	0	1	0.8

A total of 34 macroinvertebrates comprised of 9 taxa was collected in the 45 core samples taken at Zuma Beach. The sand crab *Emerita analoga* was the most abundant species. The Zuma Beach samples did not contain the large number of small sand crabs that were collected at the Broad Beach and El Matador State Beach sites. As was true at El Matador but not at Broad Beach, the high intertidal samples contained terrestrial insects.

SECTION 4.0 – DISCUSSION

In June 2013, sand cover increased in the low and mid rocky intertidal in Lechuza Cove compared to October 2012 but decreased in the high intertidal. In contrast, sand cover in the Broad Beach boulder field and the El Matador State Beach rocky intertidal decreased in the high and mid intertidal but increased somewhat in the low intertidal.

Swash zone samples at Broad Beach collected more taxa than the samples at El Matador State Beach and Zuma Beach but had a lower abundance of individuals. The El Matador State Beach swash zone samples collected large numbers of the mole crab *Emerita analoga.* The core samples taken at El Matador State Beach and Broad Beach collected large numbers of small sand crabs, indicating the beginning of the summer recruitment period for this species. The Zuma Beach core samples, however, collected few sand crabs. The narrow beach at Broad Beach did not have a high intertidal zone where wrack can accumulate. Core samples taken as landward as possible on Broad Beach contained organisms characteristic of the mid and low intertidal. Both El Matador State Beach and Zuma Beach had visible wrack lines, and core samples taken in the high intertidal on these beaches collected insects and other organisms characteristic of the high intertidal zone.

SECTION 5.0 – LITERATURE CITED

Chambers Group, Inc. (Chambers Group)

2012a Survey of Marine Biological Resources of Broad Beach, Malibu, California. Prepared for Moffatt & Nichol Engineers.

2012b Broad Beach Intertidal Sampling for the Broad Beach Shore Protection Project, Los Angeles County, California. December 2012

Moffatt & Nichol

2012 Broad Beach Restoration Project Public Trust Resource Environmental Impact Analysis, Coastal Engineering Appendix. Prepared for Broad Beach Geologic Hazard Abatement District.