

**ROCKY INTERTIDAL RESOURCE DYNAMICS
IN SAN DIEGO COUNTY:
CARDIFF, LA JOLLA, AND POINT LOMA,
FINAL EIGHT-YEAR REPORT (1997/2005)**

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EXECUTIVE SUMMARY

This final report provides the results of monitoring surveys conducted during Fall 2004 and Spring 2005 at 4 rocky intertidal sites in San Diego County and compares key species abundance patterns for the 8-year project period. The primary objective is to increase understanding of species dynamics to help assess and reduce human impacts, especially possible effects of the SANDAG Beach Replenishment Project. Cardiff Reef (possible impact site) and Scripps Reef (control site) were established in Fall 1997. Navy North and Navy South on Point Loma (established in 1995) provide additional baseline perspectives. Abundances of 14 index species were monitored semi-annually in fixed plots. Survey data were supplemented by habitat observations, photographs, and videotapes.

Cardiff State Beach upcoast of Cardiff Reef received 101,000 cubic yards of offshore sand during August 2001. There was no evidence of natural or beach replenishment sand burial or scour effects on intertidal life at Cardiff in F01 or S02, except for a few buried mussels offshore in S02. High sand levels at Cardiff in F02 apparently were unrelated to beach replenishment because similarly high sand levels also occurred at the Scripps control site. At both sites, sand affected a narrow zone of low intertidal life that was buried and/or scoured (including relatively few mussels, barnacles, anemones, turf algae, and surfgrass), thus providing insight into potential impacts should beach enhancement increase sand levels along rocky reefs. In S03 sand levels were low at Cardiff and low-moderate at Scripps. Year 7 sampling documented moderately high sand levels at Cardiff and Scripps in F03, followed by low sand levels by S04. The differing intra-reef distribution of sand at Cardiff in F03 (some anemones and turf were buried, but not mussels) demonstrated the variability in sand movement and deposition dynamics at this location. Year 8 sand levels at Cardiff and Scripps followed a pattern similar to Year 7. It is not known whether declines in surfgrass at Cardiff, and to a lesser extent at Scripps, were associated with higher sand levels in F02, F03, and F04. Other species appeared little affected by seasonally-increased sand levels or quickly recolonized.

Of 14 key species monitored, 1 (black abalone) was never found and 4 (boa kelp, sargassum weed, aggregating anemone, and sand castle worms) were relatively uncommon. Other species abundances varied little or considerably by plot, site, season, and year. Of the 4 sites, relatively unprotected Cardiff experienced the most disturbances from storm swells and sand/gravel scour over the 8-year monitoring period. The ecosystem of this sedimentary rocky reef, isolated by extensive sand and gravel beaches, represents a mosaic of species assemblages created by patchy disturbance phenomena. Major abundance trends for 7 target species at Cardiff from Years 7 to 8 had 5 species (acorn and goose barnacles, owl limpets, red turf, and ochre seastars) showing little change and 2 species (mussels and surfgrass) decreasing. Eight-year species abundance comparisons revealed 5 of 7 species declining, with acorn barnacles and seastars increasing. Short-term pre/post sand deposition comparisons indicated no change for 5 of 7 species, with acorn barnacles and seastars increasing. Multi-year pre/post sand deposition comparisons revealed no change for goose barnacles and mussels; declines for owl limpets, red turf, and surfgrass; and

increases for acorn barnacles and seastars. The other 3 sites also showed considerable smaller-scale variability, but few major trends over Years 7 to 8 (seastars increased; rockweed and owl limpets decreased at Scripps). Year 1 to 8 comparisons revealed increasing rockweed at NN and seastars at Scripps; and decreasing goose barnacles at NS, mussels at NN and NS, and sand castle worms at Scripps. Many of the variations in species trends between Cardiff and Scripps likely were related to microhabitat differences.

Seasonal cycles of abundance were apparent over the 8-year period in varying degrees for rockweed, red turf, and surfgrass, with lower cover in Spring apparently associated with “weathering” from winter storms. Other storm affects on various key species included sand/gravel/cobble scour (especially in barnacle plots at Cardiff), mussel dislodgement (particularly at Cardiff and Scripps), and bedrock breakouts (at all sites). Storm effects were patchy and recovery rates variable. Seasonal and annual variability in species abundances at the 4 sites occurred within a larger-scale oceanographic context over the 8-year monitoring period as sea conditions shifted from a long-term warming trend (culminating in the severe 1997/98 El Niño) to a cooler trend initiated by La Niña and continued cool or near normal conditions, except for a mild El Niño in F04/S05. The relatively cool 1999-2004 period experienced fewer severe storms and reduced rainfall that apparently benefited species such as rockweed, mussels, and seastars; however, warmer temperatures and heavy rains associated with the F04/S05 El Niño may have offset some of these trends in Year 8.

Given the lack of high sand levels at Cardiff Reef three months after the upcoast sand deposition, the observations that later periods of seasonally higher sand levels also occurred at the Scripps control site, the monitoring data indicating higher species abundance variability at the small, typically sand-influenced reef at Cardiff, and the reasonable relationship between weather/oceanographic patterns and most species trends, there is no clear indication of adverse impacts from the upcoast sand beach enhancement. Higher Fall sand levels at Cardiff and Scripps did affect some low-zone intertidal organisms that were buried and/or scoured; however, the disturbance was limited in time and magnitude such that most of these sand-adapted species survived or quickly recolonized.

This long-term monitoring program has enabled enhanced understanding of seasonal, annual, and multi-year patterns of species abundance dynamics. These ecological perspectives are critical for evaluating possible impacts from human activities, including the sand beach enhancement project, oil spills, and recreational visitation. The sampling data have been entered into a master database of the Multi-Agency Rocky Intertidal Network, which facilitates comparisons among similar surveys ongoing at over 70 regional intertidal sites on the Pacific Coast. Currently there are no plans to extend intertidal monitoring at the 4 San Diego County sites. This important, cost-effective survey program should be continued. Any spatial or temporal data gaps will compromise the ability to analyze, compare, and draw conclusions about natural versus human-caused changes in our valuable and relatively rare rocky intertidal ecosystems.

1. Introduction

Bedrock intertidal reefs comprise 14% of the coastline of San Diego County, with the remaining 86% consisting of sand, gravel, or cobble beaches (Smith et al. 1976). Most rocky intertidal shores in the county occur on the Point Loma and La Jolla peninsulas, with relatively few isolated reefs farther north. Intertidal reefs contain rich communities of plants and animals worthy of preservation. However, tidepools and bench habitats are subject to influences from a multitude of human activities including nearshore shipping, wastewater runoff and outfalls, onshore development, and direct disturbance or game collecting by beach explorers. Effective management of increasingly-valued intertidal resources requires dynamic baseline surveys to determine what is there and to understand how key components of this land/water interface ecosystem respond to natural environmental variations and human impacts.

In July 1997, the U.S. Navy entered into an agreement with the University of California at Santa Barbara (UCSB) to conduct rocky intertidal monitoring for the Navy on the San Diego County shoreline for a period of 5 years, with an option to extend the monitoring for an additional 5 years. In October 2001, the option to extend the monitoring was exercised for a period of 3 years for 2 sites, Navy North and Navy South. Funding to continue the surveys at Cardiff and La Jolla (Scripps) for 3 years was awarded in a separate subcontract to UCSB by AMEC Earth and Environmental, Inc., under contract to the San Diego Association of Governments. The objectives of these projects are as follows:

- To establish/maintain permanent monitoring sites at Cardiff, La Jolla, and Point Loma in order to help assess and reduce human impacts and to document long-term climatic changes.
- To assist the Navy in determining effects in condition and (beneficial or detrimental) in relationship to the Navy Beach Replenishment Project.
- To identify, quantify, and determine the condition and trend over time of key rocky intertidal resources at Cardiff reef that may be affected by the Navy Beach Replenishment Project and compare finding to three control sites at La Jolla and Point Loma.
- To increase understanding of population dynamics of important rocky intertidal species by comparing key species abundance changes among plots, seasons, years, and sites (to the extent possible) throughout central and southern California.
- To provide relevant information to resource agencies that will lead to more effective management of rocky intertidal ecosystems.

Assessing ecological conditions is a complex and often expensive undertaking. During the 1980's, Channel Islands National Park developed a cost-effective intertidal monitoring

program that has become a model for rocky shore surveys throughout the Southern California Bight (Richards & Davis 1988; Davis & Engle 1991; Ambrose et al. 1995; Engle et al. 1994a,b; Engle & Davis 1996a,b,c; Dunaway et al. 1997; Engle et al. 1997; Engle et al. 1998a,b; Raimondi et al. 1999). Instead of detailed surveys of all species at many sites, ecological conditions at representative locations are evaluated by concentrating on selected key species assemblages that are monitored seasonally in fixed plots. Qualitative reconnaissance surveys and, where feasible, one-time comprehensive surveys yield inventory data and provide ecosystem perspective for the key species monitoring. The baseline surveys for this study utilized the same key species monitoring approach, thus ensuring compatibility with ongoing studies in southern and central California. Following a workshop eight years ago (Engle et al. 1997), a Multi-Agency Rocky Intertidal Monitoring Network was established to coordinate related projects at over 50 sites ranging from San Luis Obispo County to the Mexican Border (Dunaway et al. 1997).

This annual report is a joint report for the mutual benefit of AMEC Earth and Environmental, Inc. (for SANDAG) and the U.S. Navy that continues the series of annual reports for the 4 rocky intertidal sites in San Diego County. The Year 8 report provides the results of surveys conducted during Fall 2004 and Spring 2005 and compares species abundance dynamics for the 8-year period of the project. The sites at Cardiff and Scripps reefs were established in Fall 1997 to provide baselines for the Navy Beach Replenishment Project (see First through Seventh Year Reports: Engle et al. 1998b; Engle & Farrar 1999; Engle 2000, 2001, 2002; Engle & Adams 2003; Engle 2004). The sites on Point Loma (Navy North and Navy South) had been setup for the Navy in Spring 1995 (Engle & Davis 1996c), with monitoring continued by this study. Three additional sites at the southern tip of Point Loma have been monitored separately for the Cabrillo National Monument and Minerals Management Service since Spring 1990. Data from the Cabrillo National Monument sites are reported elsewhere (Davis & Engle 1991; Engle & Davis 1996b; Engle et al. 1999).

In 2000, the Navy Beach Replenishment Project was converted to the San Diego Association of Governments (SANDAG) Regional Sand Beach Project. Two million cubic yards of sand were pumped from offshore sites to twelve San Diego County beaches during April to September 2001. The Cardiff State Beach site, located approximately 3,400-4,200 feet upcoast of Cardiff Reef, received 101,000 cubic yards of sand during August 2-10, 2001. This Year 8 (Fall 2004-Spring 2005) Report of rocky intertidal monitoring surveys at Cardiff Reef characterizes biological conditions 3½ years after the nearby sand beach replenishment.

2. Methods

2.1 Resource monitoring sites

Locations of the two rocky intertidal key species monitoring sites established in Fall 1997 to evaluate possible effects of the Navy (later SANDAG) Beach Replenishment Project are shown in Figure 1. Cardiff Reef was near beaches targeted for sand deposition. Scripps Reef was similarly surrounded by extensive sand/gravel beaches, but was not near sand enhancement beaches. Other conditions evaluated in choosing the 2 survey sites included reasonable and safe access, regional representation of stable (bedrock or large boulder) habitats, sufficient abundances of the same key species monitored elsewhere in San Diego County, and adequate bedrock surfaces for establishing fixed plots. The previously established sites on Point Loma, Navy North (NN) and Navy South (NS), also served as baselines for regional key species dynamics (Figs 1,2). General physical and biological characteristics of the 4 San Diego County rocky intertidal monitoring sites are described below. Further descriptions of the NN and NS sites can be found in Engle and Davis (1996c).

Cardiff Reef

Cardiff Reef (33.000 N Lat, 117.279 W Lon), locally known as “Tabletop Reef”, is located at the southernmost end of Cardiff State Beach, approximately 100 m south of the parking lot. The relatively small, mostly flat, rocky intertidal benches just offshore of a high seawall are isolated by extensive sand and gravel beaches upcoast and downcoast. The reef is composed of hard sedimentary rock, with the inshore portion overlain with fossilized oyster shells. The site is exposed to oceanic swells (popular with surfers), with parts influenced by sand/gravel movements. It receives heavy visitation; trampling and collecting disturbances are evident.

The innermost portion of Cardiff Reef is relatively free of life, apparently due to sand/gravel scour. The upcoast inshore reef edge has a small but dense zone of white acorn barnacles, below which is a larger expanse dominated by slippery films of green and brown slimes. Small to medium-sized clumps of goose barnacles occur along the upcoast exposed reef edge. Just below and offshore is a zone dominated by mostly small mussels in a patchy single layer, many of which are fouled with slimy algae or barnacles. A few relatively small owl limpets are scattered in open patches in the inshore mussel reef. Solitary and clonal aggregating anemones become more common in the lower mussel zone. The next lower reef flat offshore is dominated by thin sand-embedded turf, with clumps of red coralline algal turf, aggregating anemone clones, and surfgrass on the outermost reef margins. Larger bladed algae are notably rare or absent. The isolated mid-tidal reef just downcoast is dominated by mussels, larger and denser than the inshore mussels.

Scripps Reef

Scripps Reef (32.872 N Lat, 117.253 W Lon), in the vicinity of “Dike Rock”, is located approximately midway between the Scripps Pier and Black’s Canyon in La Jolla. The reef is part of the Scripps Coastal Reserve. Like Cardiff Reef, Scripps Reef is isolated by extensive sand beaches upcoast and downcoast, and backed by highly erodable bluffs. However, Scripps Reef is larger and more structurally diverse, with medium to high relief boulders and ridges separated by wet channels and pools. The site also is exposed to swells, but inshore portions are partially protected by outer reef. Scripps Reef receives moderate visitation; people have to hike from Scripps Institution or from Blacks Canyon. Visitor impacts may be less here than at Cardiff because of its proximity to Scripps Institution and designation as a reserve.

The larger reef and physical habitat diversity at Scripps Reef support a greater diversity of plants, invertebrates, and fishes than at Cardiff Reef. The prominent inshore bench is dominated by dense cover of white acorn barnacles in the upper intertidal, below which are narrow, often broken, bands of goose barnacles and mussels. Small to medium-sized owl limpets are nestled amidst the mussels and goose barnacles. The lower boulder zone has good cover of encrusting and erect coralline algae, slippery algal films and filaments, and aggregating anemone clones. A few boulder tops are covered with rockweed. The numerous pools contain lush coralline turf, solitary anemones, low bladed algae, sargassum weed, and small fishes. Larger offshore boulders have prominent cover of medium-large mussels, many of which are coated with slimy algae or barnacles. In the low intertidal zone below the outer mussel rocks are various coralline algae, bladed algae, sea palms, and surfgrass.

Navy North

The Navy North site (32.693 N Lat, 117.253 W Lon) encompasses approximately 300 m of rocky shore along the base of sheer 25-30 m high sedimentary cliffs in the central portion of the Fort Rosecrans Military Reservation on Point Loma. Navy North (NN) and South (NS) sites were established in 1995 under a contract with the Navy for baseline surveys. A prominent landmark for this site is the centrally-located pinnacle rock (10 m high; 30 m in diameter). This chimney rock is about 20 m offshore from the main promontory such that it is surrounded by water at high tide. The NN site extends from roughly 200 m upcoast of the chimney rock to 100 m downcoast. The rocky intertidal zone at this site consists primarily of broad, gently-sloping wave-cut benches composed of many horizontal layers of poorly-consolidated sandstone. There are numerous crevices, channels, and pools on the mostly low-medium relief features. There is little sand on this headland shore. The gradual beach slope at NN creates extensive intertidal reef area, extending 30-100 m offshore. The site is fully exposed to ocean swells, but the outer reef margin dissipates some of the wave energy, especially at low tide.

The extensive reef system at NN, with a range of wave exposures and a variety of microhabitats, supports diverse assemblages of intertidal plants and animals. Turf and surfgrass habitats are extensive here, but goose barnacles and mussels are rare. Pink barnacles are more prominent than white barnacles. A full description of this site can be found in Engle and Davis (1996c). Access to this site requires hiking about 1 km upcoast from the shore trail at Navy South.

Navy South

The Navy South site (32.683 N Lat, 117.250 W Lon) encompasses approximately 250 m of rocky shore along the base of 25 m high cliffs at the southern end of the Fort Rosecrans Military Reservation, 0.25 km north of the northern boundary of the Point Loma Wastewater Treatment Facility. A prominent landmark for this site is the narrow promontory separating the broad cove to the south from the narrow access inlet to the north. The NS site extends from about 100 m upcoast of the promontory tip to about 150 m downcoast. Like NN, NS intertidal shore consists primarily of wave-cut benches composed of many horizontal layers of poorly-consolidated sandstone. However, NS has a more irregular shoreline, resulting in greater diversity of physical habitats, and narrower intertidal reefs (5-20 m wide, except for the southern cove where rockweed plots are located), resulting in greater wave shock for benches not protected by headlands.

Overall, the biological character of the reef system at NS is quite similar to that of NN. The same key species assemblages are found at both sites. Like NN, turf and surfgrass predominate, while mussels and goose barnacles are rare. Rockweed is less common at Navy South compared to Navy North, apparently because the inshore habitats are more exposed at NS. A complete description of this site can be found in Engle and Davis (1996c).

2.2 Target species assemblages

Ideally one would like to monitor the abundances of all species in an area; however, limited resources require that a subset of the resident species be targeted. Intertidal zonation is frequently characterized by distributions of dominant attached plants and sessile animals (Ricketts et al. 1985). Therefore, a representative group of important taxa (species or species groups), also referred to as “target” or “key” species assemblages, can provide an accurate index of ecological conditions (see Ambrose et al. 1995 and Murray et al. 2002 for discussion). Thirteen index taxa have been monitored at the 3 Cabrillo National Monument (CABR) sites on Point Loma since 1990 (Davis & Engle 1991; Engle & Davis 1996a,b). The same species and species groups monitored at CABR were utilized in this study wherever possible in order to maximize data compatibility. Criteria used for selecting these target species assemblages include the following:

- Species ecologically important in structuring intertidal communities

- Species characteristic of discrete intertidal heights
- Species that have been well-studied
- Species especially vulnerable to human impacts
- Species practical for long-term monitoring

The index taxa surveyed at the Cardiff, Scripps, NN, and NS intertidal sites are listed in Table 1. In addition to the key species, broad categories (other plants, other animals, other biota) are scored, as well as the amount of tar and bare substrate (rock or sand). The natural history and ecology for each of the key species are summarized in Engle and Davis (1996b) and on the Multi-Agency Rocky Intertidal Network website (<http://www.marine.gov/species.htm>).

2.3 Survey procedures

The sampling techniques used to survey Cardiff, Scripps, NN, and NS sites were similar to those employed at CABR and elsewhere in southern California to ensure optimum compatibility among studies (Davis & Engle 1991; Engle & Davis 1996a,b,c.) These include qualitative species inventories combined with quantitative cover (for sessile species) or count (for mobile species) data for the index taxa within fixed plots or along fixed transects (see Ambrose et al. 1995 and Murray et al. 2002 for discussion of advantages and limitations of fixed plot sampling). Each site is sampled in Spring and Fall to evaluate seasonal population changes during the periods when maximum differences were expected.

Table 1 summarizes the sampling techniques and number of replicate fixed plots for each key species at the 4 monitoring sites. Thirty-one fixed plots and transects have been surveyed at Cardiff and Scripps Reefs since Fall 1997. Thirty-three fixed plots and transects at Navy North and Navy South have been monitored since Spring 1995. Figures 3-8 are site maps that indicate the locations of fixed plots and transects at the survey sites. Plot identification codes are explained in Table 2.

The thirty-one fixed plots and transects at Cardiff and Scripps Reefs were established during October 1997 (Tables 1-2; Figs. 3-4). These permanent sample locations were marked with 3/8 in stainless steel bolts fixed into the bedrock with epoxy. Specific bolts were marked with notches to identify the plot's number (Table 2). In addition, 4 large (1/2 in) reference bolts (also notched) were located throughout each site. These strategically-placed bolts were used as standards for measurements to plots for mapping and efficient relocation, and also as video and photo reference markers. Navy personnel C. Berdzar and E. Steenblock used a Trimble Global Positioning System (GPS) to acquire latitude and longitude coordinate values for plots, transects, and reference bolts. Distances and bearings were recorded from each notched plot and transect bolt to one or more reference bolts; other measurements were taken between nearby plots and transects. These measurements were used in conjunction with the GPS data and sketches of

physical features at each location to produce site maps (Figs. 3-4). Quadrats and transects were drawn onto each site map, with notched marker bolt positions indicated. The 33 fixed plots and transects that continue to be monitored at Navy North and Navy South originally were setup in Spring 1995 (Tables 1-2; Figs. 5-8).

Reconnaissance surveys were conducted during the Fall and Spring surveys whenever possible after key species monitoring was completed. Physical conditions were characterized at each site, including weather conditions, sea conditions, substrate types, presence of tar, and other unusual occurrences such as debris or pollutants. Biological features were noted, including habitat types and zonation, distribution and abundance of species, condition of individuals and populations (e.g., size-structure, color pattern, epiphyte load), and animal behavior. The presence and activities of birds, marine mammals, and humans were recorded. Representative habitats and microhabitats (e.g., crevices, tidepools, under-rock, under-plant) were explored and species composition and relative abundance noted. Overview photos and/or videos were taken whenever possible to document site-wide physical and biological conditions. In Spring 2002, comprehensive marine life surveys were conducted at Scripps Reef by a team from the University of California Santa Cruz as part of a project for the Multi-Agency Rocky Intertidal Network to compare representative regional sites along the West Coast (see <http://cbsurveys.ucsc.edu>). The species recorded during these surveys at Scripps Reef and at the Cabrillo National Monument (on Point Loma south of Navy North and Navy South) are listed in Table 3.

Rectangular (50 x 75 cm; 0.375 m²) photoquadrats were used to monitor the population dynamics of 5 relatively small, densely-spaced target species, rockweed (*Silvetia compressa*, formerly *Pelvetia fastigiata*), acorn barnacles (*Chthamalus* spp.), pink-thatched barnacles (*Tetraclita rubescens*), mussels (*Mytilus californianus*), and goose barnacles (*Pollicipes polymerus*) (Table 1). Bolts mark 3 of the 4 corners of each plot (upper left, lower left, upper right). Still photos were taken during each seasonal survey using a quadripod apparatus, which holds a camera and strobe in a fixed orientation over each quadrat. Five replicate photoquadrats were surveyed for each target species (except for goose barnacles at NN and NS; these have 6 replicates for consistency with the Cabrillo National Monument sites on Point Loma (at which 3 band transects were converted to photoplots, with 2 plots per transect)). Species abundance was scored from the slides in the laboratory as percentage cover by the point contact method. The slide was projected onto a grid of 100 uniformly-distributed points. The number of points occupied by key species, higher taxa, tar, and bare substrate were recorded to determine percentage cover of each taxon. After testing in Fall 2002, a digital camera system was used to take all photos starting Spring 2003. The digital photos were scored by superimposing a grid of 100 uniformly-distributed points onto each image on a computer monitor.

The number and size distribution of owl limpets (*Lottia gigantea*) were monitored within permanent circular plots at all 4 intertidal sites. There are 5 replicate plots at Cardiff and Scripps, and 6 replicate plots at NN and NS (for consistency with the Cabrillo National Monument sites on Point Loma where 3 plots were located on boulders and 3 on cliff faces). Plots were marked with a center bolt, notched to indicate the plot number. All limpets ≥ 15 mm found within a 1 m (1.5 m at Cardiff) radius circle (3.14 m^2 area) around each bolt were counted and measured (maximum length in millimeters).

Red algal turf (*Corallina* spp. and other tufted algae), surfgrass (*Phyllospadix* spp), boa kelp (*Egregia menziesii*), sargassum weed (*Sargassum muticum*), aggregating anemones (*Anthopleura elegantissima/sola*), and sand castle worms (*Phragmatopoma californica*) were sampled by line-intercepts (later point-intercepts) along 10 m long permanent transects. Six replicate transects were used at each site. At Cardiff and Scripps, 3 transects represented the middle intertidal zone dominated by red algal turf, and 3 others the low intertidal zone dominated by surfgrass. At NN and NS, 2 transects each were employed for red algal turf and surfgrass, plus 2 additional transects represented the lower half of the low zone, also dominated by surfgrass (at Cabrillo National Monument this lowest zone was previously dominated by boa kelp). In Spring 2002, a third red turf transect was added at NN and NS. Each transect was marked at both ends and the center with stainless steel bolts. From Fall 1997 through Spring 2000, the abundance and distribution of the key species, other biota, tar, and bare substrate were recorded as distances (to the nearest centimeter) along the edge of a meter tape laid out between the bolts. Starting in Fall 2000, this line-intercept method was modified to a point intercept method for consistency with other regional monitoring in the Multi-Agency Rocky Intertidal Network. Cover of the same list of biota as above was determined by scoring what was found under each of 100 points stratified along the 10 meter tape at 10 cm intervals. A comparison of line-intercept and point-intercept protocols determined that there was no significant difference in results obtained by these two methods (Pete Raimondi, personal communication).

Historically, ochre sea stars (*Pisaster ochraceus*) and black abalone (*Haliotis cracherodii*) were important components of San Diego County intertidal shores (Zedler 1976, 1978). However, these key species have been rare or absent here in recent years. Timed searches (30 person minutes) of likely habitats throughout each survey site were conducted during each sampling period in order to document possible occurrences of species of abalone or sea stars.

During 2002/2003, the Multi-Agency Rocky Intertidal Network standardized protocols and developed a centralized data management system. This process resulted in slight modifications to the San Diego County sampling that, along with a unified Microsoft Access database, make it easier to compare key species monitoring data in a regional context. All data from the four intertidal sites have been entered in this regional database.

3. Results

3.1 Field Activities and Observations for Year Eight

Field activities and observations for Years 1-7 can be found in prior annual reports (Engle et al. 1998b; Engle & Farrar 1999; Engle 2000, 2001, 2002; Engle & Adams 2003; Engle 2004). Table 4 lists the schedule of field activities for rocky intertidal baseline surveys at the 4 San Diego County sites during the eight year of this study. The surveys were conducted during periods in Fall 2004 (November 11-13) and Spring 2005 (March 5-8) when good low tides occurred during midday hours. Biologists and assistants worked about 6 hr each day (generally low tide ± 3 hr) in the field (Table 5). An additional 4 hr each day was spent preparing for field work in the morning and organizing data and notes in the evening. Results from Spring and Fall reconnaissance and key species surveys at the 4 sites are reported below. For ease of presentation, the sampling seasons are abbreviated as, for example, F04 for Fall 2004 and S05 for Spring 2005. Sites are abbreviated as Cardiff (Cardiff Reef), Scripps (Scripps Reef), NN (Navy North, Point Loma), and NS (Navy South, Point Loma).

During each visit to the San Diego County sites, qualitative physical and biological observations were recorded on Field Log data sheets and with photographs. The F97 and S98 monitoring described in the First Year Report (Engle et al. 1998b) occurred during a major El Niño event that included abnormally warm water temperatures, heavy rainfall, and large storm swells. El Niño conditions lessened during the period S98 to F98, though water temperatures remained above the long-term mean. In F98 the El Niño ended abruptly and switched to a La Niña condition that persisted through 1999, slowly degraded through 2000-2001, continued with cooler or normal temperatures in 2002-2004, and culminated in a mild El Niño in F04 to S05. As a result, compared to the 1976-1998 warm-water regime, late 1998 to early 2004 were characterized by cooler or relatively normal seawater temperatures followed by brief warming in late 2004 to early 2005. Except for the 1997-1998 and 2004-2005 El Niño periods, storms generally have been few and mild, and rainfall mostly below normal (mean San Diego rainfall for F98-S04 was 6.6 inches compared to long-term mean of 10.2 inches). In contrast, Years 1 and 8 of the monitoring experienced 17.8 and 22.5 inches of rain respectively – about twice normal. Despite the record high rains in the final year of monitoring, El Niño storm swells were not severe compared to destructive waves associated with the 1997-1998 El Niño.

Unlike the F03 surveys that took place coincidentally with a major firestorm inland that brought smoky haze and drifting ashes onto the coast, weather and sea conditions were good for sampling in F04. There was scattered evidence of prior low-moderate storm disturbance (i.e., cleared or overturned rocks, rock break-outs, scour disturbances, patches of opportunistic algae,

patches of mussel byssal threads or torn goose barnacle stalks, broken mussel shells, and algal wrack on upper beaches) at the survey sites. At Cardiff, storm effects consisted of moderate patchy damage to inshore and offshore mussel beds. No rock break-outs and only a few scoured surfaces were noted. Scattered, moderate amounts of drift kelp were present mostly downcoast from the site. At Scripps there was relatively little sign of storm disturbance since S04, except for occasional small torn-out mussel patches and scattered detached mussels and mussel shells in low reef areas. There was moderate accumulation of drift kelp at the site and adjacent sand beach. At NN evidence of storm disturbance was limited to a few small scoured spots, a few byssal threads exposed among remaining mussels, and ephemeral green algae in the upper portion of the owl limpet zone at the pinnacle rock. No break-outs of sedimentary rock layers were noted. At NS there was little evidence of storm disturbance, except that a small hole opened on the sedimentary rock face that connected into the surge cave containing mussel Plot 1. This hole will likely enlarge and change water flow to the cave. No other bedrock breakouts were noted. Another discovery was that all the purple urchins disappeared from the shaded high tide pool in which they had been observed for years. There was little kelp wrack in the north cove, but moderate amounts on the south cove beach.

As is typical in fall surveys, sand levels at Cardiff in F04 were high around the inshore and offshore reefs, and the low zone flats were sand-influenced. Table Top projection was 0.7 m above the substrate, compared to 1.5 m in Spring 2004, 0.8 m in Fall 2003, 1.5 m in Spring 2003, 0.5 m in Fall 2002, 1.1 m in Spring 2002, 1.4 m in Fall 2001, 1.6 m in Spring 2001 and 1.2 m in Fall 2000. The road cut was filled with sand that reached within 0.5 m of the rim. Sand levels along the seawall were high, with the ledge buried. Gravel and cobble were minimally present at the reef. Sand was about 0.5 m below the lower edge of mussel zone, but some anemones, surfgrass, and coralline turf were partially or fully buried. Turf transects had sand cover in low areas. There was high cover of ephemeral green algae on the inshore mussel and owl limpet reef.

Sand levels also were relatively high at Scripps Reef in F04, as observed on adjacent beaches and in low reef habitats. Generally the sand was just below the lower edge of the mussel zone, though partial burials of mussels, anemones, red turf, and barnacles were noted on downcoast beach rocks. No scour effects were evident. At NN sand levels were moderate on nearby beaches, but there was little sand influence on the rocky reef. At NS sand levels were relatively low on cove beaches, with little sand influence on the intertidal reefs.

The S05 surveys occurred after a winter with scattered storms and abnormally high rainfall. Despite rain during several days prior to the survey, sampling conditions were fine, with cloudy skies and moderate seas. There was evidence of winter rain or wave effects on the reef community, including scattered small losses of mussels (with remaining byssal threads), sickly surfgrass, and a lush carpet of low-growing green *Ulva* covering much of the inshore reef (*Ulva* typically appears on disturbed surfaces and during high nutrient conditions, such as after rain

caused landside run-off). No rock break-outs and only a few scoured surfaces were noted. Notably little drift kelp or other drift debris was present on upper beach. Scripps Reef also exhibited signs of storm disturbance since F04: occasional small torn-out mussel patches (with byssal thread remnants and bright *Ulva*) and mussel shells in low reef areas; however, no overturned rocks or scouring effects were noted and there were no obvious major cliff landslides. There was remarkably little accumulation of drift kelp or other debris at the site and adjacent sand beach. At NN evidence of rain and swell disturbance included a few rock breakouts, a few overturned rocks, sticky silt in turf flats, and patchy carpets of green *Ulva*, especially in the upper zone at the pinnacle rock. Freshwater was seeping from bluffs above the mussel bench. Notably little drift kelp or other debris was present in the usual accumulation locations. There was more evidence of rainstorm and wave disturbance at NS than at the other 3 sites, including cobble/gravel scour, patchy breakouts, some overturned rocks, and more than usual missing plot markers. Also, the hole that had opened into the surge cave enlarged considerably. Cobble/gravel scour was most evident along the upcoast portion of the site where heavy runoff from erosion ditches dropped these materials onto the intertidal flats and surge channels. Several relatively small landslides were evident in the south cove. There was little kelp wrack in north or south coves.

Sand levels usually are lower during spring surveys. As expected in S05, sand at Cardiff was low around the inshore reef; however, levels were moderate-high on the offshore mussel reef (where moving sand crosses the offshore reef), with some anemones and a few low-lying mussels partially buried. Low zone turf and grass flats were lightly sand-influenced, but not buried. Table Top projection was 1.2 m above the substrate, compared to 0.7 m in F04. The road cut was 1-1.5 m below the rim, with sand at its base. The seawall ledge was mostly well-exposed, with some sand and cobble along the base. Sand predominated around the inshore reef, with scattered cobble and very little gravel. Sand was about 1 m below lower edge of mussel zone, not burying major reef organisms. At Scripps sand levels were moderate on adjacent beaches and in low reef habitats. Generally the sand was ~0.4 m below the lower edge of the mussel zone, though a few partial burials of anemones and mussels were noted on downcoast beach rocks. At NN sand levels were high on nearby beaches, but there was little sand influence on the reef. Sand levels at NS were low-moderate in the coves, with little influence on reefs; however, accumulations of cobble and gravel were present (with local scour effects) on the upcoast portion of the site, where bluff erosion was evident.

Visitors were common at Cardiff and Scripps during both seasonal surveys, but only 2 people were seen at NS (F04), and none were seen at NN. Often 10-30 people (plus dogs at Cardiff) were present on the reefs at any one time during the low tide surveys at Cardiff and Scripps. Most visitor activities involved walking over the reef, turning over rocks, and picking up shells or animals, but at Cardiff some people collect mussels for bait when they fish from the

reef. Also, Cardiff is popular with surfers, with some surfing directly over the reef at high tide. Lifeguards occasionally drive jeeps over the upper shore portion of Cardiff Reef. Heavy construction equipment has been known to cross upper Cardiff Reef, en route to downcoast sites where cliffs were shored up to reduce bluff loss. A few spots of weathered tar were seen at the San Diego sites, but no major concentrations or fresh material.

3.2 Key Species Survey Data

The results of monitoring rocky intertidal species assemblages in fixed plots/transects at the 4 San Diego County sites in Fall 2004 and Spring 2005 are presented below, with summary data compared to previous years for each key species (see Engle et al. 1998b; Engle & Farrar 1999; Engle 2000, 2001, 2002; Engle & Adams 2003; Engle 2004 for raw data tables for prior years). Changes in percent cover are presented as differences between seasonal or annualized (mean of fall and spring) samplings, not as percent of change from a particular season's values.

Rockweed (*Silvetia compressa*)

Plots emphasizing rockweed were monitored at all sites except Cardiff Reef where *Silvetia* was absent (Tables 6-11; Fig. 9). At Scripps, rockweed cover declined from annualized highs of 64-65% the past 2 years to 40% in F04/S05. In the 8 years of surveys, rockweed abundance gradually increased from 27% to 64-65%, followed by a final year decline back to early monitoring levels. The recent decreases were evident in all 5 plots, with Plots 2, 4, and 5 showing the greatest losses. Other plants and bare substrate increased where rockweed thinned out. Rockweed cover at NN and NS remained at relatively high levels, with only slight declines recorded since last year. Plot 3 at NS lost half its cover between F04 and S05. Plot 5 at NN continued its gradual expansion from losses that occurred after S97; however, its cover remained below original 1995 levels. Over the past 8 years, *Silvetia* cover increased from 42% to 78% cover at NN and from 39% to 54% cover at NS. At all three sites, rockweed cover during the six later cooler-water years (F99-S05) was notably higher than that of the two initial warmer-water years (F97-S99). Rockweed did not occur in acorn/pink/goose barnacle or mussel target species plots, except for notably increasing amounts (averaging 18% cover the past 2 years) in three thatched barnacle plots at NN. Rockweed exhibited a slight pattern of lower abundance in spring compared to fall over the monitoring period. This seasonal pattern is not consistent for all years and is less apparent at NS.

Acorn Barnacle (*Chthamalus* spp.)

Plots targeting the small white acorn barnacles were monitored only at Cardiff and Scripps; these barnacles also occurred in low abundance within thatched barnacle plots at NN and NS, and in goose barnacle, mussel, and rockweed plots at all 4 sites (Tables 6-11; Fig. 10). *Chthamalus* cover at Cardiff recovered from 40% cover in F02/S03 to 71-72% abundance in F03/S04 and F04/S05. Trends were fairly consistent in all 5 plots. At Scripps, where sand

scour/burial is unlikely on the high barnacle ridge, acorn barnacles remained at high levels of cover in F04/S05. Plot B2 that had dropped to an all-time low of 42% cover in S04 (associated with a bloom of overgrowing ephemeral green algae), recovered by F04 nearly to previous levels. Declines in the first year of monitoring that were associated with El Niño storms were less severe, with rapid recovery (<1 year) at Scripps compared to Cardiff (3 years to recovery). Acorn barnacle cover in thatched barnacle, rockweed, goose barnacle and mussel plots at all four sites was generally low and similar to the previous year, except for declines from S04 levels in NN and NS thatched barnacle plots and in NS mussel plots.

Pink Thatched Barnacle (*Tetracilita rubescens*)

Plots targeting the relatively large thatched barnacles were surveyed at NN and NS (Tables 6-11; Fig. 10). A few *Tetracilita* occurred on rock or on mussels in several mussel and goose barnacle plots at all 4 sites. None were found in the acorn barnacle plots at Cardiff and Scripps. *Tetracilita* cover at NN and NS was similar to the past few years. Over the 8 year monitoring period, annualized thatched barnacle cover ranged from 25-50% cover at NN, and 5-12% cover at NS, with no net abundance change from Year 1 to Year 8. Most of the other cover in *Tetracilita* plots was turf algae, which has tended to fluctuate seasonally (higher in fall, lower in spring) with bare rock. A slight pattern of fall decline followed by spring increase in thatched barnacle cover was often evident during the monitoring period; this was more evident at NN than at NS. The seasonal change was associated with the variations in turf algae cover, which covered some barnacles when lush in the fall season.

Goose Barnacle (*Pollicipes polymerus*)

Goose barnacles were monitored at all 4 sites (Tables 6-11; Figs. 11-12). At NN and NS, 6 replicate plots were surveyed instead of 5 in order to maintain consistency at Point Loma with 3 sites in the Cabrillo National Monument. *Pollicipes* also were present in the mussel plots at NN and NS, but were uncommon in these plots at Scripps and Cardiff. Goose barnacle cover declined slightly at all sites since last year, except at NN where *Pollicipes* already was rare. At Cardiff, Plots 3, 4, and 5 lost cover this past year. No goose barnacles have successfully recolonized Plot 2 where a rock breakout removed the entire plot prior to S02. Plot 1, that had lost all cover from El Niño storm scour after S98, has only recovered ¼ of its original abundance in nearly 7 years. Overall, annualized *Pollicipes* cover declined from 28% to 10% during the 8-year monitoring period. Goose barnacle abundance at Scripps (where storm disturbance was not observed in any plots) lowered only slightly since last year (from 30% to 22%) and over the past 8 years (from 26% to 22%). Goose barnacles have been nearly absent from the plots at NN (~1% cover) since S02, following previous losses associated with rock breakouts and clump disappearance that have not been replaced via recruitment. Annualized abundance ranged from 12% to 16% cover from F97 through S01, but only <1% to 5% cover thereafter. At NS *Pollicipes* cover experienced gradual declines during the 8-year monitoring period, from 26%

cover in Year 1 to 8% cover in Year 8. Goose barnacle abundances in the mussel plots at the Point Loma sites also exhibited monitoring period declines (Year 1 to Year 8 = 12% to 4% at NN and 9% to 1% at NS). Losses at NN occurred primarily between S04 and F04 (from 16% to 4%) in 3 plots.

Mussel (*Mytilus californianus*)

Mussel assemblages were surveyed at all 4 sites (Tables 6-11; Figs. 11-12). A second set of mussel plots was monitored on an offshore reef at Cardiff. Inshore mussels were small-medium sized while offshore mussels were medium-large sized. Mussel recruitment and growth at Cardiff and Scripps over time has caused overgrowth of many plot markers, such that a metal detector was needed to locate plot corner bolts. Mussels also occurred in the goose barnacle plots at Cardiff, Scripps, and NS. At Cardiff, inshore mussels declined by 30% and offshore mussels by 20% after El Niño storms between F97 and S98. Since then, the mussels have steadily improved to essentially full recovery by S01, except for inshore Plot 1 (which lost all mussels when a ledge broke out between F97 and S98). Inshore Plot 1 had returned to 68% cover by F02 (compared to 83% in F97), but abundance fluctuated at lower levels thereafter (57% cover in F03/S04 and 27% cover in F04/S05). Over all plots, final year inshore mussel cover was substantially reduced from the prior year (52% vs. 87%), due to losses in 4 of the 5 plots. This resulted in final monitoring year cover below initial year cover (52% vs. 74%) (Years 4-7 ranged from 81-88% cover). Mussels in the goose barnacle plots (inshore) at Cardiff showed similar trends of 1997/1998 El Niño losses followed by gradual recovery (by F00 despite slow recovery in Plot 1) and slight losses since (including declines in Plot 2 after its S02 break-out and losses between S04 and F04). Offshore mussel plots at Cardiff showed similar patterns of decline after F97 El Niño storms, followed by gradual recovery (by S00 despite slow recovery in Plot 5). Offshore Plot 1 lost 2/3 of its cover after S00 and offshore Plot 3 lost half of its cover after F01, both losses apparently due to storm damage. These plots nearly recovered by F04, but Plot 3 lost 17% cover by S05. Overall, unlike the inshore mussel plots, offshore mussel plots increased cover slightly between Year 7 and Year 8 (from 72% to 78%) and ended up slightly above initial year level (73%).

Like Cardiff, *Mytilus* plots at Scripps have been very dynamic. They declined from 81% cover in F97 to 67% cover in S98 after El Niño storms, recovered to 85% and 93% cover by F99 and S00, declined to 47% cover by S02, gradually improved to 70% cover by S04, then declined slightly to 60% cover by S05. Declines were due to patchy losses (presumably resulting from storms) in individual plots. Plot 1 lost essentially all mussels after S00, regained $\frac{3}{4}$ of its cover after 4 years, then declined to $\frac{1}{3}$ of its cover by the final year. Plot 5 dropped from 90% to 59% cover at the same time as Plot 1, then continued to decline over the next 3 years to 14% cover in S03, but recovered by F04 to 77% cover, then was reduced to 57% cover by S05. Plots 3 and 4 recovered from El Niño losses by F99, improved to 100% cover in F01, then dropped to 35%

cover (Plot3) and 73% cover (Plot 4) by S02. Since then, Plot 3 has increased to 60% cover and Plot 4 remained fairly unchanged, except for loss of 12% from F04 to S05. Only Plot 2 remained relatively stable over the 8-year period, ranging only between 84% and 100% cover. Mussels in the goose barnacle plots (located inshore) showed less variability than those in mussel plots along the offshore edge of the reef at Scripps. Cover declined gradually from 33% in F97 to 19% in F99, followed by a gradual increase to 29-46% cover since S00. Mussels were rare at NN and NS, with the plots representing some of the few spots with mussel cover. The relatively low mussel cover at NN and NS remained relatively stable from Year 1 to Year 4 (ranging from 27% to 34% cover at NN and 18% to 22% at NS), then gradually declined to 1% cover (NN and NS) by Year 8, apparently due to storm disturbance (scour/break-out) without recovery. *Mytilus* have been absent in goose barnacle plots at NN since S01. At NS, mussels in *Pollicipes* plots declined from a peak of 18% cover in F98 to 4% cover in S05.

Owl Limpet (*Lottia gigantea*)

Owl limpets ≥ 15 mm length were counted and measured in 5 plots each at Cardiff and Scripps and 6 plots each at NN and NS (Tables 12-19; Figs. 13-18). At Cardiff, limpet counts increased from Year 1 (21 limpets/plot) to peak highs in Year 3 (45 limpets/plot), followed by gradual declines to 8 limpets/plot by Year 8. Declines were associated with encroachment of mussels into limpet plots. Although the proportion of large (≥ 30 mm) versus small (< 30 mm) limpets at Cardiff varied considerably over the past 6 years (from 28-77%), both size categories generally contributed to the increases and decreases during this period. At Scripps, limpet numbers over the 8-year monitoring period showed a bimodal pattern, with peak counts during Years 2-3 (93-96) and Years 5-7 (89-104). Abundances in Year 8 (73 limpets/plot) declined slightly from last year's level (89 limpets/plot). Both small and large limpets have contributed to the fluctuating abundance patterns; however, larger limpets have increased in proportion during the 8 years of monitoring (from 24-38% during F97-S00 to 42-56% during F00-S05). Limpet counts at NN, like Cardiff, peaked in Year 3, but subsequent declines were less severe such that Year 8 abundances (49 limpets/plot) were higher than initial Year 1 levels (43 limpets/plot). Declines apparently were due to storm damage at various times to several of the plots. Both large and small limpets contributed to the varying abundances. At NS, owl limpet numbers increased gradually from Year 1 to Year 4, then declined through Years 7-8, resulting in lower final counts (53 limpets/plot) than when monitoring began (60 limpets/plot). Declines occurred in all 6 plots and were associated with apparent patchy wave weathering (scour) of the soft sedimentary substrate. Both small and large limpets contributed to the abundance patterns.

Mean sizes varied within fairly narrow ranges, likely reflecting a combination of recruitment patterns and size-dependant mortality. Over the past 8 years, mean sizes varied from 27 to 36 mm at Cardiff (mean = 32 mm), 25 to 32 mm at Scripps (mean = 29 mm), 30 to 39 mm at NN (mean = 35 mm), and 34 to 41 mm at NS (mean = 37 mm). All sites had limpets as small

as 15 mm, with the largest limpets found at NN and NS (61-75 mm), followed by Scripps (43-60 mm), and Cardiff (44-54 mm).

Red Algal Turf (*Corallina* spp, et al.)

Red turf is a mixed species assemblage of low-growing algae that carpets the middle intertidal zones of low-relief reefs. In San Diego County this turf can contain as many as 67 types of plants, but often 2 species of erect coralline algae (*Corallina vancouveriensis* and *C. pinnatifolia*) dominate (Stewart & Myers 1980; Stewart 1982; Stewart 1989a,b). Turf cover was measured in line-intercept (F97-S00) or point-intercept (F00-S04) transects at all 4 sites (3 replicates each at Cardiff and Scripps; 2 replicates each at NN and NS) (Tables 20-25; Figs. 19-20). In S02, a third transect was established at both NN and NS to conform to the 3-replicate standard set for point-transects by the Multi-Agency Rocky Intertidal Network. Red algal turf also was common in the surfgrass transects at Cardiff and Scripps, but was overlain with grass to such an extent at NN and NS that it received low primary cover scores there. From F97 to S03, red turf cover at Cardiff varied relatively little (65-83%); however, in F03 turf abundance was only 31% because for the first time, sand covered 58% of the transects. From S04 through S05, turf returned to 52-61% cover; however, Year 8 turf cover (56%) was lower than initial monitoring year cover (80%). Red turf at Scripps was variable (28-74% cover) over the 8 years of monitoring. Turf transects here were in a more heterogeneous habitat consisting of mixed boulders and pools. The Scripps transects originally were set up to also monitor sand tube worm mounds (*Phragmatopoma californica*), but these disappeared after F97/S98, and have been absent or rare since. Overall, turf abundance at Scripps increased from Year 1 levels (28%) to 60-74% cover during Years 2-5, then gradually declined to 40% by Year 8. Lower turf levels were associated with increased sand cover in pools or higher cover of rock oysters, barnacles, and crustose algae. Apparently at times areas of turf were scoured away by winter surf, exposing the understory rock oysters and other life. At NN and NS red turf occurs on relatively uniform, flat benches. Here turf cover has been high and varied relatively little over the monitoring period from Year 1 to Year 8 (81-100% cover at NN: 90-96% cover at NS). At NN red turf cover dropped to 66% in S04; however, this was not due to loss of turf, but rather to a bloom of ephemeral green and brown algae that attached to and covered some turf.

Surfgrass (*Phyllospadix* spp.)

Surfgrass was targeted at all 4 sites, with 3 line-intercept transects each at Cardiff and Scripps, and 2 inshore and 2 offshore transects each at NN and NS (Tables 20-25; Fig. 20). It also occurred to a minor extent in the turf transects at all sites. During the past 8 years, annual *Phyllospadix* cover varied relatively little at NN (89-96%) and NS (91-98%), but was more variable at Cardiff (26-95%) and Scripps (18-44%). The transects at NN and NS are located on flat benches with dense surfgrass cover. Those at the other sites are on flat (Cardiff) or irregular (Scripps) reef edge habitats where surfgrass is patchy. Annual surfgrass cover at Cardiff

increased from Year 1 to a peak in Year 3 (95%), thereafter declining to its lowest level of 26% by Year 8 (with the greatest decline occurring in Transect 3). The pattern was similar, but less pronounced at Scripps, with peak annual cover in Year 3 (44%), followed by declines to 18-27% levels in subsequent years. Surfgrass abundance often varied seasonally, with slightly higher cover in fall compared to spring. This seasonal variation over the 8 years of monitoring was most evident at Scripps and Cardiff, but was less obvious at NN and NS (where grass beds often appeared thinner in spring, yet still covered nearly all the substrate). Typically in spring surveys, portions of the surfgrass habitat appeared thinned out, tattered, bleached, or covered with epiphytes. Some seasonal losses apparently resulted from storm damage; others may have been associated with aerial exposure to midday low tides during winter months. *Phyllospadix* decreases were generally matched by increases in understory red algal turf cover.

Other Transect Species

Boa Kelp (*Egregia menziesii*), occasionally common in low intertidal transects at the Cabrillo National Monument (at the south end of Point Loma), was not encountered over the 8-year monitoring period in turf or surfgrass transects at NN, or NS (Tables 20-23). It only rarely occurred as 1-2% cover in turf transects at Scripps (in F01 and F03) and surfgrass transects at Cardiff (in F01, S03, and F03). Sargassum weed (*Sargassum muticum*) occurred in minor amounts (1-3%, except 5-7% at Scripps during F00-F01) in turf transects at Scripps (all years except Year 8) and NS (in F00-F01 and F04) (Tables 20-23). Aggregating anemones (*Anthopleura elegantissima/sola*) were sampled mainly at Cardiff, where they covered 2-11% of the turf transects since F97 (Tables 20-23). Sand castle worms (*Phragmatopoma californica*) occupied 46% of the turf transects at Scripps in F97, but dropped to 0% after S98, except for 1-2% cover during F00-F01 and 4% cover in F04 (Tables 20-23; Fig. 19).

Black Abalone (*Haliotis cracherodii*) and Ochre Seastar (*Pisaster ochraceus*)

Black abalone and ochre seastars once were common in San Diego County, but in recent decades have been absent or uncommon, to the extent that it was not possible to establish fixed plots to survey for them. Instead, haphazard timed searches at each site were carried out to document their absence/rarity or possible recovery. No black abalone were found at any of the 4 monitoring sites since S95 at NN and NS and since F97 at Cardiff and Scripps (Table 26). No ochre seastars were found at NN or NS since S95, except for a single ochre seastar at NN in F02. Ochre seastars were absent at Cardiff from F97 to S99; however, from F99 to S05 ochre stars counts ranged from 7-32 (except for F00 and S03 when 0 and 1 stars were found because poor sea conditions made searching low intertidal crevices difficult), with peak values (20-32) occurring in F01 and F03-S05. *Pisaster ochraceus* were absent at Scripps from F97 to F98. From S99 to S05, ochre stars counts were variable, but generally increased from 4 to 223 individuals (except for S01 when no stars were found because strong surf made searching crevices along the outer reef difficult), with peak numbers (35-223) occurring from F03 and S05. Although seastar

counts are imprecise due to the large area searched, difficulty in searching crevices, and varying accessibility to the low intertidal zone, ochre seastar populations have clearly increased substantially since 1999 at Cardiff and Scripps, the 2 sites with good mussel beds upon which the seastars prey. These increases occurred despite the likelihood that some seastars have been collected as souvenirs by people visiting these two highly accessible sites.

4. Discussion

This section synthesizes information acquired during the San Diego County rocky intertidal monitoring surveys with respect to the temporal variability of index species populations and effects of human activities. The natural history and ecology of the index species are summarized in Engle and Davis (1996b). It is important to note that determination of the cause for any abundance change is a difficult process. Much can be inferred from the data and observations during the monitoring, combined with knowledge gained from previous intertidal ecology and impact studies; nevertheless, carefully designed experiments would be necessary to attribute specific causality with confidence. There now are 8 samples from each season during the period F97-S05 at Cardiff and Scripps Reefs. At Navy North and Navy South, there are 10 samples from each season from S95 to S05 (no sample was taken in S96). Navy data from 1995 are discussed in Engle and Davis (1996c). Data from 1996-2004 are discussed in Engle et al. (1999), the First Year Report (Engle et al. 1998b), Second Year Report (Engle & Farrar 1999), Third Year Report (Engle 2000), Fourth Year Report (Engle 2001), Fifth Year Report (Engle 2002), Sixth Year Report (Engle & Adams 2003), and Seventh Year Report (Engle 2004).

During the initial four years of surveys, there was no activity from the Navy/San Diego Association of Governments (SANDAG) Beach Replenishment Project. Therefore any key species changes during that period were due to natural environmental variations or to impacts from other human activities. In 2000, the Navy Beach Replenishment Project was converted to the San Diego Association of Governments (SANDAG) Regional Sand Beach Project. Two million cubic yards of sand were pumped from offshore sites to 12 San Diego County beaches from Oceanside to the north to Imperial Beach to the south during April to September 2001. The Cardiff State Beach receiver site, located approximately 3,400-4,200 feet upcoast of Cardiff Reef (south of the San Elijo Lagoon mouth and also south of Restaurant Row along Coast Highway 101), received 101,000 cubic yards of sand during August 2-10, 2001. Therefore, the Year 5 (F01-S02) rocky intertidal monitoring surveys at Cardiff Reef characterize biological conditions 3-7 months after the nearby sand beach replenishment was accomplished and the final Year 8 (F04-S05) monitoring took place 3.25-3.6 years post sand deposition. None of the other 3 sites were near beach replenishment areas (see SANDAG 2000).

Other possible smaller-scale beach replenishment activities may have occurred during the 8-year monitoring period. For example, San Elijo Lagoon was dredged in Spring 2004, with

material placed on the beach upcoast of restaurant row (north of Cardiff Reef site). It is not known whether the material reached the study area.

The composition and abundance of plants and animals on rocky intertidal reefs can be affected by sand dynamics. Where sand beaches occur near rocky reefs, a typical seasonal cycle of sand movement consists of offshore movement during the winter (due to storm waves) followed by onshore deposition during the summer (when storms are less frequent). Alongshore sand movement dynamics are complex, depending on shoreline features, ocean swells, and currents (see SANDAG 2000). Sand influence on intertidal reefs includes turbidity, scouring, and burial effects (Daly & Mathieson 1977; Seapy & Littler 1982; Taylor & Littler 1982; Littler et al. 1983, 1991; Murray & Bray 1993). Three types of organisms often dominate intertidal reefs heavily influenced by sand: 1) opportunistic species that are able to quickly establish populations on disturbed rocks, 2) resistant species that can tolerate sand scour and burial, and 3) “sand-loving” species that for various reasons thrive on sanded reefs (Murray & Bray 1993). Opportunistic species include green sea lettuce types (*Ulva* spp. and *Enteromorpha* spp.), ephemeral filamentous brown algae, white acorn barnacles (*Chthamalus* spp.), and sand castle worms (*Phragmatopoma californica*). Resistant species include tough crusts, turfs of erect coralline algae, and aggregating anemones (*Anthopleura elegantissima/sola*). Sand-loving species include a variety of brown and red algae, as well as surfgrass (Littler et al. 1983). Lower-relief reefs are most affected by sand disturbance, while higher-relief reefs are more likely to remain above the sand and be dominated by longer-lived species such as mussels, owl limpets, and goose barnacles (Littler et al. 1983).

Changes in key species abundances at Cardiff Reef could indicate effects from beach replenishment if the added sand reached the reef, if other possible causes for the changes were unlikely, and if these changes were substantially different in direction or magnitude than any at Scripps or the 2 Point Loma sites. Separate studies by AMEC Earth and Environmental, Inc. for SANDAG will determine the likelihood of replenished sand having reached Cardiff Reef. Sand levels found during F01 and S02, approximately 3 and 7 months after the upcoast sand deposition, did not exceed maximum levels observed during previous biannual surveys. The F01 sand levels were not very high, well within the range of typical levels for that time of year (e.g., F99 and F00 sand levels were higher than F01). Also, in July 2001, 1 month before upcoast beach replenishment, already high sand levels were photographed by Bonnie Becker (Scripps Institution of Oceanography). Sand levels at Cardiff in S02 were higher than expected (compared to S99, S00, and S01). Typically, sand levels are low in spring (due to beach loss resulting from winter storms), but S02 levels were slightly higher than F01 and comparable to F00 levels despite evidence that at least one storm had occurred (a couple of large rock slabs had broken off and moved, yet still contained live mussels and other organisms). None of the fixed plots or transects were buried in S02 and there was relatively little sand by the seawall. Sand levels along

the offshore edge of the offshore mussel reef extended up to the lower edge of the mussel zone, with occasional mussels buried. Except for the few buried mussels, there was no obvious evidence of sand burial or scour on the marine life at Cardiff Reef. In fact, acorn barnacle cover doubled from Year 4 to Year 5, having now recovered from El Niño storm scour losses in late 1997/early 1998. The surfgrass at Cardiff in S02 appeared thinned out and tattered, with lower cover. This condition was typically observed, to varying degrees, in spring surveys, presumably caused by winter storms and/or sun exposure during particularly low midday tides.

Sand levels at Cardiff reef in F02 were the highest observed since monitoring began. The source of this sand is not known; however, exceptionally high sand levels also were discovered at Scripps Reef in F02. Since Scripps Reef is not near any previous sand deposition sites, the most likely cause for the high sand levels at these 2 sites was unusually calm sea conditions that allowed sand to accumulate on shore. By S03, sand levels returned to expected seasonal low levels at Cardiff, but were only moderately low at Scripps. There is little sand in the vicinity of the extensive rocky reefs at NN and NS on Point Loma, so it is not surprising that sand influence is less of a factor at these sites.

The peak levels of sand on Cardiff and Scripps Reefs in F02 provided an opportunity to document sand burial effects. The presence of mussel byssal threads, and dead barnacle tests along the relatively few reef areas newly buried by sand indicated that sand burial can kill mussels and barnacles. White acorn barnacles are capable of rapid recovery, but mussels can take years to recover, depending on recruitment and other factors (Vesco and Gillard 1980). Sand burial and scour can determine the lower tide zone limit of such species assemblages. Large swells in association with high sand levels would exacerbate deleterious effects due to increased sand scour, though swells would eventually move more sand offshore. Sand-adapted species such as some turf algae, aggregating anemones and surfgrass should be less affected by sand burial, especially if the burial is not prolonged. Low areas of the turf transects at Cardiff and Scripps were buried in F02 (sand covered 21% of transects at Cardiff and 23% of transects at Scripps), with turf cover reduced. These values largely rebounded by S03, except sand still covered some portions of transects at Scripps (sand covered 3% of transects at Cardiff and 14% of transects at Scripps). Surfgrass cover declined notably at Cardiff in F02, but only in 2 of the 3 transects, both of which showed further declines by S03 while the third transect remained at high cover levels. Surfgrass transects at Scripps Reef had declined prior to F02, and actually increased in cover with the higher sand levels. It is possible, but not known, that surfgrass losses at Cardiff in F02 were caused by higher sand levels or scour. In any case, it is not unusual for surfgrass growing at the upper fringe of its zone to fluctuate in cover as physical conditions vary.

Sand levels at Cardiff in F03 were high around the reefs, but not as high as the record levels found in F02, except that for the first time since monitoring began over 70% of Turf Transect 3 was buried. Sand levels were not unusually high around the offshore mussel reef;

however, sand was particularly high in the area between the inner and outer mussel reefs, including the transect locations. In addition to the first ever burial of Turf Transect 3, about half of the other turf transects were covered, with lesser sand cover on the surfgrass transects. There was no evidence of mortality of buried anemones or turf. Some anemones along the north edge of the inshore reef were partially buried, but not any mussels. Sand covered the south portion of inshore reef, but did not affect the owl limpet plots or mussel slope. The differing distribution of sand at Cardiff Reef in F03 demonstrates the variability in sand movement and deposition dynamics at this location.

Sand levels also were high at the “control” site at Scripps Reef in F03, along the north and south reef margins and in low areas within the reef, but not as high as Fall 02. Generally the sand was 0.2-0.3 m below the lower edge of the mussel zone. Some anemones and turf were buried, but not mussels. There was little sand influence on the reefs at NN and NS. By S04, sand levels were relatively low at all 4 sites, as is typical for this time of year. The turf transects at Cardiff that had 58% sand cover in F03, had only 4% sand in S04. Surfgrass transects dropped from 18% to 5% sand cover. Red turf buried in F03 had largely rebounded to typical levels either through re-exposure or regrowth. Surfgrass cover declined 18% from F03 to S04, slightly more than previous fall to spring declines that ranged from 9-17%. Surfgrass at Scripps declined only 4% from F03 to S04. Overall, sand levels at Cardiff and Scripps in Year 7, though high enough to bury some transect species in F03, returned to typically low levels by S04, with no unusual effects on most intertidal life with the possible exception of surfgrass.

In Year 8 (F04/S05), sand levels at Cardiff and Scripps followed a pattern similar to Year 7, with relatively high levels in F04 and lower levels in S05. Some anemones, surfgrass, and coralline turf were partially or fully buried in F04, but not mussels or barnacles. Cardiff turf transects had 30% sand cover in F04, then 8% cover in S05. Scripps turf transects had 55% sand cover in F04, then 9% cover in S05. Despite some sand burial of turf, F04 turf cover at Cardiff was similar to S04 and only 9% lower in S05 (due to increased ephemeral brown algae). However, surfgrass cover did not rebound as expected from S04 to F04; instead, it declined by 10%, followed by a 20% decline from F04 to S05. Surfgrass abundance at Scripps was unchanged between S04 and F04, then declined by 8% by S05. It is not known whether the declines in surfgrass at Cardiff (and to a lesser extent at Scripps) were associated with higher sand levels in F02, F03, and F04. Surfgrass is regarded as a “sand-loving” species (Littler et al. 1983) and there was relatively little sand cover on the surfgrass transects during those fall high sand surveys; however, it is possible that the surfgrass (at its upper low-tide limit) was adversely affected by scour from shifting sand.

Table 27 summarizes broad-scale temporal trends in key species abundances at the 4 San Diego County rocky intertidal sites with respect to the following comparisons: 1) prior year changes (Years 7-8), 2) monitoring start to end changes (Years 1-8 for all sites plus 1995 to Year

8 for Navy sites), 3) annual changes before/after sand deposition up-coast of Cardiff Reef (Years 4-5), and 4) multi-year changes before/after sand deposition up-coast of Cardiff Reef (Years 1-4 compared to Years 5-8). Data for Fall and Spring surveys were combined for given years to remove seasonal fluctuations (this also averaged out some of the effect of the El Niño storms in Year 1). Major abundance trends are indicated as increasing (positive), decreasing (negative), or no change (“no change” was defined as changes in % cover ≤ 15 or changes in counts of ≤ 10 individuals/plot).

Species abundances were more dynamic at Cardiff than at any other site. Of 14 key species monitored at the San Diego County sites since F97, 1 species (black abalone) was never found and 4 species (boa kelp, sargassum weed, aggregating anemone, and sand castle worms) were relatively uncommon. For 7 target species monitored at Cardiff Reef (rockweed was absent and thatched barnacles were not targeted at Cardiff), major trends over the past year were as follows: 1) acorn barnacles, goose barnacles, owl limpets, red turf, and ochre seastars did not show major changes in abundance from F03/S04 to F04/S05; and 2) mussels and surfgrass decreased in abundance. The 8-year species abundance comparisons show 5 of the 7 species declining, with acorn barnacles and seastars increasing. Short-term pre/post sand deposition comparisons indicated no change for 5 of the 7 species, with acorn barnacles and seastars increasing. Multi-year pre/post sand deposition comparisons revealed no change for goose barnacles and mussels; declines for owl limpets, red algal turf, and surfgrass; and increases for acorn barnacles and seastars.

Scripps Reef, the next closest monitoring site to Cardiff, also bordered by sand beaches, and also open to public visitation, was more stable with regard to target species abundances (Table 27). Differences among sites are not unexpected due to the complex of physical and biological interactions that occur at each rocky intertidal location and the patchiness of some disturbance effects (e.g., storm damage). At Scripps broad-scale abundances changed relatively little over the past year for 6 of the 9 key species, while rockweed and owl limpets declined, and seastars increased. Over the 8-year monitoring period, 7 species were unchanged, sand castle worms declined, and seastars increased. There were no major abundance changes at Scripps pre/post sand deposition up-coast of Cardiff, except in multi-year comparisons mussels declined and rockweed and seastars increased.

Many of the variations in trends between Cardiff and Scripps likely are related to microhabitat differences between the 2 sites. Acorn barnacles on the low relief reef at Cardiff are more susceptible to sand/gravel scour than those on the more stable, high relief ridge at Scripps. Cardiff barnacles were impacted by the severe F97/S98 El Niño storms (that destroyed a portion of the parking lot), then recovered to new highs by Year 8. Goose barnacles on low relief ledges at Cardiff experienced storm-related scour and rock breakouts that did not occur along the Scripps ridge that is partially sheltered by the outer boulder reef. Mussels at both sites

experienced patchy storm-related losses. The inshore mussel reef plots at Cardiff experienced losses (35% annualized decline; losses in 4 of 5 plots) in Year 8 (cause unknown, but coincident with El Niño elevated water temperatures and heavy rainfall) that did not occur at the offshore reef or at Scripps.

The low relief mussel zone habitat at Cardiff is marginal for owl limpets compared to the high relief, crevice-rich ridge at Scripps. Expanding mussel cover on the inshore reef during Years 4-7 encroached on owl limpet grazing space and likely lead to their declines. The turf zone at Cardiff is flatter and more prone to sanding than the pool and boulder turf areas at Scripps. The surfgrass zone is marginal at both sites, but the low relief surfgrass habitat at Cardiff is more susceptible to sand influence than the medium relief boulder habitat at Scripps. Sand castle worms, targeted only at Scripps, were decimated following the F97/S98 El Niño storms, and have shown essentially no recovery 7 years later. Sand castle worms are capable of rapid recolonization if conditions permit. Sand castle worm mounds also are vulnerable to crushing via trampling by reef visitors (Zedler 1976, 1978). Scripps Reef is protected from collecting, but is a popular destination for beach explorers.

Ochre searstar counts increased dramatically at both Cardiff and Scripps from complete absence during F97-F98 to nearly 30 at Cardiff and over 200 at Scripps by S05, while only 1 was found at NN/NS during the 8-year monitoring. Also, only 1 ochre searstar has been found at the Cabrillo National Monument at the southern tip of Point Loma since 1990 (Engle & Davis 1996b; Engle et al. 1999; Becker, unpublished data). Southern California seastars have been devastated during warm-water periods since 1978 due to a wasting disease apparently caused by a *Vibrio*-type bacterium (Eckert et al. 2000). Seastars at the Northern Channel Islands have experienced population increases during the cooler-water years following the 1997-1998 El Niño (Blanchette et al. 2005). It is not surprising that ochre seastars appeared at Cardiff and Scripps and not at the Navy sites, since their principal prey (mussels) are common at the former locations and very rare farther south at Point Loma. Increased numbers of seastars may reduce mussel abundances, especially in the lowest intertidal zones (Blanchette et al. 2005).

Navy North and Navy South sites, located on Point Loma where sandy beaches are fewer and less extensive, and where public visitation is rare, exhibited fewer major trends in key species abundances than Cardiff or Scripps (Table 27). At both sites, all of the broad-scale species levels remained relatively unchanged over the past year and many other abundance comparisons were relatively unchanged. Both sites showed long-term declines in goose barnacles and mussels as the few remaining specimens gradually disappeared without significant recruitment occurring. Two differences include: 1) Rockweed increased more at NN over this 8-year monitoring period (even expanding in several thatched barnacle plots), and 2) owl limpets increased since 1995 at NN, but declined more over the past four years at NS (where sedimentary rock breakouts occurred more frequently). Overall, owl limpets are the most

variable species monitored. In addition to changes associated with rock breakouts that occasionally devastate particular plots, sampling variability is inherently greater for this species due to difficulties in locating and recognizing smaller individuals often hidden in crevices.

Trends at NN and NS mostly were similar to those at three sites (monitored by the National Park Service since 1990 using the same protocol) at the Cabrillo National Monument (CNM) at the southern end of Point Loma (Engle & Davis 1996b; Engle et al. 1999; Becker, unpublished data). For example, like NN/NS, rockweed, goose barnacles, mussels, and surfgrass at CNM were unchanged from Years 7 to 8. Over the 8-year monitoring period, at CNM rockweed cover was relatively unchanged or increased slightly, already uncommon/rare goose barnacles and mussels remained unchanged overall, and the abundant surfgrass also was mostly unchanged. As at NN and NS, owl limpet counts at CNM were quite variable.

Along with the broad-scale trends exhibited by key species over the 8-year project period, considerable smaller-scale variability occurred among plots, sites, and sampling dates. Many differences were related to varying cycles of patchy disturbance and recovery from storm surf damage (with recovery typically more prolonged for bedrock break-out losses compared to losses only of biotic cover). El Niño storms likely caused many of the changes in key species populations during the 1997/98 period (see Engle et al. 1998b). Storms can thin out rockweed and surfgrass patches, scour barnacle zones, and tear out mussel clumps (Gunnill 1983; Stewart 1989a; Ambrose et al. 1995; Engle and Davis 1996b; Engle et al. 1998b). These effects occurred at all 4 monitoring sites, but were most evident at the north county locations, especially at Cardiff Reef. For example, most inshore mussel plots at Cardiff took about 3 years to recover from losses associated with El Niño storm disturbances that occurred after the initial F97 sampling, though 1 plot never fully recovered. Offshore mussels at Cardiff, less damaged by the El Niño storms, recovered in 2 years, but then experienced patchy losses in certain plots after S00 and F01. Mussels at Scripps were less affected by the El Niño storms and recovered in about 1 year; however, patchy losses in particular plots in F00, F01, and F04 resulted in plots exhibiting varying stages of recovery by Year 8. Other cycles of patchy losses presumably due to storms were documented for acorn barnacles at Cardiff and Scripps, for goose barnacles at Cardiff and NN, and for owl limpets and mussels at NN and NS.

Seasonal patterns of abundance were apparent in varying degrees for the following key species: rockweed, pink thatched barnacles, red turf, and surfgrass. These within-year variations were likely due to winter storms, which wore down or removed portions of plants that then regrew over the milder summers. Rockweed and surfgrass tended to cycle between higher cover in fall and lower in spring, with the extent of this pattern varying by site and year. This pattern also was evident at the Cabrillo National Monument sites on Point Loma (Engle & Davis 1996b; Engle et al. 1999; Becker, unpublished data). Fall plants looked healthier, while spring plants often appeared partially bleached, thinned, and tattered. At Cardiff and Scripps, red turf cover

tended to fluctuate between taller erect coralline algae in fall and short “sand turf” in the spring. The sand turf apparently represents a low form of red turf “weathered” by winter storms and sand abrasion. The sand turf form was not evident much at NN and NS, where sand influence was minimal, but turf at these Point Loma sites often appeared to be shorter during the spring samples. In many years at NN, thatched barnacle cover tended to be higher in spring and lower in fall, despite the fact that these barnacles are relatively large and long-lived. The changing cover of thatched barnacles was primarily associated with coralline turf seasonality. Taller coralline turf in the barnacle plots during fall samples often obscured the thatched barnacles, which were re-exposed in spring after winter storms weathered the turf.

The seasonal and annual variability in species abundances at the 4 San Diego County sites took place within a larger-scale oceanographic context over the 8-year period of this project as sea conditions shifted from a long-term warming trend (culminating in the severe 1997/98 El Niño) to a cooler trend initiated by La Niña and continued relatively cool or near normal conditions, except for a mild El Niño in F04/S05. Figures 21 and 22 show these seawater temperature patterns based on satellite sea surface thermal imagery (NOAA CoastWatch West Coast Regional Node website: http://coastwatch.pfel.noaa.gov/time_series.html) and surface temperatures recorded daily at the Scripps Pier (<http://www-mlrg.ucsd.edu/shoresta/index.html>). Long-term warming has been associated with northward shifts in the ranges of southern species (Barry et al. 1995; Engle & Richards 2001) and with dramatic declines in the abundance of zooplankton (Roemmich & McGowan 1995) and kelp beds (Dayton et al. 1999) in southern California. The species assemblages monitored at the San Diego County sites through 1998 reflected the cumulative effects of this 22-year warming pattern.

The period 1999-2004, characterized by cooler or near normal temperatures, fewer severe storms, and often reduced rainfall apparently benefited some key species populations, such as rockweed, mussels, and seastars (the warmer temperatures and heavy rains associated with the F04/S05 El Niño may have offset some of these trends in Year 8). Though patchy storm damage reduced abundances at some sites, there is a tendency of modestly higher abundances of these species during the cooler-water years. For example, rockweed cover was higher at all monitored sites in Year 7 versus Year 1. Mussels declined at the Point Loma sites (where recruitment appears to be minimal), but maintained or increased (from El Niño losses) dense populations at Cardiff and Scripps, as indicated by continued overgrowth of bolts and expansion into the owl limpet plots at Cardiff. Increased numbers of adult stars at Cardiff and Scripps likely reflect a combination of recruitment and migration inshore from the shallow subtidal to feed on increased abundances of mussels. Cooler, nutrient-rich conditions promote the growth of marine plants. Invertebrate recruitment likely was enhanced by productive, cool-water conditions. Thriving plankton populations can provide additional food for intertidal filter-feeders, such as barnacles and mussels. Also, cooler water may stress organisms adapted to warm conditions, and

expanding species may usurp the space previously occupied by less competitive taxa (e.g., mussels encroaching on owl limpet territories).

The rocky intertidal sites in San Diego County have experienced especially interesting environmental changes during the 8 years of this study. The monitoring has documented changes associated with warm, wet, and stormy periods bracketing cool, dry, and mild oceanographic periods. The occasional and extremely patchy effects of storm swells, with variable recovery cycles were a major source of within- and between-site heterogeneity. Seasonal abundance patterns, related to winter storms, rainfall, aerial exposure, and other short-term environmental changes, were evident for particular key species. The long-term monitoring program has enabled enhanced understanding of these overlapping patterns of change through time, such that possible impacts from human activities including the sand beach enhancement project are easier to detect and evaluate.

Possible effects from the nearshore sand deposition upcoast of Cardiff Reef in August 2001 would have been most likely during Year 5 (F01/S02). However, sand levels at Cardiff Reef were not high in F01 and though higher than expected in S02, not beyond the typical annual range. Overall, except for a few buried mussels on the offshore reef in S02, there were no changes in key species abundances between Years 4 and 5 that indicated obvious impacts from sand added upcoast of Cardiff Reef, if in fact the additional sand reached the reef. F02, F03, and F04 revealed seasonally high sand levels at Cardiff Reef that were higher than in years prior to the sand deposition. During these periods, sand in low areas did adversely affect relatively few species outside of the monitoring plots (e.g., low zone mussels and barnacles), and might have contributed to recent declines in monitored mussels, owl limpets, red turf, and surfgrass. However, similarly high sand levels also occurred at Scripps Reef (which had not been near any sand beach enhancement activities) during the same time periods, with similar affects on some low-zone species (mostly outside of plots which are on higher relief rocks, but possibly affecting low turf and surfgrass transects).

Given the lack of high sand levels at Cardiff Reef 3 months after the upcoast sand deposition, the observations that 0.6-3.6 year later periods of seasonally higher sand levels also occurred at the Scripps control site, the monitoring data indicating higher species abundance variability at the small, typically sand-influenced reef at Cardiff, and the reasonable relationship between weather/oceanographic patterns and most species trends, there is no clear indication of adverse impacts from the upcoast sand beach enhancement to date. Seasonally higher sand levels at Cardiff and Scripps did affect particular low intertidal life that was buried or perhaps scoured for an extended period, thus providing insight into potential impacts should beach enhancement increase sand levels along rocky reefs. For example, sand burial can determine the lower limit of mussel beds and barnacle zones on sand-influenced reefs.

Currently there are no plans to continue intertidal monitoring at the 4 San Diego sites. Results of the monitoring program confirm the importance of periodic surveys that provide a dynamic baseline against which to evaluate possible effects, not just of sand beach replenishment, but also of oil spills or other potential impacts and effects of public visitation. Trend data from these sites have been entered into a master database of the Multi-Agency Rocky Intertidal Network, which permits long-term comparisons among similar surveys ongoing at over 70 other regional intertidal sites in California. It is important to San Diego County, the State of California, and the U.S. Navy to avoid data gaps in this long-term monitoring, because such gaps will compromise the ability to analyze, compare, and draw conclusions about natural versus human-caused changes in our valuable rocky intertidal ecosystems.

5. Conclusions

Based on the eighth-year results of rocky intertidal surveys in San Diego County, the following conclusions are presented:

1) Four rocky intertidal sites were monitored biannually from Fall 1997 through Spring 2005 for changes in abundances of 14 key species to evaluate possible effects from the Navy (later SANDAG) Beach Replenishment Project. Cardiff (possible impact site) and Scripps (control site) are bordered by extensive sand beaches. Navy North and Navy South sites on Point Loma, with little adjacent sand, provide additional baseline perspectives.

2) A section of Cardiff State Beach, located approximately 3,400-4,200 feet upcoast of Cardiff Reef, received 101,000 cubic yards of offshore sand during August 2-10, 2001. Three months after the sand deposition, reef edge sand levels were within typical seasonal height ranges at Cardiff and Scripps. Sand levels 7 months post-deposition were moderately high (for spring surveys) at Cardiff and low-moderate at Scripps. There was no evidence of sand burial or scour effects on marine life at Cardiff or Scripps in F01 or S02, except for a few buried mussels on the offshore reef at Cardiff in S02.

3) High sand levels at Cardiff in F02 (15 months after the sand deposition) apparently were unrelated to beach replenishment because similarly high sand levels also occurred at the Scripps control site. At both sites, sand affected a narrow zone of low intertidal life (mostly outside of monitoring plots) that was buried or perhaps scoured (including relatively few mussels, barnacles, anemones, turf algae, and surfgrass), thus providing insight into potential impacts should beach enhancement increase sand levels along rocky reefs. In S03 sand levels were low at Cardiff and low-moderate at Scripps.

4) Year 7 sampling documented moderately high sand levels at Cardiff and Scripps in F03, followed by relatively low sand levels by S04, all within the range of seasonal variation previously documented. The differing intra-reef distribution of sand at Cardiff in F03 (some anemones and turf buried, but not mussels) demonstrated the variability in sand movement and deposition dynamics at this location.

5) In Year 8, sand levels at Cardiff and Scripps followed a pattern similar to Year 7, with relatively high levels in F04 and lower levels in S05. Some low-zone anemones, surfgrass, and coralline turf were partially or fully buried in F04, but not mussels or barnacles. It is not known whether the declines in surfgrass (considered a “sand-loving” species) at Cardiff (and to a lesser extent at Scripps) were associated with higher sand levels in F02, F03, and F04. Other species appeared little affected by seasonally-increased sand levels or quickly recolonized.

6) Of 14 key species monitored, 1 (black abalone) was never found and 4 (boa kelp, sargassum weed, aggregating anemone, and sand castle worms) were relatively uncommon. Other species abundances varied little or considerably by plot, site, season, and year. Of the 4 sites, relatively unprotected Cardiff experienced the most disturbances from storm swells and sand/gravel scour over the 8-year monitoring period. The ecosystem of this sedimentary rocky reef, isolated by extensive sand and gravel beaches, represents a mosaic of species assemblages created by patchy disturbance phenomena.

7) Major abundance trends for 7 target species at Cardiff from Years 7 to 8 were: 5 species (acorn and goose barnacles, owl limpets, red turf, and ochre seastars) showing little change and 2 species (mussels and surfgrass) decreasing. Eight-year species abundance comparisons revealed 5 of 7 species declining, with acorn barnacles and seastars increasing. Short-term pre/post sand deposition comparisons indicated no change for 5 of 7 species, with acorn barnacles and seastars increasing. Multi-year pre/post sand deposition comparisons revealed no change for goose barnacles and mussels; declines for owl limpets, red turf, and surfgrass; and increases for acorn barnacles and seastars.

8) The other 3 sites also showed considerable smaller-scale variability, but few major trends over Years 7 to 8 (seastars increased; rockweed and owl limpets decreased at Scripps). Year 1 to 8 comparisons revealed increasing rockweed at NN and seastars at Scripps; and decreasing goose barnacles at NS, mussels at NN and NS, and sand castle worms at Scripps. Many of the variations in species trends between Cardiff and Scripps likely were related to microhabitat differences.

9) Seasonal cycles of abundance were apparent over the 8-year period in varying degrees for rockweed, red turf, and surfgrass, with lower cover in Spring apparently associated with “weathering” from winter storms. Other storm affects on various key species included

sand/gravel/cobble scour (especially in barnacle plots at Cardiff), mussel dislodgement (particularly at Cardiff and Scripps), and bedrock breakouts (at all sites). Storm effects were patchy and recovery rates variable.

10) Seasonal and annual variability in species abundances at the 4 sites occurred within a larger-scale oceanographic context over the 8-year monitoring period as sea conditions shifted from a long-term warming trend (culminating in the severe 1997/98 El Niño) to a cooler trend initiated by La Niña and continued cool or near normal conditions, except for a mild El Niño in F04/S05. The relatively cool 1999-2004 period experienced fewer severe storms and reduced rainfall that apparently benefited species such as rockweed, mussels, and seastars; however, warmer temperatures and heavy rains associated with the F04/S05 El Niño may have offset some of these trends in Year 8.

11) Given the lack of high sand levels at Cardiff Reef three months after the upcoast sand deposition, the observations that later periods of seasonally higher sand levels also occurred at the Scripps control site, the monitoring data indicating higher species abundance variability at the small, typically sand-influenced reef at Cardiff, and the reasonable relationship between weather/oceanographic patterns and most species trends, there is no clear indication of adverse impacts from the upcoast sand beach enhancement. Seasonally higher sand levels at Cardiff and Scripps did affect some low-zone intertidal organisms that were buried and/or scoured; however, the disturbance was limited in time and magnitude such that most of these sand-adapted species survived or quickly recolonized.

12) This long-term monitoring program has enabled enhanced understanding of seasonal, annual, and multi-year patterns of species abundance dynamics. These ecological perspectives are critical for evaluating possible impacts from human activities, including the sand beach enhancement project, oil spills, and recreational visitation. The sampling data have been entered into a master database of the Multi-Agency Rocky Intertidal Network, which facilitates comparisons among similar surveys ongoing at over 70 regional intertidal sites on the Pacific Coast. Currently there are no plans to extend intertidal monitoring at the 4 San Diego County sites. This important, cost-effective survey program should be continued. Any spatial or temporal data gaps will compromise the ability to analyze, compare, and draw conclusions about natural versus human-caused changes in our valuable and relatively rare rocky intertidal ecosystems.

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Table 1. Summary of Key Species Assemblages Monitored at the Four San Diego County Sites.

In addition to the targeted key species (indicated by bullets), other species or higher taxa sampled within plots/transects are listed. Black abalone (*Haliotis cracherodii*), though not currently present at the sites, are searched for in case they reappear.

Technique/Taxa	Cardiff Reef	Scripps Reef	Navy North	Navy South	Total Sites
Photoplot Dimensions (50 X 75 cm)					
• Rockweed (<i>Silvetia compressa</i>)		5	5	5	3
• Acorn Barnacle (<i>Chthamalus spp.</i>)	5	5			2
• Pink Thatched Barnacle (<i>Tetracita rubescens</i>)			5	5	2
• California Mussel (<i>Mytilus californianus</i>) Inshore	5	5	5	5	4
• California Mussel (<i>Mytilus californianus</i>) Offshore	5				1
• Goose Barnacle (<i>Pollicipes polymerus</i>)	5	5	6	6	4
Other Plants					
Other Animals					
Tar					
Bare Substrate					
Circular Plot Dimensions (1 m radius)*					
• Owl Limpet (<i>Lottia gigantea</i>)	5	5	6	6	4
Point Transect Dimensions (10 m)					
• Red Algal Turf (<i>Corallina spp. et al.</i>)	3	3	3	3	4
• Surfgrass (<i>Phyllospadix spp.</i>) Inshore	3	3	2	2	4
• Surfgrass (<i>Phyllospadix spp.</i>) Offshore			2	2	2
Boa Kelp (<i>Egregia menziesii</i>)					
Sargassum Weed (<i>Sargassum muticum</i>)					
Aggregating Anemone (<i>Anthopleura elegantissima/sola</i>)					
Sand Castle Worm (<i>Phragmatopoma californica</i>)					
California Mussel (<i>Mytilus californianus</i>)					
Other Biota					
Tar					
Bare Substrate					
Timed Search Dimensions (30 person-minutes)					
• Black Abalone (<i>Haliotis cracherodii</i>)	1	1	1	1	4
• Ochre Sea Star (<i>Pisaster ochraceus</i>)	1	1	1	1	4
Total Key Species Per Site	8	9	9	9	

* except at Cardiff, circular plots are 1.5 m radius.

Table 2. Rocky Intertidal Survey Plots and Plot Identification Codes.

Plot Type	Key Species	Plot Code	Plot Code	Plot Code	Plot Code
		Cardiff	Scripps	Navy North	Navy South
Photoplot	Barnacles	B1 B2 B3 B4 B5	B1 B2 B3 B4 B5	B1 B2 B3 B4 B5	B1 B2 B3 B4 B5
	Rockweed		Pe1 Pe2 Pe3 Pe4 Pe5	Pe1 Pe2 Pe3 Pe4 Pe5	Pe1 Pe2 Pe3 Pe4 Pe5
	Mussel	M1 M2 M3 M4 M5	M1 M2 M3 M4 M5	M0 M1 M2 M3 M4	M5 M1 M2 M3 M4
	Offshore Mussel	OM1 OM2 OM3 OM4 OM5			
	Goose barnacle	Po1 Po2 Po3 Po4 Po5	Po1 Po2 Po3 Po4 Po5	M5 M6 M7 M8 M9 M10	M0 M6 M7 M8 M9 M10
Circular Plot	Owl limpet	L1 L2 L3 L4 L5	L1 L2 L3 L4 L5	L1 L2 L3 L4 L5 L6	L1 L2 L3 L4 L5 L6
Point Transect	Red algal turf	T1 T2 T3	T1 T2 T3	T1 T2 T7	T1 T2 T7
	Surfgrass	G1 G2 G3	G4 G5 G6	G3 G4 G5 G6	G3 G4 G5 G6

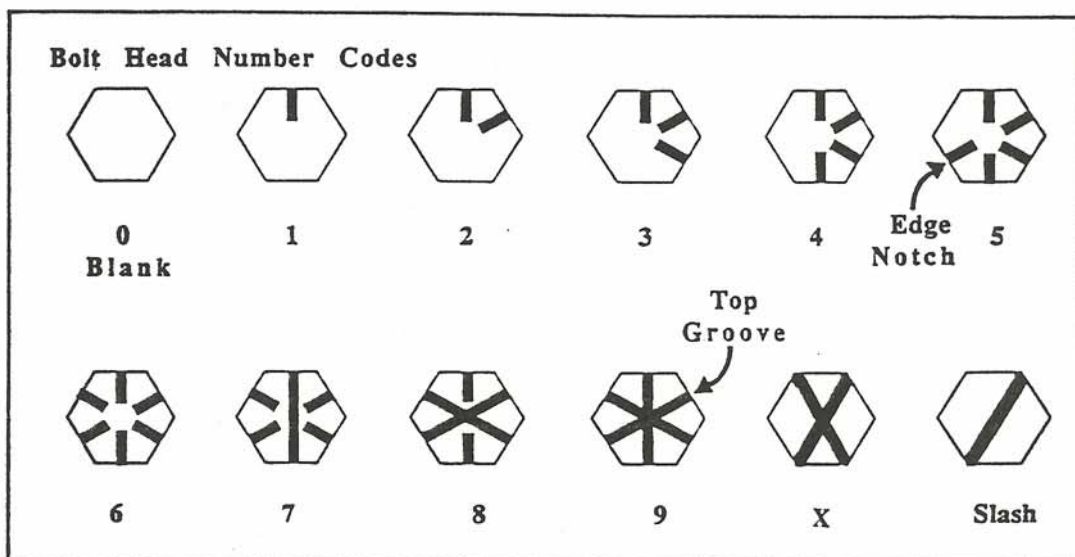


Table 3. Intertidal Species Recovered by Coast Biodiversity Survey: Scripps and Cabrillo National Monument.

Data provided by University of California Santa Cruz SWAT Team. See website (<http://cbsurveys.ucsc.edu>) for methodology and further information.

Species	Scripps 2002	Cabrillo 1 2002	Cabrillo 1 2004	Cabrillo 3 2002
<i>Acanthina lugubris</i>	X	X	X	X
<i>Acanthinucella</i> spp	X		X	
<i>Acrosorium ciliolatum</i>	X	X	X	X
<i>Adula/Lithophaga</i> spp		X		
<i>Ahnfeltiopsis leptophylla</i>	X			X
<i>Alia</i> spp			X	
<i>Amphiroa beauvoisii</i>				X
<i>Amphissa versicolor</i>				X
<i>Anthopleura elegantissima</i>	X	X	X	X
<i>Anthopleura sola</i>	X	X	X	X
<i>Archidistoma psammion</i>			X	
<i>Asterina miniata</i>	X			X
<i>Balanus glandula</i>	X	X	X	X
Blue green algae			X	X
Boring clam			X	
<i>Bossiella</i> spp		X	X	X
<i>Brachidontes/Septifer</i> spp	X	X	X	X
<i>Bryopsis</i> spp	X			X
<i>Bugula</i> spp	X			
<i>Bulla gouldiana</i>	X			X
<i>Calliarthron</i> spp		X		X
<i>Callophyllis</i> spp	X	X	X	
<i>Caulacanthus ustulatus</i>	X	X	X	X
<i>Centroceras/Ceramium/Polysiphonia</i> spp	X	X	X	X
<i>Ceratostoma nuttalli</i>			X	X
<i>Cerithiopsis cosmia</i>			X	
<i>Chaetomorpha spiralis</i>	X	X		X
<i>Chondracanthus canaliculatus</i>	X	X	X	X
<i>Chondria acrorhizophora</i>	X	X	X	
<i>Chondria arcuata</i>			X	
<i>Chondria californica</i>		X		
<i>Chondria dasyphylla</i>			X	
<i>Chondria decipiens</i>	X			
<i>Chondria nidifica</i>		X		
<i>Chondria oppositoclada</i>				X
<i>Chthamalus</i> spp	X	X	X	X
<i>Cladophora columbiana</i>			X	
<i>Cladophora graminea</i>				X
<i>Codium fragile</i>			X	X
<i>Colpomenia/Leathesia</i> spp	X	X	X	X
<i>Conus californicus</i>	X	X	X	
<i>Corallina</i> spp	X	X	X	X
<i>Cryptopleura/Hymenena</i> spp	X	X	X	X
<i>Cumagloia andersonii</i>			X	
<i>Cycloxanthops novemdentatus</i>	X			
<i>Dasya binghamiae</i>			X	
Diatoms	X	X	X	X

Table 3 (Contd.). Intertidal Species Recovered by Coast Biodiversity Survey: Scripps and Cabrillo National Monument.

Species	Scripps 2002	Cabrillo 1 2002	Cabrillo 1 2004	Cabrillo 3 2002
<i>Dictyopteris undulata</i>		X	X	X
<i>Dictyota binghamiae/flabellata</i>	X	X	X	X
<i>Dirona picta</i>			X	
<i>Egregia menziesii</i>		X	X	X
<i>Eisenia arborea</i>	X	X	X	X
<i>Encrusting coralline</i>	X	X	X	X
<i>Endarachne binghamiae</i>	X	X	X	X
<i>Epitonium tinctum</i>	X	X	X	
<i>Erythroglossum californicum</i>	X	X	X	
<i>Fissurella volcano</i>	X	X	X	X
<i>Gastroclonium parvum</i>			X	
<i>Gastroclonium subarticulatum</i>	X	X	X	X
<i>Gelidium coulteri</i>	X	X	X	
<i>Gelidium coulteri/pusillum</i>	X	X	X	X
<i>Gelidium pusillum</i>	X		X	X
<i>Gelidium robustum</i>	X	X	X	X
<i>Gelidium spp</i>	X	X		
<i>Gracilariopsis andersonii/papenfussii</i>	X	X	X	X
<i>Gymnogongrus platyphyllus</i>		X		
<i>Halichondria spp</i>			X	
<i>Halidrys dioica</i>		X	X	X
<i>Hermisenda crassicornis</i>			X	
<i>Herposiphonia littoralis</i>	X	X		
<i>Heterosiphonia japonica</i>		X	X	X
<i>Hildenbrandia/Peyssonnelia spp</i>	X	X	X	X
<i>Hypnea valentiae</i>	X	X	X	X
<i>Jania crassa</i>	X	X		X
<i>Kalypso paleacea</i>			X	
<i>Kelletia kelletii</i>				X
<i>Laurencia pacifica/masonii</i>	X	X	X	X
<i>Laurencia snyderae</i>	X			
<i>Lepidochitona dentiens</i>		X	X	X
<i>Lepidochitona hartwegii</i>	X	X	X	X
<i>Lepidozona spp</i>			X	
<i>Lithopoma gibberosum</i>		X		X
<i>Lithothrix aspergillum</i>	X	X	X	X
<i>Littorina keenae</i>	X	X	X	X
<i>Littorina plena/scutulata</i>	X	X	X	X
<i>Lottia austrodigitalis/digitalis</i>	X	X	X	X
<i>Lottia gigantia</i>	X	X	X	X
<i>Lottia limatula</i>	X	X	X	X
<i>Lottia paradigitalis/strigatella</i>	X	X	X	X
<i>Lottia pelta</i>	X	X	X	X
<i>Lottia scabra/conus</i>	X	X	X	X
<i>Macrocystis spp</i>			X	
<i>Macron lividus</i>	X	X	X	X
<i>Mazzaella affinis</i>			X	X
<i>Mazzaella leptorhynchus</i>	X	X	X	X
<i>Megabalanus californicus</i>	X			
<i>Membranipora spp</i>			X	

Table 3 (Contd.). Intertidal Species Recovered by Coast Biodiversity Survey: Scripps and Cabrillo National Monument.

Species	Scripps 2002	Cabrillo 1 2002	Cabrillo 1 2004	Cabrillo 3 2002
<i>Microcladia coulteri</i>		X		X
<i>Mopalia spp</i>			X	
<i>Mytilus californianus</i>	X	X	X	
<i>Navanax inermis</i>	X			
<i>Nienburgia andersoniana</i>		X	X	X
<i>Nuttallina spp</i>	X	X	X	X
<i>Ocenebra circumtexta</i>		X		X
<i>Opalia funiculata</i>			X	
<i>Ophiuroid</i>				X
<i>Osmundea sinicola</i>	X	X	X	X
<i>Osmundea spectabilis</i>	X	X	X	X
<i>Pachydictyon coriaceum</i>	X	X	X	X
<i>Pachygrapsus crassipes</i>	X	X	X	X
<i>Pagurus hirsutiusculus</i>	X	X	X	X
<i>Pagurus samuelis</i>	X	X	X	X
<i>Phragmatopoma californica</i>	X	X	X	X
<i>Phyllospadix scouleri</i>	X		X	X
<i>Phyllospadix torreyi</i>	X	X	X	X
<i>Pilumnus spinohirsutus</i>	X			
<i>Pisaster giganteus</i>				X
<i>Pisaster ochraceus</i>	X			
<i>Pista spp</i>			X	
<i>Plocamium cartilagineum</i>	X	X	X	X
<i>Pollicipes polymerus</i>	X	X	X	X
<i>Polysiphonia spp</i>	X	X	X	X
<i>Porphyra spp</i>		X	X	
<i>Prionitis angusta</i>		X	X	
<i>Prionitis cornea</i>		X		
<i>Prionitis lanceolata</i>		X	X	
<i>Prionitis lyallii</i>		X		
<i>Prionitis spp</i>				X
<i>Pseudochama exogyra</i>	X	X	X	X
<i>Pseudogloiophloea confusa</i>			X	
<i>Pseudolithoderma nigrum</i>		X		
<i>Pseudomelatoma torosa</i>			X	
<i>Pterocladia media</i>	X			
<i>Pterocladia capillacea</i>	X	X	X	X
<i>Pterosiphonia baileyi</i>			X	X
<i>Pterosiphonia bipinnata</i>	X			X
<i>Pterosiphonia dendroidea</i>	X	X	X	
<i>Pugettia gracilis/richii</i>			X	X
<i>Pugettia producta</i>			X	
<i>Ralfsiaceae</i>	X	X	X	X
<i>Rhodymenia californica</i>	X	X	X	
<i>Rhodymenia pacifica</i>		X	X	
<i>Rictaxis punctocaelatus</i>			X	
<i>Roperia poulsoni</i>	X			
<i>Sargassum agardhianum</i>	X			X
<i>Sargassum muticum</i>	X	X	X	X
<i>Scytosiphon spp</i>				X

Table 3 (Contd.). Intertidal Species Recovered by Coast Biodiversity Survey: Scripps and Cabrillo National Monument.

Species	Scripps 2002	Cabrillo 1 2002	Cabrillo 1 2004	Cabrillo 3 2002
<i>Serpula vermicularis</i>	X			X
<i>Serpulorbis squamigerus</i>	X	X	X	X
<i>Silvetia compressa</i>	X	X	X	X
<i>Sphacelaria californica</i>			X	X
<i>Spirorbis spp</i>	X	X	X	X
<i>Spyridia filamentosa</i>				X
<i>Strongylocentrotus purpuratus</i>			X	
<i>Taonia lennebackeriae</i>	X	X	X	X
<i>Tegula aureotincta</i>	X	X	X	X
<i>Tegula eiseni</i>	X	X	X	X
<i>Tegula funebris</i>	X	X	X	X
<i>Tetraclita rubescens</i>	X	X	X	X
<i>Tiffaniella snyderiae</i>	X	X	X	X
<i>Ulva spp</i>	X	X	X	X
<i>Zonaria farlowii</i>	X			

Table 4. Field Activities for the San Diego County Rocky Intertidal Monitoring Project.

Season	Date	Site	Activity
Fall 2004	November 11	Cardiff Reef	Rocky intertidal fall sampling
	November 14	Scripps Reef	Rocky intertidal fall sampling
	November 12	Navy North, Pt. Loma	Rocky intertidal fall sampling
	November 13	Navy South, Pt. Loma	Rocky intertidal fall sampling
Spring 2005	March 5	Cardiff Reef	Rocky intertidal spring sampling
	March 6	Scripps Reef	Rocky intertidal spring sampling
	March 7	Navy North, Pt. Loma	Rocky intertidal spring sampling
	March 8	Navy South, Pt. Loma	Rocky intertidal spring sampling

Table 5. Personnel Participating in San Diego County Rocky Intertidal Surveys.

Participants	Affiliation	Status	Fall 04	Spring 05
Jack Engle	University of California, Santa Barbara	Employee	X	X
Jennifer Klaib	University of California, Santa Barbara	Employee	X	X
Coral Gilbert	San Diego State University	Volunteer	X	X
Michelle Gregory	San Diego State University	Volunteer	X	
Susan Kevin	San Diego State University	Volunteer		X
Brendan Reed	San Diego State University	Volunteer		X
Angela Tsai	San Diego State University	Volunteer	X	
Penny Owens	Santa Barbara Channel Keeper	Volunteer	X	
Colleen Wisniewski	San Diego Bay Keeper	Volunteer		X
Jason Price	CA Department of Fish and Game	Volunteer		X
Alivia Alamilla	Private	Volunteer		X
Sam Embry	Private	Volunteer		X
Bob Gladden	Private	Volunteer	X	X
Hilary Warren	Private	Volunteer		X
Dave Young	Private	Volunteer		X

Table 6. Fall 2004 Species Abundances in Photoplots.

CARDIFF REEF	BARNACLES (% COVER)							INSHORE MUSSELS (% COVER)							OFFSHORE MUSSELS (% COVER)							GOOSE BARNACLES (% COVER)						
PHOTO PLOT #	B1	B2	B3	B4	B5	AVG	SE	M1	M2	M3	M4	M5	AVG	SE	OM1	OM2	OM3	OM4	OM5	AVG	SE	Po1	Po2	Po3	Po4	Po5	AVG	SE
# POINTS SCORED	100	100	100	100	100			100	100	100	100	100			100	100	100	100	100			100	100	100	100	100		
ACORN BARNACLE	59	82	63	79	54	67	6	0	0	0	1	0	0	0	0	1	0	3	0	1	1	15	2	0	0	1	4	3
THATCHED BARNACLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
ROCKWEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
CALIFORNIA MUSSEL	0	0	0	0	0	0	0	26	53	74	91	34	56	12	79	98	63	86	85	82	6	0	0	30	59	51	28	12
GOOSE BARNACLE	0	0	0	0	0	0	0	6	7	5	4	0	4	1	0	0	0	0	0	0	0	8	0	35	4	14	12	6
OTHER PLANTS	0	0	0	6	14	4	3	32	36	19	4	62	31	10	21	1	11	2	4	8	4	2	32	8	32	17	18	6
OTHER ANIMALS	0	0	0	0	0	0	0	13	0	0	0	0	3	3	0	0	3	2	7	2	1	0	1	0	0	1	0	0
BARE SUBSTRATE	41	18	37	15	32	29	5	23	4	2	0	4	7	4	0	0	23	7	4	7	4	75	65	27	5	16	38	14

SCRIPPS REEF	BARNACLES (% COVER)							ROCKWEED (% COVER)							MUSSELS (% COVER)							GOOSE BARNACLES (% COVER)						
PHOTO PLOT #	B1	B2	B3	B4	B5	AVG	SE	Pe1	Pe2	Pe3	Pe4	Pe5	AVG	SE	M1	M2	M3	M4	M5	AVG	SE	Po1	Po2	Po3	Po4	Po5	AVG	SE
# POINTS SCORED	100	100	100	100	100			100	100	100	100	100			100	100	100	100	100			100	100	100	100	100		
ACORN BARNACLE	88	86	86	76	91	85	3	0	0	1	0	2	1	0	1	0	0	1	2	1	0	3	5	1	5	9	5	1
THATCHED BARNACLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROCKWEED	0	0	0	0	0	0	0	60	10	36	73	28	41	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CALIFORNIA MUSSEL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34	93	62	76	77	68	10	42	47	63	34	43	46	5
GOOSE BARNACLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	31	24	21	18	22	2
OTHER PLANTS	4	1	0	6	0	2	1	37	68	44	22	57	46	8	37	5	24	7	0	15	7	11	3	6	12	5	7	2
OTHER ANIMALS	0	0	0	0	0	0	0	1	3	0	1	0	1	1	1	1	1	2	0	1	0	1	1	0	2	1	1	0
BARE SUBSTRATE	8	13	14	18	9	12	2	2	19	19	4	13	11	4	27	1	13	14	21	15	4	25	13	6	26	24	19	4

NAVY NORTH	BARNACLES (% COVER)							ROCKWEED (% COVER)							MUSSELS (% COVER)							GOOSE BARNACLES (% COVER)							
PHOTO PLOT #	B1	B2	B3	B4	B5	AVG	SE	Pe1	Pe2	Pe3	Pe4	Pe5	AVG	SE	M0	M1	M2	M3	M4	AVG	SE	M5	M6	M7	M8	M9	M10	AVG	SE
# POINTS SCORED	100	100	100	100	100			100	100	100	100	100			100	100	100	100	100			100	100	100	100	100	100		
ACORN BARNACLE	6	1	0	2	1	2	1	2	0	0	0	0	0	0	0	0	3	1	1	1	1	2	1	4	2	2	0	2	1
THATCHED BARNACLE	44	33	13	40	21	30	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROCKWEED	0	0	34	23	37	19	8	83	94	92	100	59	86	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CALIFORNIA MUSSEL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3	1	0	1	0	0	0	0	0	0	0	0	0
GOOSE BARNACLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	13	4	3	4	0	0	0	0	1	1	
OTHER PLANTS	27	42	38	29	36	34	3	14	5	8	0	35	12	6	65	49	25	66	33	48	8	22	38	27	9	40	41	30	5
OTHER ANIMALS	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	4	2	3	3	1	3	2	3	1	2	0	2	0
BARE SUBSTRATE	22	24	15	6	5	14	4	1	1	0	0	6	2	1	34	44	59	30	50	43	5	69	59	66	88	56	59	66	5

NAVY SOUTH	BARNACLES (% COVER)							ROCKWEED (% COVER)							MUSSELS (% COVER)							GOOSE BARNACLES (% COVER)							
PHOTO PLOT #	B1	B2	B3	B4	B5	AVG	SE	Pe1	Pe2	Pe3	Pe4	Pe5	AVG	SE	M5	M1	M2	M3	M4	AVG	SE	M0	M6	M7	M8	M9	M10	AVG	SE
# POINTS SCORED	100	100	100	100	100			100	100	100	100	100			100	100	100	100	100			100	100	100	100	100	100		
ACORN BARNACLE	4	3	3	1	0	2	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0	1	2	1	0
THATCHED BARNACLE	6	5	2	5	8	5	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	2	0	0	1	0
ROCKWEED	0	0	0	0	0	0	0	65	45	56	66	54	57	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CALIFORNIA MUSSEL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	14	10	0	0	6	6	2
GOOSE BARNACLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	1	1	3	11	11	12	6	7	8	1
OTHER PLANTS	87	70	56	89	81	77	6	32	53	41	29	45	40	4	70	59	55	84	59	65	5	37	41	28	42	59	32	40	4
OTHER ANIMALS	1	1	1	0	1	1	0	0	0	0	0	0	0	0	5	33	1	0	1	8	6	3	0	0	0	2	5	2	1
BARE SUBSTRATE	2	21	38	5	10	15	7	3	2	3	5	1	3	1	25	7	42	14	35	25	6	54	33	47	46	32	48	43	4

Table 7. Spring 2005 Species Abundances in Photoplots.

CARDIFF REEF	BARNACLES (% COVER)							INSHORE MUSSELS (% COVER)							OFFSHORE MUSSELS (% COVER)							GOOSE BARNACLES (% COVER)						
PHOTOPLOT #	B1	B2	B3	B4	B5	AVG	SE	M1	M2	M3	M4	M5	AVG	SE	OM1	OM2	OM3	OM4	OM5	AVG	SE	Po1	Po2	Po3	Po4	Po5	AVG	SE
# POINTS SCORED	100	100	100	100	100			100	100	100	100	100			100	100	100	100	100			100	100	100	100	100		
ACORN BARNACLE	84	76	77	79	73	78	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	11	3	0	0	7	4
THATCHED BARNACLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0
ROCKWEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CALIFORNIA MUSSEL	0	0	0	0	0	0	0	28	29	72	92	20	48	14	86	76	46	84	81	75	7	2	0	23	57	40	24	11
GOOSE BARNACLE	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	9	0	17	2	7	7	3
OTHER PLANTS	1	6	1	10	13	6	2	59	69	19	3	73	45	14	7	1	3	0	7	4	1	35	51	31	23	14	31	6
OTHER ANIMALS	0	0	0	0	0	0	0	5	0	0	0	0	1	1	1	1	4	5	9	4	1	1	2	1	0	2	1	0
BARE SUBSTRATE	15	18	22	11	14	16	2	8	1	8	5	7	6	1	6	22	47	9	3	17	8	30	35	25	18	37	29	3

SCRIPPS REEF	BARNACLES (% COVER)							ROCKWEED (% COVER)							MUSSELS (% COVER)							GOOSE BARNACLES (% COVER)						
PHOTOPLOT #	B1	B2	B3	B4	B5	AVG	SE	Pe1	Pe2	Pe3	Pe4	Pe5	AVG	SE	M1	M2	M3	M4	M5	AVG	SE	Po1	Po2	Po3	Po4	Po5	AVG	SE
# POINTS SCORED	100	100	100	100	100			100	100	100	100	100			100	100	100	100	100			100	100	100	100	100		
ACORN BARNACLE	74	76	74	77	82	77	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	4	0	3	9	4	1
THATCHED BARNACLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROCKWEED	0	0	0	0	0	0	0	64	8	26	63	30	38	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CALIFORNIA MUSSEL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	84	60	64	57	60	8	39	52	59	33	29	42	6
GOOSE BARNACLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	14	21	23	31	21	3
OTHER PLANTS	0	1	0	9	0	2	2	32	57	52	36	46	45	5	16	5	25	11	3	12	4	0	3	7	14	7	6	2
OTHER ANIMALS	1	0	0	0	0	0	0	0	5	2	1	0	2	1	1	2	0	0	2	1	0	3	0	1	1	0	1	1
BARE SUBSTRATE	25	23	26	14	18	21	2	4	30	20	0	24	16	6	47	9	15	25	38	27	7	39	27	12	26	24	26	4

NAVY NORTH	BARNACLES (% COVER)							ROCKWEED (% COVER)							MUSSELS (% COVER)							GOOSE BARNACLES (% COVER)							
PHOTOPLOT #	B1	B2	B3	B4	B5	AVG	SE	Pe1	Pe2	Pe3	Pe4	Pe5	AVG	SE	M0	M1	M2	M3	M4	AVG	SE	M5	M6	M7	M8	M9	M10	AVG	SE
# POINTS SCORED	100	100	100	100	100			100	100	100	100	100			100	100	100	100	100			100	100	100	100	100	100		
ACORN BARNACLE	2	3	0	4	4	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
THATCHED BARNACLE	48	31	12	23	14	26	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROCKWEED	2	0	30	21	28	16	6	62	74	76	96	45	71	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CALIFORNIA MUSSEL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	4	0	0	1	1	0	0	0	0	0	0	0	0
GOOSE BARNACLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	7	0	8	3	2	2	0	0	0	0	1	1	0
OTHER PLANTS	10	23	32	29	44	28	6	38	17	24	4	53	27	8	61	52	23	65	47	50	7	20	35	46	39	37	32	35	4
OTHER ANIMALS	2	2	3	0	0	1	1	0	1	0	0	0	0	0	1	2	0	2	1	1	0	1	1	0	1	3	1	0	0
BARE SUBSTRATE	36	41	23	23	10	27	5	0	8	0	0	2	2	2	37	45	66	33	44	45	6	77	64	52	60	62	64	63	3

NAVY SOUTH	BARNACLES (% COVER)							ROCKWEED (% COVER)							MUSSELS (% COVER)							GOOSE BARNACLES (% COVER)							
PHOTOPLOT #	B1	B2	B3	B4	B5	AVG	SE	Pe1	Pe2	Pe3	Pe4	Pe5	AVG	SE	M5	M1	M2	M3	M4	AVG	SE	M0	M6	M7	M8	M9	M10	AVG	SE
# POINTS SCORED	100	100	100	100	100			100	100	100	100	100			100	100	100	100	100			100	100	100	100	100	100		
ACORN BARNACLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	1	0
THATCHED BARNACLE	10	0	1	4	9	5	2	0	0	0	0	0	0	0	0	0	2	0	1	1	0	0	0	3	0	0	0	1	1
ROCKWEED	0	0	0	0	0	0	0	64	48	28	63	58	52	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CALIFORNIA MUSSEL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	2	0	0	2	2	1	11	7	0	0	3	4	2
GOOSE BARNACLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	13	11	11	4	5	7	2
OTHER PLANTS	65	60	28	87	77	63	10	34	52	67	27	41	44	7	71	34	60	29	45	48	8	34	38	16	22	36	21	28	4
OTHER ANIMALS	3	0	4	1	1	2	1	0	0	0	0	0	0	0	18	1	1	2	5	5	3	3	0	4	0	0	1	1	1
BARE SUBSTRATE	22	40	67	8	13	30	11	2	0	5	10	1	4	2	2	65	35	68	49	44	12	62	38	59	66	60	67	59	4

Table 8. Photoplot Species Summary Data by Site: Cardiff and Scripps.

Mean % cover and standard error data for 8 taxa in 4 key species zones (barnacle, rockweed, mussel/goose barnacle) at Cardiff and Scripps. N = 5.

DATE	CARDIFF BARNACLE								CARDIFF INSHORE MUSSELS								CARDIFF OFFSHORE MUSSELS								CARDIFF GOOSE BARNACLES							
	AB	TB	RW	CM	GB	OP	OA	BS	AB	TB	RW	CM	GB	OP	OA	BS	AB	TB	RW	CM	GB	OP	OA	BS	AB	TB	RW	CM	GB	OP	OA	BS
DATE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE
F97	57 5	0 0	0 0	1 1	0 0	0 0	0 0	42 4	1 0	0 0	0 0	89 3	1 1	1 0	0 0	9 3	0 0	1 1	0 0	83 3	0 0	2 2	2 1	12 3	2 1	0 0	0 0	38 3	33 5	3 1	1 0	24 3
S98	34 11	0 0	0 0	1 1	0 0	10 5	1 0	55 15	0 0	0 0	0 0	59 15	0 0	9 9	0 0	30 7	0 0	0 0	0 0	63 9	0 0	10 3	4 1	23 8	2 1	0 0	0 0	20 2	24 5	12 4	0 0	41 3
F98	7 4	0 0	0 0	0 0	0 0	1 1	0 0	92 4	19 7	1 0	0 0	54 15	0 0	20 18	0 0	7 1	8 3	7 3	0 0	58 7	0 0	25 3	2 1	0 0	12 3	0 0	0 0	8 2	19 6	18 3	1 0	41 9
S99	13 7	0 0	0 0	0 0	0 0	73 11	0 0	14 4	16 5	2 1	0 0	57 15	0 0	16 15	0 0	9 1	4 1	11 4	0 0	60 10	0 0	13 5	7 1	5 1	25 4	1 1	0 0	15 4	17 6	33 9	1 0	8 2
F99	12 6	0 0	0 0	0 0	0 0	0 0	0 0	88 6	8 3	0 0	0 0	65 15	5 2	9 9	1 0	12 5	3 2	10 5	0 0	69 10	0 0	6 3	10 5	1 1	13 8	0 0	0 0	18 5	24 7	8 2	0 0	36 3
S00	25 6	0 0	0 0	1 1	0 0	2 2	1 1	71 7	1 1	0 0	0 0	71 14	6 2	1 1	1 1	19 12	4 2	8 4	0 0	78 10	0 0	1 0	4 3	5 3	12 10	0 0	0 0	25 8	27 6	3 1	1 0	32 4
F00	26 7	0 0	0 0	0 0	0 0	0 0	0 0	74 7	2 1	0 0	0 0	77 10	6 3	1 0	0 0	13 8	0 0	4 3	0 0	75 12	0 0	6 3	3 2	11 8	11 9	0 0	0 0	39 8	23 4	1 1	1 1	25 2
S01	30 7	0 0	0 0	0 0	1 1	0 0	0 0	68 7	3 2	0 0	0 0	85 7	4 2	0 0	0 0	8 5	2 2	3 2	0 0	74 13	1 1	7 6	1 1	11 5	15 9	0 0	0 0	35 7	24 5	0 0	0 0	25 3
F01	60 5	0 0	0 0	0 0	0 0	0 0	0 0	40 5	1 1	0 0	0 0	87 9	5 3	0 0	0 0	6 4	0 0	3 2	0 0	75 13	0 0	12 9	2 1	8 4	13 12	0 0	0 0	37 9	23 4	1 1	0 0	26 5
S02	64 4	0 0	0 0	0 0	0 0	0 0	1 1	34 4	1 1	0 0	0 0	88 7	5 2	1 1	0 0	6 4	1 1	2 1	0 0	69 12	0 0	8 8	3 1	16 8	14 10	0 0	0 0	34 13	18 6	7 5	0 0	27 11
F02	40 4	0 0	0 0	0 0	0 0	0 0	0 0	60 4	1 1	0 0	0 0	87 5	4 2	1 1	1 0	7 3	0 0	2 2	0 0	69 12	0 0	16 10	5 2	8 3	11 9	0 0	0 0	29 13	17 7	1 0	0 0	42 14
S03	40 1	0 0	0 0	0 0	0 0	5 3	0 0	56 2	0 0	0 0	0 0	81 12	4 2	4 4	0 0	10 7	1 0	1 1	0 0	67 11	0 0	15 10	7 2	9 5	9 7	0 0	0 0	28 13	18 7	9 4	1 1	35 11
F03	65 2	0 0	0 0	0 0	0 0	1 1	0 0	33 2	0 0	0 0	0 0	87 8	5 3	4 3	2 2	3 2	0 0	0 0	0 0	70 11	0 0	23 12	5 3	1 1	10 9	0 0	0 0	29 11	16 7	7 2	1 1	36 15
S04	77 4	0 0	0 0	0 0	0 0	5 3	0 0	17 1	0 0	0 0	0 0	87 8	4 2	4 4	2 2	3 3	0 0	1 0	0 0	74 8	0 0	10 6	9 3	6 2	10 7	0 0	0 0	36 15	17 6	10 4	1 1	26 11
F04	67 6	0 0	0 0	0 0	0 0	4 3	0 0	29 5	0 0	0 0	0 0	56 12	4 1	31 10	3 3	7 4	1 1	0 0	0 0	82 6	0 0	8 4	2 1	7 4	4 3	0 0	0 0	28 12	12 6	18 6	0 0	38 14
S05	78 2	0 0	0 0	0 0	0 0	6 2	0 0	16 2	0 0	0 0	0 0	48 14	0 0	45 14	1 1	6 1	0 0	0 0	0 0	75 7	0 0	4 1	4 1	17 8	7 4	0 0	0 0	24 11	7 3	31 6	1 0	29 3

DATE	SCRIPPS BARNACLE								SCRIPPS ROCKWEED								SCRIPPS MUSSEL								SCRIPPS GOOSE BARNACLES							
	AB	TB	RW	CM	GB	OP	OA	BS	AB	TB	RW	CM	GB	OP	OA	BS	AB	TB	RW	CM	GB	OP	OA	BS	AB	TB	RW	CM	GB	OP	OA	BS
DATE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE
F97	85 1	0 0	0 0	0 0	0 0	0 0	0 0	15 1	1 1	0 0	37 6	5 1	0 0	24 5	3 2	29 7	0 0	0 0	0 0	81 3	1 0	3 2	0 0	15 3	6 1	0 0	0 0	33 6	26 5	1 0	1 0	33 3
S98	67 3	0 0	0 0	0 0	0 0	0 0	0 0	33 3	0 0	0 0	17 5	7 3	0 0	36 7	2 1	38 11	0 0	0 0	0 0	67 6	1 1	5 3	1 0	26 6	7 2	0 0	0 0	25 6	27 4	1 1	0 0	40 4
F98	91 2	0 0	0 0	0 0	0 0	1 1	0 0	8 2	8 5	0 0	35 9	1 1	0 0	48 8	1 1	8 4	2 1	0 0	0 0	74 7	0 0	14 6	1 0	8 3	33 5	0 0	0 0	25 5	26 3	1 1	1 0	15 5
S99	92 3	0 0	0 0	0 0	0 0	0 0	0 0	8 3	15 8	0 0	35 7	2 1	0 0	41 8	1 1	7 2	9 3	1 1	0 0	74 7	3 2	7 3	0 0	7 3	40 3	0 0	0 0	20 4	30 3	3 1	0 0	7 2
F99	95 3	0 0	0 0	0 0	0 0	0 0	0 0	5 3	4 2	0 0	49 11	0 0	0 0	37 8	0 0	9 3	0 0	2 1	0 0	85 5	2 1	6 3	0 0	5 3	11 1	0 0	0 0	19 3	37 3	1 1	1 0	31 4
S00	96 1	0 0	0 0	0 0	0 0	0 0	0 0	4 1	8 3	0 0	45 10	1 1	0 0	26 7	2 1	19 7	1 0	0 0	0 0	93 2	1 1	2 2	0 0	3 2	4 1	0 0	0 0	28 2	31 2	1 1	1 0	35 2
F00	94 1	0 0	0 0	0 0	0 0	0 0	0 0	6 1	12 8	0 0	46 8	1 1	0 0	24 6	1 1	16 6	2 1	0 0	0 0	70 19	0 0	20 18	0 0	8 7	11 3	0 0	0 0	31 2	32 5	2 1	1 0	23 4
S01	94 2	0 0	0 0	0 0	0 0	0 0	0 0	6 2	7 5	0 0	52 8	1 1	0 0	20 4	2 2	18 6	2 1	0 0	0 0	66 20	0 0	18 16	1 0	14 11	9 3	0 0	0 0	36 2	29 3	1 1	1 0	25 3
F01	97 1	0 0	0 0	0 0	0 0	0 0	0 0	3 1	7 6	0 0	56 10	0 0	0 0	27 11	0 0	10 6	4 3	0 0	0 0	65 21	0 0	3 2	0 0	27 17	5 1	0 0	0 0	37 4	29 3	2 1	0 0	27 3
S02	97 1	0 0	0 0	0 0	0 0	0 0	0 0	3 1	3 2	0 0	57 10	0 0	0 0	23 7	1 1	17 6	15 6	0 0	0 0	47 17	0 0	14 9	0 0	24 14	7 1	0 0	0 0	38 2	28 3	1 1	1 1	24 3
F02	98 1	0 0	0 0	0 0	0 0	0 0	0 0	2 1	1 1	0 0	74 12	0 0	0 0	16 7	0 0	10 5	9 9	0 0	0 0	51 17	0 0	19 7	1 1	20 10	8 3	0 0	0 0	34 3	24 4	5 2	0 0	28 4
S03	86 2	0 0	0 0	0 0	0 0	1 1	0 0	14 3	0 0	0 0	56 13	0 0	0 0	25 9	0 0	18 7	4 4	0 0	0 0	53 15	0 0	16 5	1 1	26 9	3 1	0 0	0 0	29 3	26 3	8 2	1 1	34 1
F03	98 1	0 0	0 0	0 0	0 0	1 0	0 0	2 1	1 1	0 0	67 14	0 0	0 0	25 12	0 0	7 2	5 4	0 0	0 0	60 12	0 0	20 6	2 1	14 7	8 2	0 0	0 0	31 5	29 2	8 1	1 0	23 3
S04	77 10	0 0	0 0	0 0	0 0	13 9	0 0	10 3	8 4	0 0	62 12	0 0	0 0	21 10	3 2	3 6	0 0	0 0	0 0	70 7	1 0	13 6	1 0	14 5	5 2	0 0	0 0	35 4	30 2	2 1	1 0	26 3
F04	85 3	0 0	0 0	0 0	0 0	2 1	0 0	12 2	1 0	0 0	41 11	0 0	0 0	46 8	1 1	11 4	1 0	0 0	0 0	68 10	0 0	15 7	1 0	15 4	5 1	0 0	0 0	46 5	22 2	7 2	1 0	19 4
S05	77 1	0 0	0 0	0 0	0 0	2 2	0 0	21 2	0 0	0 0	38 11	0 0	0 0	45 5	2 1	16 6	0 0	0 0	0 0	60 8	0 0	12 4	1 0	27 7	4 1	0 0	0 0	42 6	21 3	6 2	1 1	26 4

AB=ACORN BARNACLE TB=THATCHED BARNACLE RW=ROCKWEED GB=GOOSE BARNACLE
CM=CALIFORNIA MUSSEL OP=OTHER PLANTS OA=OTHER ANIMALS BS=BARE SUBSTRATE

Table 9. Photoplot Species Summary Data by Site: Navy North and Navy South.

Mean % cover and standard error data for 8 taxa in 4 key species zones (barnacle, rockweed, mussel/goose barnacle) at Navy North and Navy South. N = 5, except N = 6 for goose barnacles at Navy North

	NAVY NORTH BARNACLE									NAVY NORTH ROCKWEED									NAVY NORTH MUSSEL									NAVY NORTH GOOSE BARNACLE								
	AB	TB	RW	CM	GB	OP	OA	BS		AB	TB	RW	CM	GB	OP	OA	BS		AB	TB	RW	CM	GB	OP	OA	BS		AB	TB	RW	CM	GB	OP	OA	BS	
DATE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE		
S95	9	3	28	3	1	1	0	0	19	8	0	0	41	4	0	0	4	2	0	0	0	0	85	3	0	0	10	3	0	0	1	0	0	0	57	3
F95	2	1	22	2	1	0	0	0	51	6	0	0	23	4	0	0	2	0	1	0	0	0	81	9	0	0	17	9	0	0	2	0	1	0	58	6
S96																																				
F96	9	1	29	2	1	0	0	0	8	2	0	0	52	4	0	0	3	1	0	0	0	0	73	11	0	0	24	11	0	0	3	1	0	0	69	5
S97	12	4	32	2	1	1	0	0	4	2	0	0	50	2	1	1	0	0	0	0	0	0	73	11	0	0	25	10	0	0	1	0	0	0	71	6
F97	4	1	21	3	1	1	0	0	62	4	0	0	11	2	0	0	1	0	0	0	0	0	50	15	0	0	48	16	0	0	1	1	0	0	62	6
S98	5	2	30	1	1	1	0	0	17	3	1	1	46	2	0	0	7	3	0	0	0	0	35	10	0	0	57	13	0	0	7	3	0	0	53	5
F98	23	7	21	2	2	1	0	0	53	8	2	2	0	0	2	2	0	1	3	2	0	0	45	12	0	0	53	13	0	0	1	1	3	2	32	2
S99	28	4	45	3	1	1	0	0	22	6	2	1	2	1	1	1	0	4	2	2	1	0	46	11	0	0	47	13	2	1	4	2	2	1	30	3
F99	4	1	38	5	3	1	0	0	47	4	0	0	7	3	2	1	0	0	0	0	0	70	15	0	0	24	16	2	2	2	1	0	0	51	8	
S00	9	2	59	3	3	2	0	0	12	2	0	0	17	3	0	0	2	1	1	0	0	0	64	15	0	0	35	15	0	0	2	1	1	0	49	6
F00	2	1	50	8	8	3	0	0	20	6	0	0	20	2	0	0	1	0	0	0	0	0	74	15	0	0	25	15	0	0	1	1	0	0	62	6
S01	9	2	50	6	4	2	0	0	7	2	1	0	29	5	0	0	2	1	0	0	0	0	72	13	0	0	26	12	0	0	2	1	0	0	64	7
F01	13	3	33	2	8	5	0	0	42	3	0	0	5	1	0	0	1	1	0	0	0	0	78	16	0	0	21	16	0	0	1	1	0	0	49	6
S02	16	2	49	4	6	3	0	0	9	3	0	0	20	2	0	0	3	1	2	1	0	0	74	14	0	0	23	15	0	0	3	1	2	1	72	4
F02	0	0	31	6	12	6	0	0	49	7	1	0	7	2	0	0	2	1	0	0	0	0	85	12	0	0	13	12	0	0	2	1	0	0	48	5
S03	1	0	31	3	9	4	0	0	34	3	1	0	24	3	0	0	1	0	0	0	0	0	83	14	0	0	16	14	0	0	1	0	0	0	60	3
F03	0	0	20	4	20	8	0	0	55	6	0	0	5	1	0	0	1	0	0	0	0	0	89	9	0	0	11	8	0	0	1	0	0	0	44	5
S04	11	2	33	4	16	6	1	0	0	11	3	2	1	27	4	0	0	2	1	0	0	0	81	10	0	0	16	10	1	0	2	1	0	0	61	3
F04	2	1	30	6	19	8	0	0	34	3	0	0	14	4	0	0	2	1	1	1	0	0	86	7	0	0	12	6	0	0	2	1	1	0	66	5
S05	3	1	26	7	16	6	0	0	28	6	1	1	27	5	0	0	2	2	0	0	0	0	71	8	0	0	27	8	0	0	2	2	0	0	63	3

	NAVY SOUTH BARNACLE									NAVY SOUTH ROCKWEED									NAVY SOUTH MUSSEL									NAVY SOUTH GOOSE BARNACLE								
	AB	TB	RW	CM	GB	OP	OA	BS		AB	TB	RW	CM	GB	OP	OA	BS		AB	TB	RW	CM	GB	OP	OA	BS		AB	TB	RW	CM	GB	OP	OA	BS	
DATE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE		
S95	7	2	15	2	0	0	0	0	34	7	2	1	42	6	0	0	13	5	0	0	1	0	23	5	11	2	28	5	1	0	35	8	4	1	58	4
F95	1	0	12	1	0	0	0	0	48	7	0	0	40	8	0	0	0	0	0	1	0	0	23	4	12	3	33	6	1	1	30	7	1	0	47	7
S96																																				
F96	2	1	8	1	0	0	0	0	48	9	1	1	40	9	0	0	11	5	0	0	0	0	51	6	0	0	38	6	0	0	11	5	0	0	49	5
S97	3	1	11	1	0	0	0	0	25	10	0	0	60	10	1	1	0	0	0	0	0	0	52	6	0	0	38	5	0	0	9	5	1	0	55	5
F97	1	0	7	1	0	0	0	0	69	9	3	1	20	8	0	0	9	2	0	0	0	0	38	5	0	0	52	3	1	1	9	2	0	0	24	5
S98	0	0	7	1	0	0	0	0	0	60	11	8	2	26	9	0	0	0	0	0	0	0	40	5	0	0	51	5	0	0	9	3	0	0	36	6
F98	4	2	9	3	0	0	0	0	76	4	7	1	4	3	0	0	1	0	0	0	0	0	46	4	0	0	51	5	2	2	1	1	0	0	48	2
S99	4	1	11	2	0	0	0	0	60	4	12	2	12	5	0	0	7	3	2	2	0	0	49	3	0	0	49	3	1	1	0	0	0	0	26	5
F99	5	3	14	4	0	0	0	0	61	3	6	3	14	3	0	0	4	2	1	3	2	1	54	6	0	0	40	5	4	4	2	1	0	0	26	3
S00	2	1	10	3	0	0	0	0	52	7	7	1	28	9	0	0	4	2	1	0	0	0	52	7	0	0	44	7	0	0	4	2	4	2	1	0
F00	3	1	12	3	0	0	0	0	62	5	4	1	19	6	0	0	3	1	3	1	2	2	53	5	0	0	42	5	2	1	3	1	3	2	36	4
S01	3	3	13	4	0	0	0	0	45	6	5	1	33	10	0	0	4	2	1	1	1	0	45	7	1	0	18	13	3	2	38	5	2	33	11	0
F01	7	3	8	2	0	0	0	0	76	3	0	0	10	3	0	0	3	2	2	0	0	0	54	5	0	0	42	6	1	0	3	2	2	2	24	2
S02	4	3	16	5	0	0	0	0	52	5	1	1	26	10	1	1	0	0	0	0	0	0	56	5	0	0	41	6	0	0	3	2	3	1	43	5
F02	1	1	10	4	0	0	0	0	77	4	1	0	12	5	0	0	1	1	0	0	1	0	63	7	0	0	36	7	0	0	1	1	0	0	21	5
S03	1	0	5	2	0	0	0	0	65	7	1	0	29	8	0	0	1	0	1	0	0	0	62	8	0	0	36	9	0	0	1	1	0	0	43	4
F03	2	0	4	2	0	0	0	0	71	9	1	0	22	10	0	0	2	1	2	2	0	0	62	6	0	0	36	7	0	0	2	1	2	2	23	1
S04	7	3	6	2	0	0	0	0	52	10	2	1	33	8	0	0	2	1	9	5	1	1	57	6	0	0	41	6	0	0	2	1	9	5	55	4
F04	2	1	5	1	0	0	0	0	77	6	1	0	15	7	0	0	3	1	0	0	0	0	57	4	0	0	40	4	0	0	3	1	0	0	43	4
S05	0	0	5	2	0	0	0	0	63	10	2	1	30	11	0	0	4	2	0	0	1	0	52	7	0	0	44	7	0	0	4	2	0	0	49	4

AB=ACORN BARNACLE TB=THATCHED BARNACLE RW=ROCKWEED GB=GOOSE BARNACLE
CM=CALIFORNIA MUSSEL OP=OTHER PLANTS OA=OTHER ANIMALS BS=BARE SUBSTRATE

Table 10. Photoplot Key Species Summary Data by Quadrat: Cardiff and Scripps.

Percent cover data for 5 index taxa (acorn barnacles, thatched barnacles, rockweed, mussels, goose barnacles) at Cardiff and Scripps.

CARDIFF	ACORN					THATCHED					INSHORE MUSSEL					OFFSHORE MUSSEL					GOOSE BARNACLE				
DATE	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5	M1	M2	M3	M4	M5	OM1	OM2	OM3	OM4	OM5	Po1	Po2	Po3	Po4	Po5
F97	60	54	75	52	44	0	0	0	0	0	83	81	96	89	95	78	95	76	84	83	37	22	50	23	31
S98	46	4	12	62	46	0	0	0	0	0	0	73	85	67	72	62	89	62	67	35	29	20	41	8	24
F98	0	0	0	19	17	0	0	0	0	0	0	46	79	62	83	66	75	52	61	36	0	20	39	13	24
S99	3	1	0	27	33	0	0	0	0	0	0	56	82	64	84	87	80	51	48	36	0	19	37	8	19
F99	8	2	1	16	34	0	0	0	0	0	12	61	88	63	99	98	82	61	65	39	9	24	49	12	25
S00	36	9	14	27	41	0	0	0	0	0	19	70	94	74	99	99	93	80	73	43	9	32	43	17	33
F00	32	8	12	30	46	0	0	0	0	0	42	73	94	82	96	34	100	95	85	62	11	26	34	16	26
S01	40	10	17	42	43	0	0	0	0	0	59	85	96	88	97	33	100	97	85	56	11	26	37	17	28
F01	72	43	60	59	64	0	0	0	0	0	53	96	97	90	100	29	100	100	77	68	14	15	35	20	32
S02	69	55	73	56	69	0	0	0	0	0	62	87	98	91	100	33	100	51	83	79	10	0	36	16	27
F02	36	40	39	53	30	0	0	0	0	0	68	88	89	90	100	29	99	56	76	83	4	0	37	17	27
S03	43	40	39	41	36	0	0	0	0	0	34	87	94	92	100	32	96	51	77	80	6	0	38	17	31
F03	68	62	69	69	58	0	0	0	0	0	58	82	100	93	100	34	86	56	93	81	7	0	35	9	31
S04	79	82	87	75	64	0	0	0	0	0	56	91	95	93	100	57	95	57	83	80	13	1	31	8	30
F04	59	82	63	79	54	0	0	0	0	0	26	53	74	91	34	79	98	63	86	85	8	0	35	4	14
S05	84	76	77	79	73	0	0	0	0	0	28	29	72	92	20	86	76	46	84	81	9	0	17	2	7

SCRIPPS	ACORN					THATCHED					ROCKWEED					MUSSEL					GOOSE BARNACLE				
DATE	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5	Pe1	Pe2	Pe3	Pe4	Pe5	M1	M2	M3	M4	M5	Po1	Po2	Po3	Po4	Po5
F97	83	86	86	80	88	0	0	0	0	0	54	20	42	43	26	84	91	76	76	78	29	37	11	17	37
S98	71	59	77	62	64	0	0	0	0	0	33	6	16	19	10	70	86	61	52	66	30	36	16	22	33
F98	91	92	93	84	93	0	0	0	0	0	52	9	32	55	25	79	90	66	52	83	29	27	20	19	33
S99	94	92	96	81	97	0	0	0	0	0	48	18	32	52	23	82	92	64	53	77	36	35	26	20	31
F99	97	96	98	85	99	0	0	0	0	0	74	26	36	75	35	93	96	77	72	86	42	44	40	27	33
S00	95	96	98	93	99	0	0	0	0	0	70	24	29	69	34	97	99	87	90	90	33	32	35	25	31
F00	95	97	91	92	95	0	0	0	0	0	62	25	39	66	37	1	99	94	98	59	40	45	32	20	24
S01	96	95	95	87	96	0	0	0	0	0	75	26	47	63	47	0	98	95	100	38	30	39	30	18	26
F01	97	97	99	94	98	0	0	0	0	0	71	25	51	85	47	9	100	100	100	17	33	31	35	17	30
S02	95	98	99	93	99	0	0	0	0	0	80	20	53	74	57	8	100	35	73	21	27	38	26	20	30
F02	99	98	98	96	99	0	0	0	0	0	95	34	61	96	82	12	100	46	76	19	27	34	24	11	24
S03	89	88	87	77	87	0	0	0	0	0	77	17	45	92	49	24	94	59	73	14	26	32	30	17	25
F03	96	100	99	94	100	0	0	0	0	0	86	24	49	100	78	42	97	53	74	32	30	33	24	25	32
S04	76	42	97	77	92	0	0	0	0	0	74	28	39	91	76	73	92	52	78	56	30	31	35	23	30
F04	88	86	86	76	91	0	0	0	0	0	60	10	36	73	28	34	93	62	76	77	18	31	24	21	18
S05	74	76	74	77	82	0	0	0	0	0	64	8	26	63	30	36	84	60	64	57	16	14	21	23	31

Table 11. Photoplot Key Species Summary Data by Quadrat: Navy North and Navy South.

Percent cover data for 5 index taxa (acorn barnacles, thatched barnacles, rockweed, mussels, goose barnacles) at Navy North and Navy South.

NORTH	ACORN					THATCHED					ROCKWEED					MUSSEL										GOOSE BARNACLE											
DATE	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5	Pe1	Pe2	Pe3	Pe4	Pe5	M0	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M0	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10
S95	8	1	4	20	12	31	24	29	18	38	86	97	82	77	85	8	14	21	44	19	0	1	0	5	0	1	16	21	23	1	26	25	16	15	11	25	13
F95	3	0	0	7	2	24	20	25	14	28	96	90	94	72	51		11	16	27	14	0	0	0	1	0	0		18	19	1	25	26	14	13	14	28	14
S96																																					
F96	10	8	7	10	10	28	31	33	22	31	73	86	88	84	32	13	10	24	40	16	0	2	0	3	0	1	10	13	17	0	14	22	17	7	12	25	17
S97	26	6	4	16	10	27	31	39	30	35	65	94	97	71	39	23	26	29	53	15	3	1	0	6	0	0	12	13	15	0	26	21	21	8	8	33	6
F97	6	2	3	5	5	20	25	26	12	21	34	84	80	48	5	22	32	34	61	18	8	5	0	2	5	1	15	17	14	0	25	25	20	7	8	23	8
S98	10	2	1	7	3	27	31	34	30	30	20	57	57	36	4	27	32	26	66	14	7	8	0	5	2	0	11	8	10	1	18	15	15	4	10	26	8
F98	51	22	13	10	17	21	27	25	15	16	30	67	69	50	7	26	22	29	62	12	4	7	1	3	2	0	17	12	11	0	21	20	21	6	9	31	10
S99	42	26	23	28	20	48	48	55	40	35	29	70	57	63	9	28	25	28	57	13	6	4	0	4	4	0	16	17	15	0	21	15	17	4	13	31	9
F99	4	6	0	7	4	40	38	49	42	21	52	96	90	91	21	37	34	28	72	8	2	2	0	0	2	0	11	21	18	0	24	20	23	3	9	30	10
S00	5	14	12	11	4	65	54	65	53	59	39	96	90	77	16	32	34	29	57	11	5	2	0	4	1	0	16	20	22	0	23	10	4	4	7	34	10
F00	7	0	0	4	1	70	65	43	44	27	71	93	93	94	18	34	21	26	44	2	5	0	1	2	0	1	19	34	24	0	28	9	6	3	9	32	10
S01	10	15	6	8	5	67	59	44	42	36	72	87	94	84	23	35	27	24	54	5	1	0	0	1	3	0	17	31	21	0	15	11	1	0	10	32	11
F01	13	22	12	12	4	40	34	28	36	27	93	96	94	92	15	15	20	24	5	0	1	0	0	1	0	0	17	29	21	0	17	13	0	2	2	14	6
S02	21	17	9	18	13	58	44	55	49	38	91	95	87	78	17	21	26	20	13	2	0	0	0	0	1	0	18	26	27	0	17	6	0	0	1	11	4
F02	0	0	0	0	0	55	21	27	29	24	95	96	97	99	39	11	17	12	5	0	0	0	0	0	0	0	21	34	28	0	16	2	0	0	0	0	0
S03	0	1	0	1	1	42	31	32	24	24	96	96	99	95	29	14	13	16	6	0	0	0	0	0	0	0	19	34	26	0	12	3	0	0	1	2	0
F03	0	0	0	0	0	36	19	18	14	12	96	96	97	100	54	7	6	10	1	0	0	0	0	0	0	0	18	29	23	0	10	3	0	0	0	0	0
S04	10	12	3	12	17	46	28	27	33	29	83	93	91	95	42	11	18	9	0	0	0	0	0	0	0	0	17	23	26	0	12	3	0	0	0	0	1
F04	6	1	0	2	1	44	33	13	40	21	83	94	92	100	59	1	1	3	1	0	0	0	0	0	0	0	0	0	6	0	13	4	0	0	0	0	0
S05	2	3	0	4	4	48	31	12	23	14	62	74	76	96	45	1	0	4	0	0	0	0	0	0	0	0	0	1	7	0	8	2	0	0	0	0	1

SOUTH	ACORN					THATCHED					ROCKWEED					MUSSEL										GOOSE BARNACLE											
DATE	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5	Pe1	Pe2	Pe3	Pe4	Pe5	M0	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M0	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10
S95	15	9	3	6	3	14	12	14	22	13	59	51	51	30	45	2	37	21	30	14	14	14	14	1	11	3	19	8	14	16	10	8	26	28	28	31	18
F95	1	2	0	0		12	10	9	16							1	30	22	31	18	13	13	15	0	13	3	17	4	16	20	10	12	27	28	25	40	19
S96																																					
F96	1	1	2	4	3	7	9	6	10	9	68	37	61	38	51	4	41	17	45	18	18	20	18	3	19	7	21	10	22	17	16	11	27	29	27	34	19
S97	4	4	1	7	1	11	14	8	14	9	71	48	51	37	54	9	53	23	7	22	19	17	16	6	21	5	14	6	12	1	3	3	25	27	28	32	25
F97	1	2	0	0	0	10	9	7	6	5	54	32	45	30	28	7	45	17	7	17	17	22	22	5	25	9	19	5	25	0	13	6	26	32	28	33	21
S98	0	0	0	0	0	5	5	8	9	7	54	36	30	33	49	5	60	23	4	19	10	31	18	9	27	8	22	6	14	0	8	10	20	27	21	30	21
F98	1	10	5	3	0	6	5	5	20	8	53	41	39	38	58	9	48	11	3	17	16	25	28	4	25	19	22	12	6	0	6	10	23	31	23	18	23
S99	8	4	5	2	3	15	12	6	9	15	53	55	52	45	41	7	51	5	3	18	13	29	22	2	26	8	22	11	8	1	7	11	19	21	22	16	21
F99	16	1	2	3	2	24	8	3	15	21	70	42	40	55	63	8	56	2	6	14	14	22	13	3	17	8	23	7	7	2	6	11	25	23	20	18	21
S00	3	1	0	5	1	12	5	8	6	21	66	47	31	46	69	8	65	0	5	12	6	23	14	4	18	5	18	5	0	0	5	6	19	21	18	21	20
F00	4	5	3	1	2	17	5	9	9	19	67	44	41	62	49	10	58	0	8	9	8	23	13	4	12	9	20	0	2	0	7	9	26	17	18	7	16
S01	14	0	1	1	0	15	3	5	22	21	58	36	38	53	66	6	71	0	3	8	18	19	12	3	10	8	21	1	1	0	6	9	27	17	25	8	21
F01	19	4	7	2	1	14	4	1	8	12	62	36	61	63	49	3	59	0	0	2	8	13	8	4	2	7	25	0	1	0	9	8	24	20	20	9	25
S02	16	0	2	4	0	17	6	3	23	30	63	40	50	64	61	5	50	0	2	4	9	14	9	5	1	10	19	0	1	0	8	8	22	22	20	9	17
F02	3	0	0	0	0	16	3	1	21	7	63	37	72	75	70	3	26	0	0	1	3	15	15	6	1	6	24	1	0	12	0	0	14	13	9	5	18
S03	1	1	1	0	0	8	0	0	8	9	63	45	78	83	42	5	20	0	0	2	3	10	8	2	4	5	16	0	0	0	7	1	13	9	11	4	19
F03	2	2	3	1	1	9	1	0	4	7	76	44	68	72	50	0	0	0	0	2	3	13	8	0	0	8	1	0	0	0	5	16	13	14	13	6	13
S04	6	3	20	2	2	7	5	1	12	7	63	39	60	72	51	6	7	0	0	0	7	12	9	1	2	9	2	0	0	0	7	11	14	13	13	4	10
F04	4	3	3	1	0	6	5	2	5	8	65	45	56	66	54	0	1	0	0	0	3	14	10	0	0	6	0	0	0	0	5	3	11	11	12	6	7
S05	0	0	0	0	0	10	0	1	4	9	64	48	28	63	58	9	0	2	0	0	1	11	7	0	0	3	0	0	0	1	0	0	13	11	11	4	5

Table 12. Fall 2004 Owl Limpet Size Distribution in Circular Plots at Cardiff and Scripps.

LENGTH (MM)	CARDIFF REEF PLOTS (# OF LIMPETS)							SCRIPPS REEF PLOTS (# OF LIMPETS)						
	1	2	3	4	5	ALL	%	1	2	3	4	5	ALL	%
15	0	0	0	0	0	0	0	0	1	2	3	1	7	2
16	0	0	1	0	0	1	3	0	4	1	1	0	6	2
17	0	1	0	0	0	1	3	0	3	4	3	1	11	3
18	0	1	0	0	0	1	3	1	2	2	0	0	5	1
19	0	0	0	0	0	0	0	0	4	4	2	1	11	3
20	0	0	0	1	0	1	3	0	0	4	8	1	13	3
21	0	0	0	0	0	0	0	0	1	2	2	1	6	2
22	0	0	0	0	0	0	0	1	2	1	5	0	9	2
23	1	0	0	1	0	2	5	0	2	1	7	2	12	3
24	0	0	0	2	0	2	5	0	1	3	4	3	11	3
25	1	0	0	1	0	2	5	0	3	5	6	0	14	4
26	1	0	0	0	0	1	3	2	7	2	3	2	16	4
27	1	0	0	1	0	2	5	2	7	3	6	2	20	5
28	0	1	0	0	0	1	3	0	6	5	3	2	16	4
29	0	0	0	1	0	1	3	2	4	2	4	2	14	4
30	0	0	0	0	0	0	0	0	1	10	5	5	21	6
31	2	0	0	0	0	2	5	5	4	0	3	5	17	4
32	0	1	0	0	0	1	3	1	6	5	0	4	16	4
33	1	0	1	0	0	2	5	3	2	7	3	4	19	5
34	0	0	0	0	0	0	0	1	3	9	2	5	20	5
35	0	0	0	0	0	0	0	3	3	2	2	4	14	4
36	1	1	0	1	0	3	8	3	1	5	3	5	17	4
37	0	1	0	0	0	1	3	0	2	3	2	4	11	3
38	0	0	0	0	0	0	0	2	3	2	1	3	11	3
39	0	0	0	0	0	0	0	4	2	2	1	1	10	3
40	1	1	0	1	0	3	8	3	2	2	1	0	8	2
41	1	0	0	0	0	1	3	2	0	2	2	1	7	2
42	0	1	0	0	0	1	3	4	1	1	0	2	8	2
43	0	1	0	0	0	1	3	9	1	0	0	0	10	3
44	0	0	0	0	0	0	0	0	1	0	0	0	1	0
45	1	0	1	1	0	3	8	2	0	1	0	0	3	1
46	0	1	0	0	0	1	3	4	1	2	0	0	7	2
47	0	2	0	0	0	2	5	2	0	0	0	0	2	1
48	0	0	0	1	0	1	3	1	0	0	0	0	1	0
49	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	1	0	0	0	0	1	0
51	0	0	0	0	0	0	0	1	0	0	0	0	1	0
52	0	0	0	0	0	0	0	2	0	0	0	0	2	1
53	0	0	0	0	0	0	0	0	0	0	0	0	0	0
54	0	0	0	0	0	0	0	1	0	0	0	0	1	0
55	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58	0	0	0	0	0	0	0	0	0	0	0	0	0	0
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0	0	0	0
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0	0	0	0	0	0	0	0
75	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL #	11	12	3	11	0	37	100	62	80	94	82	61	379	100
MIN SIZE	23	17	16	20		16		18	15	15	15	15	15	
MAX SIZE	45	47	45	45		47		54	46	54	41	42	54	
AVG SIZE	33	36	31	29		32		39	29	30	27	31	31	
ST DEV	7	11	15	8		10		8	7	8	7	6	7	
ST ERROR	3	5	7	4		5		3	3	4	3	3	3	

Table 13. Fall 2004 Owl Limpet Size Distribution in Circular Plots at Navy North and South.

LENGTH (MM)	NAVY NORTH PLOTS (# OF LIMPETS)								NAVY SOUTH PLOTS (# OF LIMPETS)							
	1	2	3	4	5	6	ALL	%	1	2	3	4	5	6	ALL	%
15	0	0	0	0	0	0	0	0	0	0	0	4	3	0	7	2
16	1	1	0	2	0	1	5	2	2	0	0	1	1	1	5	2
17	2	1	2	1	0	1	7	3	0	0	0	0	3	1	4	1
18	2	0	4	0	0	2	8	3	0	1	0	2	1	1	5	2
19	1	0	1	0	0	1	3	1	0	1	0	2	0	2	5	2
20	2	3	1	1	0	1	8	3	1	0	1	7	3	4	16	5
21	2	3	1	0	0	0	6	2	1	1	0	3	1	2	8	3
22	1	3	2	0	1	1	8	3	1	0	1	1	2	1	6	2
23	0	2	0	0	0	0	2	1	1	0	0	3	1	4	9	3
24	1	1	3	0	2	0	7	3	0	0	1	1	0	4	6	2
25	0	1	0	0	1	0	2	1	0	1	0	1	0	0	2	1
26	1	0	0	1	0	1	3	1	0	0	1	1	1	0	3	1
27	0	1	1	3	3	0	8	3	0	1	1	3	0	0	5	2
28	0	1	0	2	3	1	7	3	2	0	0	2	0	3	7	2
29	0	0	3	3	2	1	9	4	1	0	2	1	0	1	5	2
30	0	2	0	1	0	1	4	2	1	0	0	2	0	3	6	2
31	0	0	0	2	0	1	3	1	1	1	2	1	0	2	7	2
32	0	0	0	2	0	4	6	2	2	1	2	1	1	1	8	3
33	1	0	0	2	0	3	6	2	1	0	1	2	0	2	6	2
34	1	0	0	0	0	2	3	1	0	1	0	1	1	1	4	1
35	0	1	1	2	1	3	8	3	3	0	2	2	0	1	8	3
36	1	1	2	2	2	1	9	4	1	1	1	0	1	3	7	2
37	0	0	3	3	1	1	8	3	0	0	2	2	0	0	4	1
38	2	0	1	0	2	2	7	3	2	3	2	0	4	2	13	4
39	3	2	0	0	1	2	8	3	1	1	1	3	1	0	7	2
40	0	0	1	1	2	0	4	2	0	0	2	1	1	2	6	2
41	2	2	1	4	1	0	10	4	1	0	0	2	0	4	7	2
42	4	0	0	3	5	1	13	5	1	0	0	0	0	4	5	2
43	1	2	0	1	1	1	6	2	0	0	0	0	2	1	3	1
44	4	2	0	2	1	2	11	4	0	0	1	1	4	2	8	3
45	1	1	0	1	1	0	4	2	2	0	0	5	1	5	13	4
46	1	0	0	1	2	0	4	2	1	0	1	2	2	3	9	3
47	3	3	0	0	2	0	8	3	1	0	1	1	0	3	6	2
48	1	3	1	1	1	1	8	3	2	1	1	1	7	1	13	4
49	1	0	2	1	2	0	6	2	0	0	0	1	2	3	6	2
50	3	0	0	0	0	0	3	1	0	0	1	2	1	0	4	1
51	0	1	0	0	0	0	1	0	1	1	1	0	1	3	7	2
52	0	1	2	0	0	0	3	1	0	2	0	0	1	2	5	2
53	1	1	1	1	0	0	4	2	0	2	0	0	0	3	5	2
54	0	0	3	0	1	0	4	2	0	0	0	1	0	1	2	1
55	1	0	2	0	0	0	3	1	1	1	1	0	0	0	3	1
56	1	0	0	0	0	0	1	0	1	2	0	1	0	0	4	1
57	0	0	2	0	0	0	2	1	1	1	0	0	0	0	2	1
58	1	1	0	0	0	0	2	1	0	1	0	0	1	0	2	1
59	0	0	0	0	0	0	0	0	0	1	0	0	1	0	2	1
60	0	1	2	0	0	0	3	1	2	2	1	2	1	0	8	3
61	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0	0	1	0	0	0	1	2	1
63	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
65	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
68	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	1
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
71	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
72	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL #	47	43	43	43	38	35	249	100	37	28	30	66	49	81	291	100
MIN SIZE	16	16	17	16	22	16	16		16	18	20	15	15	16	15	
MAX SIZE	71	72	61	53	54	48	72		68	62	60	60	60	69	69	
AVG SIZE	38	37	37	35	38	32	36		39	44	37	32	37	38	38	
ST DEV	13	14	15	9	9	9	12		14	14	10	12	14	13	13	
ST ERROR	5	6	6	4	4	3	5		6	6	4	5	6	5	5	

Table 14. Spring 2005 Owl Limpet Size Distribution in Circular Plots at Cardiff and Scripps.

LENGTH (MM)	CARDIFF REEF PLOTS (# OF LIMPETS)								SCRIPPS REEF PLOTS (# OF LIMPETS)							
	1	2	3	4	5	ALL	%		1	2	3	4	5	ALL	%	
15	0	1	0	0	0	1	3		0	5	4	8	0	17	5	
16	0	0	0	0	0	0	0		0	3	7	3	0	13	4	
17	0	0	0	0	0	0	0		0	2	9	3	2	16	5	
18	0	1	0	0	0	1	3		0	1	5	4	0	10	3	
19	0	0	0	0	0	0	0		1	4	3	3	0	11	3	
20	0	0	0	2	0	2	5		0	8	4	5	0	17	5	
21	0	1	0	0	0	1	3		0	2	4	2	0	8	2	
22	0	0	0	1	0	1	3		1	5	3	3	4	16	5	
23	0	0	0	2	1	3	8		2	1	4	8	1	16	5	
24	0	0	0	0	0	0	0		1	4	0	2	0	7	2	
25	0	0	0	0	1	1	3		0	3	2	6	1	12	3	
26	0	0	0	0	0	0	0		1	3	3	5	2	14	4	
27	0	1	1	0	0	2	5		3	3	4	3	7	20	6	
28	0	0	0	0	0	0	0		2	6	2	3	2	15	4	
29	2	0	0	0	0	2	5		1	1	8	1	3	14	4	
30	0	1	0	0	0	1	3		4	6	5	4	2	21	6	
31	1	0	0	1	0	2	5		2	2	2	2	2	10	3	
32	0	0	0	0	0	0	0		2	2	3	1	1	9	3	
33	1	0	0	2	0	3	8		4	1	5	2	1	13	4	
34	0	0	0	3	0	3	8		1	3	2	2	2	10	3	
35	0	0	0	0	0	0	0		2	3	0	4	2	11	3	
36	0	1	0	0	0	1	3		2	2	3	2	3	12	3	
37	0	0	0	0	0	0	0		3	1	1	1	4	10	3	
38	0	0	0	0	0	0	0		2	1	1	0	0	4	1	
39	0	0	0	0	0	0	0		3	2	0	0	4	9	3	
40	1	0	0	0	0	1	3		2	2	2	1	0	7	2	
41	0	0	0	1	0	1	3		2	1	0	0	1	4	1	
42	0	0	0	1	0	1	3		3	0	0	0	0	3	1	
43	1	1	0	0	0	2	5		4	1	1	0	0	6	2	
44	0	1	0	0	0	1	3		1	1	1	0	0	3	1	
45	0	1	0	1	0	2	5		3	0	0	0	0	3	1	
46	0	1	0	0	0	1	3		3	0	1	0	0	4	1	
47	0	1	1	0	0	2	5		0	0	0	0	0	0	0	
48	0	0	0	1	0	1	3		2	0	0	0	0	2	1	
49	0	0	0	0	0	0	0		2	0	0	0	0	2	1	
50	1	0	0	0	0	1	3		2	0	0	0	0	2	1	
51	0	0	0	0	0	0	0		0	0	0	0	0	0	0	
52	1	0	0	0	0	1	3		0	0	0	0	0	0	0	
53	0	0	0	0	0	0	0		2	0	0	0	0	2	1	
54	0	0	0	0	0	0	0		0	0	0	0	0	0	0	
55	0	0	0	0	0	0	0		0	1	0	0	0	1	0	
56	0	0	0	0	0	0	0		0	0	0	0	0	0	0	
57	0	0	0	0	0	0	0		0	0	0	0	0	0	0	
58	0	0	0	0	0	0	0		0	0	0	0	0	0	0	
59	0	0	0	0	0	0	0		0	0	0	0	0	0	0	
60	0	0	0	0	0	0	0		0	0	0	0	0	0	0	
61	0	0	0	0	0	0	0		0	0	0	0	0	0	0	
62	0	0	0	0	0	0	0		0	0	0	0	0	0	0	
63	0	0	0	0	0	0	0		0	0	0	0	0	0	0	
64	0	0	0	0	0	0	0		0	0	0	0	0	0	0	
65	0	0	0	0	0	0	0		0	0	0	0	0	0	0	
66	0	0	0	0	0	0	0		0	0	0	0	0	0	0	
67	0	0	0	0	0	0	0		0	0	0	0	0	0	0	
68	0	0	0	0	0	0	0		0	0	0	0	0	0	0	
69	0	0	0	0	0	0	0		0	0	0	0	0	0	0	
70	0	0	0	0	0	0	0		0	0	0	0	0	0	0	
71	0	0	0	0	0	0	0		0	0	0	0	0	0	0	
72	0	0	0	0	0	0	0		0	0	0	0	0	0	0	
73	0	0	0	0	0	0	0		0	0	0	0	0	0	0	
74	0	0	0	0	0	0	0		0	0	0	0	0	0	0	
75	0	0	0	0	0	0	0		0	0	0	0	0	0	0	
TOTAL #	8	11	2	15	2	38	100		63	80	89	78	44	354	100	
MIN SIZE	29	15	27	20	23	15			19	15	15	15	17	15		
MAX SIZE	52	47	47	48	25	52			53	55	46	40	41	55		
AVG SIZE	38	34	37	32	24	34			37	27	25	24	30	28		
ST DEV	9	12	14	9	1	10			8	8	8	7	6	9		
ST ERROR	4	5	6	4	1	5			4	4	3	3	3	4		

Table 15. Spring 2005 Owl Limpet Size Distribution in Circular Plots at Navy North and South.

LENGTH (MM)	NAVY NORTH PLOTS (# OF LIMPETS)								NAVY SOUTH PLOTS (# OF LIMPETS)							
	1	2	3	4	5	6	ALL	%	1	2	3	4	5	6	ALL	%
15	2	0	0	2	0	1	5	1	2	1	0	2	1	0	6	2
16	2	0	0	0	2	2	6	2	0	0	0	4	0	1	5	1
17	2	0	1	0	0	4	7	2	2	0	2	0	2	0	6	2
18	0	0	0	2	2	4	8	2	3	0	0	1	1	1	6	2
19	3	1	1	0	1	0	6	2	4	0	0	3	1	2	10	3
20	6	1	1	4	2	2	16	5	3	0	1	6	4	2	16	5
21	2	0	1	2	3	2	10	3	2	0	1	5	2	3	13	4
22	3	1	2	3	0	2	11	3	3	1	0	4	3	4	15	4
23	1	0	2	1	2	1	7	2	3	0	0	5	2	2	12	3
24	2	0	1	1	1	3	8	2	1	0	0	6	3	4	14	4
25	5	0	1	2	2	2	12	3	0	0	2	5	4	3	14	4
26	1	2	1	3	1	2	10	3	2	1	0	2	2	7	14	4
27	8	0	5	1	0	4	18	5	2	2	0	5	1	1	11	3
28	1	2	5	3	0	3	14	4	0	0	1	3	1	4	9	3
29	3	0	0	2	0	0	5	1	0	0	0	1	0	3	4	1
30	3	5	1	2	2	3	16	5	0	0	0	5	2	1	8	2
31	1	2	0	0	2	0	5	1	0	0	0	3	2	3	8	2
32	4	1	2	0	1	0	8	2	1	2	1	3	0	1	8	2
33	0	2	2	1	0	1	6	2	1	0	0	2	0	0	3	1
34	0	0	0	3	1	0	4	1	0	1	0	3	1	1	6	2
35	2	3	1	1	1	0	8	2	1	0	1	6	0	2	10	3
36	0	1	1	3	2	2	9	3	0	1	1	0	2	1	5	1
37	1	2	3	2	4	0	12	3	0	2	0	2	2	0	6	2
38	1	0	2	1	1	2	7	2	1	0	1	1	0	2	5	1
39	0	0	0	3	2	2	7	2	1	0	1	2	1	2	7	2
40	1	2	1	3	0	0	7	2	3	0	0	0	1	2	6	2
41	0	1	2	2	0	3	8	2	3	0	1	1	0	1	6	2
42	1	0	0	0	2	3	6	2	3	0	0	0	3	0	6	2
43	0	1	2	2	0	1	6	2	1	0	2	0	1	4	8	2
44	0	1	0	0	3	3	7	2	1	0	1	1	0	0	3	1
45	5	3	1	2	2	2	15	4	2	0	0	1	2	5	10	3
46	0	1	0	2	2	1	6	2	1	1	1	0	0	3	6	2
47	2	0	0	2	1	1	6	2	1	0	0	4	3	3	11	3
48	1	1	0	1	3	0	6	2	1	1	1	4	1	1	9	3
49	0	2	0	0	1	1	4	1	1	0	0	0	2	4	7	2
50	3	2	1	1	3	0	10	3	0	1	0	1	2	2	6	2
51	2	2	0	2	0	1	7	2	1	0	1	0	3	2	7	2
52	0	0	0	0	1	0	1	0	0	2	1	3	1	1	8	2
53	1	1	2	0	0	0	4	1	0	0	0	1	0	2	3	1
54	1	0	2	1	3	0	7	2	0	1	0	1	0	0	2	1
55	1	0	1	0	0	0	2	1	0	0	1	0	0	1	2	1
56	0	0	0	0	0	0	0	0	1	3	0	0	0	0	4	1
57	2	1	1	0	0	0	4	1	0	1	1	0	0	0	2	1
58	0	1	3	0	0	0	4	1	1	0	0	1	1	0	3	1
59	0	0	1	0	0	0	1	0	1	0	0	0	1	0	2	1
60	0	0	0	0	0	0	0	0	1	2	0	1	0	0	4	1
61	0	1	2	0	0	1	4	1	0	1	0	0	1	0	2	1
62	0	0	0	0	0	0	0	0	0	1	0	0	0	1	2	1
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	0	1	0	0	0	0	1	0	1	0	0	0	0	0	1	0
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	1
71	1	1	0	0	0	0	2	1	0	0	0	0	0	0	0	0
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL #	74	45	52	60	53	59	343	100	56	25	22	98	59	85	345	100
MIN SIZE	15	19	17	15	16	15	15		15	15	17	15	15	16	15	
MAX SIZE	71	71	61	54	54	61	71		68	62	57	60	61	70	70	
AVG SIZE	32	40	37	33	36	31	34		34	44	37	31	34	36	34	
ST DEV	13	12	13	10	12	11	12		15	14	12	11	13	13	13	
ST ERROR	5	5	5	4	5	5	5		6	6	4	5	5	5	5	

Table 16. Owl Limpet Density and Size Summary Data by Site: Cardiff and Scripps

Total number of limpets and shell length statistics at Cardiff and Scripps.

CARDIFF REEF (5 plots at 3 m dia)

DATE	NUM	#S	#L	MIN	MAX	AVG	SD	SE
F97	94	24	70	15	53	35	8	3
S98	114	26	88	15	53	36	9	4
F98	162	76	86	15	52	31	10	4
S99	168	118	50	15	51	27	8	4
F99	225	98	127	16	54	30	7	3
S00	221	104	117	15	47	30	7	3
F00	158	66	92	15	44	29	7	3
S01	136	39	97	16	46	34	8	3
F01	123	61	62	15	45	29	7	3
S02	138	60	78	15	47	30	7	3
F02	71	20	51	21	45	32	5	2
S03	79	26	53	16	49	32	8	3
F03	66	21	45	17	50	34	7	3
S04	66	20	46	16	54	33	7	3
F04	37	15	22	16	47	32	10	5
S05	38	14	24	15	52	34	10	5

SCRIPPS REEF (5 plots at 2 m dia)

DATE	NUM	#S	#L	MIN	MAX	AVG	SD	SE
F97	311	229	82	15	55	26	7	3
S98	398	302	96	15	43	25	6	3
F98	503	350	153	15	55	26	7	3
S99	458	310	148	15	46	26	7	3
F99	496	321	175	15	56	28	7	3
S00	433	267	166	15	50	28	7	3
F00	412	213	199	15	59	30	8	4
S01	369	165	204	15	57	31	7	3
F01	416	182	234	15	55	32	8	3
S02	505	258	247	15	59	31	8	4
F02	521	272	249	15	58	30	9	4
S03	524	281	243	15	55	29	8	4
F03	452	224	228	15	53	30	7	3
S04	436	225	211	15	60	30	7	3
F04	379	171	208	15	54	31	7	3
S05	354	206	148	15	55	28	9	4

#S = # LIMPETS < 30 mm #L = # LIMPETS >= 30 mm

Table 17. Owl Limpet Density and Size Summary Data by Site: Navy North and Navy South

Total number of limpets and shell length statistics at Navy North and Navy South.

NAVY NORTH (6 plots at 2 m dia)

DATE	NUM	#S	#L	MIN	MAX	AVG	SD	SE
S95	187	41	146	15	54	36	8	3
F95	181	32	149	16	55	39	9	4
S96								
F96	187	77	110	15	58	33	11	4
S97	213	101	112	15	64	33	11	5
F97	261	122	139	15	65	32	11	5
S98	259	127	132	15	69	31	10	4
F98	405	187	218	15	63	31	10	4
S99	403	219	184	15	64	30	10	4
F99	443	191	252	15	71	32	10	4
S00	424	115	309	15	69	35	9	4
F00	359	67	292	15	73	39	11	5
S01	402	96	306	15	71	38	12	5
F01	334	103	231	15	70	36	11	5
S02	352	93	259	15	71	37	11	4
F02	276	95	181	15	71	35	11	5
S03	331	94	237	17	72	37	11	4
F03	280	58	222	15	75	39	12	5
S04	299	65	234	16	69	39	11	4
F04	249	83	166	16	72	36	12	5
S05	343	143	200	15	71	34	12	5

NAVY SOUTH (6 plots at 2 m dia)

DATE	NUM	#S	#L	MIN	MAX	AVG	SD	SE
S95	270	70	200	16	63	36	9	4
F95	290	48	242	15	66	39	11	4
S96								
F96	350	125	225	15	64	35	12	5
S97	330	94	236	15	65	38	12	5
F97	361	111	250	15	68	36	12	5
S98	364	107	257	15	69	37	11	5
F98	390	123	267	15	68	37	12	5
S99	413	173	240	15	65	34	12	5
F99	399	152	247	15	63	34	11	4
S00	423	114	309	15	63	37	11	4
F00	456	112	344	15	66	38	12	5
S01	476	135	341	15	65	38	12	5
F01	376	111	265	15	62	37	11	5
S02	349	70	279	15	62	38	10	4
F02	282	85	197	15	61	36	11	4
S03	293	71	222	15	62	37	11	4
F03	279	52	227	15	69	41	12	5
S04	267	56	211	15	70	41	13	5
F04	291	93	198	15	69	38	13	5
S05	345	155	190	15	70	34	13	5

#S = # LIMPETS < 30 mm #L = # LIMPETS >= 30 mm

Table 18. Owl Limpet Density and Size Summary Data by Plot: Cardiff and Scripps.

Number of limpets and shell length (mm) statistics for circular plots at Cardiff and Scripps.

DATE	CARDIFF 1						CARDIFF 2						CARDIFF 3						CARDIFF 4						CARDIFF 5					
	NUM	MIN	MAX	AVG	SD	SE	NUM	MIN	MAX	AVG	SD	SE	NUM	MIN	MAX	AVG	SD	SE	NUM	MIN	MAX	AVG	SD	SE	NUM	MIN	MAX	AVG	SD	SE
F97	34	16	53	35	7	3	22	24	50	39	6	3	17	21	48	34	9	4	12	15	38	26	5	2	9	24	41	34	6	3
S98	34	15	51	39	9	4	19	20	53	38	7	3	27	22	51	36	9	4	24	16	42	31	6	3	10	15	46	35	9	4
F98	25	17	43	28	8	4	30	15	52	32	11	5	43	16	50	34	10	4	52	15	48	28	9	4	12	24	49	38	9	4
S99	38	17	51	27	7	3	23	15	48	22	7	3	47	15	49	27	8	4	42	16	42	28	7	3	18	15	47	30	11	5
F99	31	16	48	30	8	4	29	16	54	32	9	4	45	17	47	32	7	3	93	18	42	28	5	2	27	16	46	31	9	4
S00	34	15	45	30	8	4	37	18	47	33	8	3	49	15	39	29	6	3	76	18	45	31	6	3	25	15	36	27	6	3
F00	25	16	44	26	8	4	41	15	44	29	8	3	26	18	43	32	7	3	55	15	42	30	7	3	11	21	37	32	5	2
S01	31	16	46	31	9	4	31	18	44	33	9	4	24	19	44	35	6	3	40	20	44	34	6	3	10	29	41	35	4	2
F01	28	18	43	29	7	3	31	22	45	31	6	3	30	15	44	29	9	4	25	18	42	27	7	3	9	19	40	30	7	3
S02	21	15	45	31	9	4	33	19	43	32	6	3	38	15	47	30	7	3	37	17	38	28	6	3	9	26	38	33	4	2
F02	12	24	42	34	5	2	12	22	44	34	6	3	12	21	40	31	5	2	31	21	45	32	6	2	4	21	37	31	7	3
S03	16	17	44	32	9	4	18	16	49	32	9	4	13	16	45	33	7	3	28	19	39	30	6	3	4	26	39	33	6	3
F03	14	17	50	37	13	6	13	17	39	28	7	3	11	22	45	38	6	3	24	20	44	32	4	2	4	32	40	35	4	2
S04	20	19	54	36	11	5	11	16	35	28	6	3	10	18	44	37	7	3	22	22	46	34	7	3	3	26	36	30	6	2
F04	11	23	45	33	7	3	12	17	47	36	11	5	3	16	45	31	15	7	11	20	45	29	8	4	0					
S05	8	29	52	38	9	4	11	15	47	34	12	5	2	27	47	37	14	6	15	20	48	32	9	4	2	23	25	24	1	1

DATE	SCRIPPS 1						SCRIPPS 2						SCRIPPS 3						SCRIPPS 4						SCRIPPS 5					
	NUM	MIN	MAX	AVG	SD	SE	NUM	MIN	MAX	AVG	SD	SE	NUM	MIN	MAX	AVG	SD	SE	NUM	MIN	MAX	AVG	SD	SE	NUM	MIN	MAX	AVG	SD	SE
F97	32	17	55	31	9	4	60	15	41	25	6	3	42	15	46	24	7	3	122	15	37	25	5	2	55	17	41	27	7	3
S98	33	18	43	29	7	3	76	15	39	23	6	3	69	15	38	22	6	3	137	15	40	26	5	2	83	15	43	28	7	3
F98	61	15	55	30	10	4	99	15	40	25	6	3	89	15	45	24	6	3	150	15	41	25	6	3	104	15	49	30	7	3
S99	54	15	46	30	8	4	105	15	39	25	6	3	91	16	45	26	6	3	124	15	45	25	6	3	84	16	42	29	7	3
F99	58	15	55	30	8	4	108	15	42	28	6	3	101	16	56	28	7	3	130	15	48	24	7	3	99	15	44	28	7	3
S00	56	18	48	32	8	4	102	16	48	29	6	3	94	15	50	29	7	3	100	15	49	25	7	3	81	15	46	30	6	3
F00	63	18	59	33	10	5	90	16	43	29	7	3	88	16	49	28	7	3	96	16	49	30	7	3	75	15	42	29	8	4
S01	56	18	57	36	9	4	89	16	47	31	6	3	82	17	47	30	6	3	80	15	53	31	7	3	62	15	41	30	7	3
F01	53	18	54	37	9	4	94	17	48	31	6	3	105	15	48	30	7	3	89	16	55	33	9	4	75	17	41	30	7	3
S02	64	16	57	37	9	4	116	15	48	30	7	3	122	15	45	28	7	3	112	15	59	33	9	4	91	15	42	29	7	3
F02	64	15	55	37	10	5	85	15	48	30	7	3	130	15	50	28	7	3	140	15	58	30	9	4	102	15	45	29	8	3
S03	71	16	52	34	10	5	95	15	48	28	7	3	134	15	47	27	7	3	125	15	55	29	8	3	99	16	53	30	8	3
F03	75	15	53	32	8	3	71	18	41	29	6	3	124	15	46	29	7	3	100	16	49	30	7	3	82	15	46	32	7	3
S04	65	22	47	34	7	3	80	15	43	29	7	3	98	15	50	29	7	3	108	15	60	30	9	4	85	15	55	31	7	3
F04	62	18	54	39	8	3	80	15	46	29	7	3	94	15	54	30	8	4	82	15	41	27	7	3	61	15	42	31	6	3
S05	63	19	53	37	8	4	80	15	55	27	8	4	89	15	46	25	8	3	78	15	40	24	7	3	44	17	41	30	6	3

Table 19. Owl Limpet Density and Size Summary Data by Plot: Navy North and Navy South.

Number of limpets and shell length (mm) statistics for circular plots at Navy North and Navy South.

	NAVY NORTH 1						NAVY NORTH 2						NAVY NORTH 3						NAVY NORTH 4						NAVY NORTH 5						NAVY NORTH 6					
DATE	NUM	MIN	MAX	AVG	SD	SE	NUM	MIN	MAX	AVG	SD	SE	NUM	MIN	MAX	AVG	SD	SE	NUM	MIN	MAX	AVG	SD	SE	NUM	MIN	MAX	AVG	SD	SE	NUM	MIN	MAX	AVG	SD	SE
S95	35	20	50	36	8	3	34	18	48	35	8	3	25	15	49	37	9	4	24	23	54	34	7	3	36	15	50	36	9	4	33	18	47	36	8	3
F95	35	17	55	39	10	4	27	16	50	39	8	3	28	16	55	41	11	4	32	21	53	36	8	3	36	17	52	37	10	4	23	26	55	42	8	3
S96																																				
F96	33	15	57	32	11	5	20	15	53	35	13	5	20	16	53	35	11	4	37	15	48	30	10	4	41	17	53	32	9	4	36	15	58	34	12	5
S97	38	15	64	36	12	5	15	25	60	39	10	4	21	20	51	36	12	5	42	15	51	28	10	4	56	15	50	31	10	4	41	15	62	33	12	5
F97	52	15	65	32	13	5	23	15	51	32	11	4	29	15	60	36	13	5	53	15	53	29	10	4	62	15	53	30	11	4	42	16	53	32	12	5
S98	38	17	60	30	10	4	24	17	56	35	10	4	30	15	55	33	12	5	53	15	50	31	8	3	59	19	51	32	8	3	55	15	69	30	11	4
F98	94	15	63	28	10	4	47	15	60	30	12	5	50	15	61	31	12	5	68	15	56	31	10	4	71	15	54	31	9	4	75	15	55	33	10	4
S99	85	15	64	31	10	4	45	15	48	28	9	4	54	16	61	32	11	5	69	15	52	29	10	4	73	15	54	30	9	4	77	15	54	30	10	4
F99	80	15	71	34	10	4	46	17	57	34	10	4	59	15	67	33	12	5	87	15	55	30	9	4	84	15	52	30	9	4	86	15	53	32	9	4
S00	73	17	68	38	9	4	38	21	62	38	9	4	52	23	69	38	10	4	92	19	55	33	9	4	81	15	59	33	9	4	88	16	58	35	10	4
F00	70	15	70	39	12	5	45	23	71	44	11	4	57	17	73	44	10	4	60	15	58	35	11	4	59	20	61	38	9	4	68	15	58	37	12	5
S01	66	17	70	40	12	5	42	19	71	43	11	4	57	21	71	45	11	4	89	17	58	33	10	4	66	18	62	37	8	3	82	15	62	34	13	5
F01	46	15	70	38	12	5	39	15	68	39	12	5	40	20	70	45	11	4	70	17	57	32	9	4	63	16	50	34	9	4	76	17	59	35	11	5
S02	39	18	69	40	11	5	36	20	69	43	11	5	37	26	71	47	10	4	77	15	61	35	9	4	82	16	50	33	10	4	81	18	57	37	9	4
F02	36	15	71	38	13	5	28	15	69	38	14	6	44	15	71	41	13	5	87	15	49	32	8	3	69	16	50	31	9	3	32	17	58	37	9	4
S03	48	17	70	36	13	6	39	19	69	39	13	5	47	21	72	40	13	5	86	17	53	35	8	3	69	17	51	35	7	3	42	18	56	37	11	4
F03	50	15	68	39	11	5.0	41	15	70	42	13	5.0	39	20	75	42	13	5	68	15	62	39	10	4	47	15	57	37	12	5	35	15	59	38	12	5
S04	52	17	64	40	11	5	41	18	69	43	11	5	32	18	61	44	11	5	63	16	64	38	10	4	60	24	53	37	9	4	51	19	61	34	11	4
F04	47	16	71	38	13	5.0	43	16	72	37	14	6.0	43	17	61	37	15	6	43	16	53	35	9	4	38	22	54	38	9	4	35	16	48	32	9	3
S05	74	15	71	32	13	5	45	19	71	40	12	5	52	17	61	37	13	5	60	15	54	33	10	4	53	16	54	36	12	5	59	15	61	31	11	5

	NAVY SOUTH 1						NAVY SOUTH 2						NAVY SOUTH 3						NAVY SOUTH 4						NAVY SOUTH 5						NAVY SOUTH 6					
DATE	NUM	MIN	MAX	AVG	SD	SE	NUM	MIN	MAX	AVG	SD	SE	NUM	MIN	MAX	AVG	SD	SE	NUM	MIN	MAX	AVG	SD	SE	NUM	MIN	MAX	AVG	SD	SE	NUM	MIN	MAX	AVG	SD	SE
S95	51	18	60	37	10	4	27	19	52	38	8	3	34	16	54	35	10	4	54	16	52	35	9	4	42	20	63	37	10	4	62	18	60	37	9	4
F95	46	17	56	40	8	4	36	27	57	42	7	3	41	15	62	36	12	5	70	15	60	36	11	5	38	20	66	42	11	4	59	15	63	43	10	4
S96																																				
F96	54	16	55	37	10	4	29	27	64	41	10	4	47	15	51	32	11	5	89	15	59	31	12	5	52	15	61	35	12	5	79	15	59	37	12	5
S97	61	16	59	38	12	5	25	24	65	44	11	4	52	17	60	34	11	5	79	15	59	34	11	5	49	18	63	38	12	5	64	18	62	40	11	5
F97	55	15	59	39	12	5	35	16	68	38	15	6	51	15	52	33	11	5	78	15	60	35	10	4	57	15	63	36	12	5	85	15	64	37	12	5
S98	58	17	62	39	12	5	38	20	69	40	13	5	53	15	52	32	11	5	76	15	62	37	10	4	56	15	65	38	12	5	83	17	65	38	11	5
F98	62	15	68	34	14	6	46	16	59	37	13	5	46	15	52	32	11	4	61	15	65	39	11	5	74	15	64	38	12	5	101	16	63	38	12	5
S99	68	15	58	31	12	5	45	15	65	37	13	5	41	15	51	32	10	4	90	15	60	31	12	5	64	15	61	35	12	5	105	15	62	35	12	5
F99	69	15	59	33	11	5	44	15	58	35	10	4	54	15	55	31	10	4	81	18	61	35	10	4	58	15	63	36	10	4	93	15	60	35	11	5
S00	75	15	60	37	11	5	54	15	57	36	10	4	54	15	61	33	11	4	87	16	62	36	10	4	60	16	62	38	11	4	93	17	63	38	11	5
F00	82	17	66	40	12	5	52	16	60	40	12	5	54	15	61	37	11	5	114	16	64	34	13	5	54	16	65	43	11	4	100	15	65	39	12	5
S01	82	16	65	40	13	5	55	18	58	42	11	4	41	18	62	38	11	4	121	16	63	32	12	5	60	19	64	41	12	5	117	15	65	38	12	5
F01	63	16	60	37	13	5	51	19	62	38	10	4	31	15	60	40	12	5	81	15	55	33	11	4	61	15	62	37	11	4	89	16	62	37	11	5
S02	61	15	59	37	12	5	50	27	55	40	8	3	30	21	62	43	10	4	68	19	62	35	10	4	56	20	57	39	9	4	84	17	62	38	11	4
F02	47	15	56	36	12	5	41	19	54	38	9	4	20	18	59	41	12	5	41	15	52	31	10	4	56	15	56	36	9	4	77	15	61	36	11	5
S03	42	17	62	39	11	5	40	17	58	40	11	4	19	24	59	41	11	5	52	16	53	31	10	4	67	15	56	37	10	4	73	17	60	39	10	4
F03	36	22	67	43	13	5.0	27	18	64	45	13	5	32	15	63	35	14	6	59	16	58	35	9	4	53	21	64	43	8	3	72	18	69	42	12	5
S04	37	17	67	43	13	5	27	15	64	43	15	6	30	15	64	35	14	6	57	17	57	36	11	4	49	15	58	42	10	4	67	45	70	41	13	5
F04	37	16	68	39	14	6.0	28	18	62	44	14	6.0	30	20	60	37	10	4	66	15	60	32	12	5	49	15	60	37	14	6	81	16	69	38		

Table 20. Fall 2004 Species Abundances Along Point-Intercept Transects.

CARDIFF REEF TAXA	POINT-INTERCEPT TRANSECTS									
	TURF ZONE					GRASS ZONE				
	1	2	3	AVG	SE	1	2	3	AVG	SE
FEATHER BOA KELP	1	0	0	0	0	0	0	0	0	0
SARGASSUM WEED	0	0	0	0	0	0	0	0	0	0
RED ALGAL TURF	65	52	67	61	5	36	47	82	55	14
SURF GRASS	3	1	0	1	1	59	41	7	36	15
AGGREGATING ANEMONE	7	4	8	6	1	0	0	5	2	2
SAND TUBE WORM	0	0	0	0	0	0	0	0	0	0
MUSSEL	0	0	0	0	0	0	0	0	0	0
OTHER BIOTA	0	1	1	1	0	2	1	1	1	0
BARE SUBSTRATE	24	42	24	30	6	3	11	5	6	2

SCRIPPS REEF TAXA	POINT-INTERCEPT TRANSECTS									
	TURF ZONE					GRASS ZONE				
	1	2	3	AVG	SE	4	5	6	AVG	SE
FEATHER BOA KELP	0	0	0	0	0	0	0	0	0	0
SARGASSUM WEED	0	0	0	0	0	0	0	0	0	0
RED ALGAL TURF	36	27	19	27	5	61	26	41	43	10
SURF GRASS	1	0	0	0	0	17	16	40	24	8
AGGREGATING ANEMONE	0	1	0	0	0	2	0	1	1	1
SAND TUBE WORM	7	4	0	4	2	0	0	1	0	0
MUSSEL	0	0	0	0	0	3	0	4	2	1
OTHER BIOTA	9	12	11	11	1	7	3	7	6	1
BARE SUBSTRATE	47	58	70	58	7	10	55	6	24	16

NAVY NORTH TAXA	POINT-INTERCEPT TRANSECTS												
	TURF ZONE					INSHORE GRASS ZONE				OFFSHORE GRASS ZONE			
	1	2	7	AVG	SE	3	6	AVG	SE	4	5	AVG	SE
FEATHER BOA KELP	0	0	0	0	0	0	0	0	0	0	0	0	0
SARGASSUM WEED	0	0	0	0	0	0	0	0	0	0	0	0	0
RED ALGAL TURF	94	95	95	95	0	0	1	1	0	7	9	8	1
SURF GRASS	5	0	0	2	2	100	99	100	0	93	88	91	2
AGGREGATING ANEMONE	0	0	0	0	0	0	0	0	0	0	0	0	0
SAND TUBE WORM	0	0	0	0	0	0	0	0	0	0	0	0	0
MUSSEL	0	0	0	0	0	0	0	0	0	0	0	0	0
OTHER BIOTA	1	0	0	0	0	0	0	0	0	0	3	2	1
BARE SUBSTRATE	0	5	5	3	2	0	0	0	0	0	0	0	0

NAVY SOUTH TAXA	POINT-INTERCEPT TRANSECTS												
	TURF ZONE					INSHORE GRASS ZONE				OFFSHORE GRASS ZONE			
	1	2	7	AVG	SE	5	6	AVG	SE	3	4	AVG	SE
FEATHER BOA KELP	0	0	0	0	0	0	0	0	0	0	0	0	0
SARGASSUM WEED	0	1	1	1	0	0	0	0	0	0	0	0	0
RED ALGAL TURF	94	89	93	92	2	1	4	3	1	5	1	3	2
SURF GRASS	5	10	6	7	2	99	93	96	2	95	99	97	2
AGGREGATING ANEMONE	0	0	0	0	0	0	0	0	0	0	0	0	0
SAND TUBE WORM	0	0	0	0	0	0	0	0	0	0	0	0	0
MUSSEL	0	0	0	0	0	0	0	0	0	0	0	0	0
OTHER BIOTA	0	0	0	0	0	0	3	2	1	0	0	0	0
BARE SUBSTRATE	1	0	0	0	0	0	0	0	0	0	0	0	0

Table 21. Spring 2005 Species Abundances Along Point-Intercept Transects.

CARDIFF REEF TAXA	POINT-INTERCEPT TRANSECTS									
	TURF ZONE					GRASS ZONE				
	1	2	3	AVG	SE	1	2	3	AVG	SE
FEATHER BOA KELP	0	0	0	0	0	0	0	0	0	0
SARGASSUM WEED	0	0	0	0	0	0	0	0	0	0
RED ALGAL TURF	43	58	54	52	4	19	9	86	38	24
SURF GRASS	2	6	0	3	2	24	20	4	16	6
AGGREGATING ANEMONE	10	5	7	7	1	1	2	4	2	1
SAND TUBE WORM	0	0	0	0	0	0	0	0	0	0
MUSSEL	0	0	0	0	0	0	0	0	0	0
OTHER BIOTA	39	10	27	25	8	54	65	4	41	19
BARE SUBSTRATE	6	21	12	13	4	2	4	2	3	1

SCRIPPS REEF TAXA	POINT-INTERCEPT TRANSECTS									
	TURF ZONE					GRASS ZONE				
	1	2	3	AVG	SE	4	5	6	AVG	SE
FEATHER BOA KELP	0	0	0	0	0	0	0	0	0	0
SARGASSUM WEED	0	0	0	0	0	0	0	0	0	0
RED ALGAL TURF	62	59	43	55	6	77	62	53	64	7
SURF GRASS	3	0	0	1	1	10	11	24	15	5
AGGREGATING ANEMONE	0	1	0	0	0	0	0	2	1	1
SAND TUBE WORM	5	0	0	2	2	0	0	0	0	0
MUSSEL	0	0	0	0	0	4	0	3	2	1
OTHER BIOTA	2	13	14	10	4	2	11	5	6	3
BARE SUBSTRATE	28	27	43	33	5	7	16	13	12	3

NAVY NORTH TAXA	POINT-INTERCEPT TRANSECTS												
	TURF ZONE					INSHORE GRASS ZONE				OFFSHORE GRASS ZONE			
	1	2	7	AVG	SE	3	6	AVG	SE	4	5	AVG	SE
FEATHER BOA KELP	0	0	0	0	0	0	0	0	0	0	0	0	0
SARGASSUM WEED	0	0	0	0	0	0	0	0	0	0	0	0	0
RED ALGAL TURF	93	92	94	93	0	5	5	5	0	9	20	15	4
SURF GRASS	4	0	0	1	2	95	92	94	1	91	80	86	4
AGGREGATING ANEMONE	0	0	0	0	0	0	0	0	0	0	0	0	0
SAND TUBE WORM	0	0	0	0	0	0	0	0	0	0	0	0	0
MUSSEL	0	0	0	0	0	0	0	0	0	0	0	0	0
OTHER BIOTA	3	6	3	4	1	0	3	2	1	0	0	0	0
BARE SUBSTRATE	0	2	3	2	1	0	0	0	0	0	0	0	0

NAVY SOUTH TAXA	POINT-INTERCEPT TRANSECTS												
	TURF ZONE					INSHORE GRASS ZONE				OFFSHORE GRASS ZONE			
	1	2	7	AVG	SE	5	6	AVG	SE	3	4	AVG	SE
FEATHER BOA KELP	0	0	0	0	0	0	0	0	0	0	0	0	0
SARGASSUM WEED	0	0	0	0	0	0	0	0	0	0	0	0	0
RED ALGAL TURF	96	92	95	94	2	15	6	11	4	25	7	16	7
SURF GRASS	3	8	3	5	2	83	93	88	4	72	93	83	9
AGGREGATING ANEMONE	0	0	0	0	0	0	0	0	0	0	0	0	0
SAND TUBE WORM	0	0	0	0	0	0	0	0	0	0	0	0	0
MUSSEL	0	0	0	0	0	0	0	0	0	0	0	0	0
OTHER BIOTA	0	0	0	0	0	0	0	0	0	0	0	0	0
BARE SUBSTRATE	1	0	2	1	0	2	1	2	0	3	0	2	1

Table 22. Point-Intercept Transect Species Summary Data by Site: Cardiff and Scripps.

Mean % cover (+/- SE) data for Cardiff, Scripps ; Cardiff and Scripps have 10 taxa in 2 intertidal zones (turf and grass) at 2 sites (N = 3).

DATE	CARDIFF REEF TURF												CARDIFF REEF GRASS																								
	BK		SW		RT		SG		AA		TW		M		OB		BS		BK		SW		RT		SG		AA		TW		M		OB		BS		
	AV	SE	AV	SE	AV	SE	AV	SE	AV	SE	AV	SE	AV	SE	AV	SE	AV	SE	AV	SE	AV	SE	AV	SE	AV	SE	AV	SE	AV	SE	AV	SE	AV	SE			
F97	0	0	0	0	82	5	4	3	11	4	0	0	0	0	0	0	2	2	0	0	0	0	30	10	63	9	0	0	0	0	3	2	0	0	4	2	
S98	0	0	0	0	77	9	4	3	11	5	0	0	0	0	0	0	9	6	0	0	0	0	39	8	51	9	1	0	0	0	2	2	1	1	5	3	
F98	0	0	0	0	80	6	12	7	7	3	0	0	0	0	0	0	1	1	0	0	0	0	12	3	86	5	0	0	0	0	0	0	2	2	1	1	
S99	0	0	0	0	83	2	10	5	7	5	0	0	0	0	0	0	0	0	0	0	0	0	23	11	76	12	0	0	0	0	1	1	0	0	0	0	
F99	0	0	0	0	77	8	20	10	3	3	0	0	0	0	0	0	0	0	0	0	0	0	4	2	95	3	0	0	0	0	0	0	0	0	0	0	
S00	0	0	0	0	75	6	20	10	4	3	0	0	0	0	0	0	2	2	0	0	0	0	5	2	95	3	0	0	0	0	1	1	0	0	0	0	
F00	0	0	0	0	77	10	21	10	2	1	0	0	0	0	0	0	0	0	0	0	0	0	3	1	96	2	0	0	0	0	0	0	0	0	1	1	
S01	0	0	0	0	80	8	17	10	3	2	0	0	0	0	0	0	0	0	0	0	0	0	20	5	79	4	0	0	0	0	0	0	0	0	0	0	
F01	0	0	0	0	73	9	16	9	3	2	0	0	0	0	0	0	8	4	1	1	0	0	14	5	83	7	0	0	0	0	0	0	0	0	2	2	
S02	0	0	0	0	82	1	10	5	6	3	0	0	0	0	0	0	2	2	0	0	0	0	33	8	64	8	0	0	0	0	0	0	0	0	2	1	
F02	0	0	0	0	65	8	3	3	4	2	0	0	0	0	0	0	27	5	0	0	0	0	43	16	48	17	1	1	0	0	0	0	3	1	5	2	
S03	0	0	0	0	78	5	4	2	5	1	0	0	0	0	0	1	1	11	6	1	1	0	0	56	19	38	21	1	1	0	0	0	0	2	1	3	1
F03	0	0	0	0	31	2	6	3	5	2	0	0	0	0	0	0	58	7	2	2	0	0	20	19	64	20	2	2	0	0	0	0	0	0	12	9	
S04	0	0	0	0	60	8	5	3	5	2	0	0	0	0	22	11	7	4	0	0	0	0	24	19	46	17	2	2	0	0	0	0	25	12	2	1	
F04	0	0	0	0	61	5	1	1	6	1	0	0	0	0	1	0	30	6	0	0	0	0	55	14	36	15	2	2	0	0	0	0	1	0	6	2	
S05	0	0	0	0	52	4	3	2	7	1	0	0	0	0	25	8	13	4	0	0	0	0	38	24	16	6	2	1	0	0	0	0	41	19	3	1	

DATE	SCRIPPS REEF TURF										SCRIPPS REEF GRASS																									
	BK		SW		RT		SG		AA		TW		M		OB		BS		BK		SW		RT		SG		AA		TW		M		OB		BS	
	AV	SE	AV	SE	AV	SE	AV	SE	AV	SE	AV	SE	AV	SE	AV	SE	AV	SE	AV	SE	AV	SE	AV	SE	AV	SE	AV	SE	AV	SE	AV	SE	AV	SE		
F97	0	0	1	1	27	7	0	0	0	0	46	8	6	2	2	1	19	3	0	0	0	0	51	11	37	3	0	0	0	1	5	5	2	1	5	3
S98	0	0	2	1	28	10	0	0	0	0	13	6	2	1	0	1	52	7	0	0	0	0	46	7	26	1	0	0	0	0	4	3	5	2	13	6
F98	0	0	1	1	66	3	2	2	0	0	0	0	0	0	0	1	29	3	0	0	0	0	46	1	41	2	0	0	1	1	5	3	5	3	3	2
S99	0	0	2	1	64	7	2	2	0	0	0	0	0	0	5	3	28	5	0	0	0	0	49	6	33	6	0	0	1	0	8	5	2	2	8	6
F99	0	0	2	0	76	2	3	3	0	0	0	0	0	0	1	1	18	3	0	0	0	0	28	6	52	2	0	0	0	0	3	2	15	6	1	1
S00	0	0	2	1	72	6	3	3	1	0	0	0	0	0	0	0	22	6	0	0	0	0	43	7	36	2	3	3	0	0	9	4	8	3	2	1
F00	0	0	7	2	62	3	4	4	0	0	2	2	4	1	2	1	20	6	0	0	0	0	55	1	30	4	0	0	0	0	4	2	3	2	7	4
S01	0	0	5	1	58	1	3	3	0	0	2	2	4	2	3	2	26	5	0	0	0	0	61	3	20	5	0	0	0	0	5	2	6	4	7	2
F01	1	1	6	1	57	8	2	2	0	0	1	1	0	0	1	1	32	9	0	0	0	0	60	5	23	2	0	0	0	0	4	3	8	4	5	2
S02	0	0	2	2	71	5	1	1	0	0	0	0	1	1	6	2	19	6	0	0	0	0	69	4	14	4	0	0	0	0	4	2	9	5	4	1
F02	0	0	2	2	52	4	1	1	1	1	0	0	0	0	8	2	35	5	0	0	0	0	41	12	29	2	0	0	0	0	3	2	12	2	15	13
S03	0	0	2	1	57	7	2	2	1	0	0	0	0	0	12	1	27	6	0	0	0	0	53	7	21	1	0	0	0	0	4	3	15	3	6	3
F03	1	1	3	1	54	5	3	3	1	0	0	0	0	0	12	1	26	3	0	0	0	0	48	10	29	8	0	0	0	0	3	2	15	5	5	1
S04	0	0	2	1	37	1	5	5	1	0	0	0	0	0	32	6	22	4	0	0	0	0	49	6	25	4	0	0	0	0	3	2	18	1	5	0
F04	0	0	0	0	27	5	0	0	0	0	4	2	0	0	11	1	58	7	0	0	0	0	43	10	24	8	1	1	0	0	2	1	6	1	24	16
S05	0	0	0	0	52	4	3	2	7	1	0	0	0	0	25	8	13	4	0	0	0	0	38	24	16	6	2	1	0	0	0	0	41	19	3	1

BK=BOA KELP SW=SARGASSUM WEED RT=RED ALGAL TURF SG=SURF GRASS TW=SAND TUBE WORM
AA=AGGREGATING ANEMONE OB=OTHER BIOTA BS=BARE SUBSTRATE M=MUSSEL

Table 23. Point-Intercept Transect Species Summary Data by Site: Navy North and Navy South.

Mean % cover (+/- SE) data for Navy North and Navy South; Navy North and Navy South have 7 taxa in 3 intertidal zones (turf, inshore grass, offshore grass) at 3 sites (F97-F01 N=2; starting S02 N=3).

DATE	NAVY NORTH TURF							NAVY NORTH INSHORE GRASS							NAVY NORTH OFFSHORE GRASS						
	BK	SW	RT	SG	AA	OB	BS	BK	SW	RT	SG	AA	OB	BS	BK	SW	RT	SG	AA	OB	BS
	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE
S95	0 0	0 0	97 0	0 0	0 0	0 0	3 0	0 0	0 0	3 3	95 5	0 0	0 0	1 1	0 0	0 0	9 3	90 4	0 0	0 0	1 1
F95	0 0	0 0	97 2	0 0	0 0	0 0	3 2	0 0	0 0	0 0	100 0	0 0	0 0	0 0	0 0	0 0	4 1	96 1	0 0	0 0	0 0
S96																					
F96	0 0	0 0	100 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	100 0	0 0	0 0	0 0	0 0	0 0	6 1	94 1	0 0	0 0	0 0
S97	0 0	0 0	100 0	0 0	0 0	0 0	0 0	0 0	0 0	1 1	99 1	0 0	0 0	0 0	0 0	0 0	7 1	93 1	0 0	0 0	0 0
F97	0 0	0 0	99 1	1 1	0 0	0 0	0 0	0 0	0 0	1 1	99 1	0 0	0 0	0 0	0 0	0 0	9 2	92 2	0 0	0 0	0 0
S98	0 0	0 0	98 0	1 1	0 0	0 0	1 1	0 0	0 0	2 3	96 3	0 0	0 0	1 1	0 0	0 0	21 9	79 9	0 0	0 0	0 0
F98	0 0	0 0	97 2	2 2	0 0	0 0	1 1	0 0	0 0	2 1	99 1	0 0	0 0	0 0	0 0	0 0	6 2	94 2	0 0	0 0	0 0
S99	0 0	0 0	97 1	2 2	0 0	0 0	1 1	0 0	0 0	1 1	99 1	0 0	0 0	0 0	0 0	0 0	8 2	92 2	0 0	0 0	0 0
F99	0 0	0 0	96 2	3 2	0 0	0 0	1 1	0 0	0 0	1 1	99 1	0 0	0 0	0 0	0 0	0 0	4 0	97 0	0 0	0 0	0 0
S00	0 0	0 0	96 2	3 2	0 0	0 0	3 0	0 0	0 0	1 0	98 0	0 0	0 0	1 0	0 0	0 0	12 4	88 4	0 0	0 0	1 0
F00	0 0	0 0	96 1	3 2	0 0	0 0	2 1	0 0	0 0	1 1	99 1	0 0	0 0	1 0	0 0	0 0	9 2	92 2	0 0	0 0	0 0
S01	0 0	0 0	97 2	3 2	0 0	0 0	1 0	0 0	0 0	6 4	94 4	0 0	0 0	1 0	0 0	0 0	17 5	83 5	0 0	0 0	0 0
F01	0 0	0 0	96 0	2 2	0 0	0 0	2 2	0 0	0 0	1 1	99 1	0 0	0 0	0 0	0 0	0 0	18 8	82 8	0 0	0 0	0 0
S02	0 0	0 0	98 1	2 2	0 0	0 0	1 0	0 0	0 0	4 3	94 4	0 0	2 1	1 1	0 0	0 0	17 9	82 9	0 0	1 0	0 0
F02	0 0	0 0	97 1	1 1	0 0	0 0	1 0	0 0	0 0	1 0	100 0	0 0	0 0	0 0	0 0	0 0	10 2	90 2	0 0	0 0	1 0
S03	0 0	0 0	93 2	1 2	0 0	4 3	1 1	0 0	0 0	2 1	98 1	0 0	1 0	0 0	0 0	0 0	12 4	88 4	0 0	0 0	0 0
F03	0 0	0 0	96 0	1 1	0 0	1 1	2 1	0 0	0 0	1 0	99 1	0 0	1 0	0 0	0 0	0 0	8 1	91 2	0 0	1 0	1 0
S04	0 0	0 0	66 0	1 1	0 0	27 0	6 1	0 0	0 0	3 1	96 2	0 0	1 0	1 1	0 0	0 0	13 4	87 4	0 0	0 0	0 0
F04	0 0	0 0	95 0	2 2	0 0	0 0	3 2	0 0	0 0	1 0	100 0	0 0	0 0	0 0	0 0	0 0	8 1	91 2	0 0	2 1	0 0
S05	0 0	0 0	93 0	1 2	0 0	4 1	2 1	0 0	0 0	5 0	94 1	0 0	2 1	0 0	0 0	0 0	15 4	86 4	0 0	0 0	0 0

DATE	NAVY SOUTH TURF							NAVY SOUTH INSHORE GRASS							NAVY SOUTH OFFSHORE GRASS						
	BK	SW	RT	SG	AA	OB	BS	BK	SW	RT	SG	AA	OB	BS	BK	SW	RT	SG	AA	OB	BS
	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE	AV SE
S95	0 0	0 0	95 2	0 0	0 0	0 0	5 1	0 0	0 0	3 0	95 1	0 0	0 0	2 1	0 0	0 0	5 5	92 7	0 0	0 0	3 2
F95	0 0	0 0	98 3	2 2	0 0	0 0	1 1	0 0	0 0	2 1	98 1	0 0	0 0	0 0	0 0	0 0	0 0	100 0	0 0	0 0	0 0
S96																					
F96	0 0	0 0	98 1	1 1	0 0	0 0	1 0	0 0	0 0	1 0	99 0	0 0	0 0	0 0	0 0	0 0	2 2	98 2	0 0	0 0	0 0
S97	0 0	0 0	96 4	4 4	0 0	0 0	0 0	0 0	0 0	3 1	97 1	0 0	0 0	0 0	0 0	0 0	0 1	99 1	0 0	0 0	0 0
F97	0 0	0 0	94 4	5 5	0 0	0 0	1 1	0 0	0 0	0 0	100 0	0 0	0 0	0 1	0 0	0 0	1 1	99 1	0 0	0 0	0 0
S98	0 0	0 0	90 0	4 4	0 0	0 0	6 4	0 0	0 0	4 1	96 0	0 0	0 0	1 0	0 0	0 0	9 9	82 15	0 0	0 0	9 6
F98	0 0	0 0	99 0	1 0	0 0	0 0	0 0	0 0	0 0	1 0	99 0	0 0	0 0	0 0	0 0	0 0	6 5	94 5	0 0	0 0	0 0
S99	0 0	0 0	94 4	6 5	0 0	0 0	0 0	0 0	0 0	4 3	95 4	0 0	0 0	1 1	0 0	0 0	8 8	92 8	0 0	0 0	0 0
F99	0 0	0 0	92 3	8 3	0 0	0 0	0 0	0 0	0 0	0 0	100 0	0 0	0 0	0 0	0 0	0 0	0 0	100 0	0 0	0 0	0 0
S00	0 0	0 0	92 2	8 2	0 0	0 0	0 0	0 0	0 0	5 2	95 2	0 0	0 0	1 1	0 0	0 0	1 1	99 0	0 0	0 0	1 0
F00	0 0	1 0	91 2	9 2	0 0	0 0	0 0	0 0	0 0	1 0	97 1	0 0	1 0	2 0	0 0	0 0	0 0	100 0	0 0	0 0	0 0
S01	0 0	1 0	91 2	9 2	0 0	0 0	0 0	0 0	0 0	7 2	93 2	0 0	0 0	0 0	0 0	0 0	4 2	96 2	0 0	0 0	0 0
F01	0 0	3 1	89 4	9 3	0 0	0 0	0 0	0 0	0 0	4 2	96 2	0 0	0 0	0 0	0 0	0 0	5 4	96 4	0 0	0 0	0 0
S02	0 0	0 0	90 4	7 2	0 0	4 1	1 0	0 0	0 0	7 1	94 1	0 0	0 0	0 0	0 0	0 0	4 3	96 3	0 0	1 0	0 0
F02	0 0	0 0	94 1	4 1	0 0	2 2	1 1	0 0	0 0	4 1	97 1	0 0	0 0	0 0	0 0	0 0	5 4	95 4	0 0	1 0	0 0
S03	0 0	0 0	95 1	4 1	0 0	1 0	0 0	0 0	0 0	4 0	96 1	0 0	0 0	1 0	0 0	0 0	2 1	98 1	0 0	1 0	0 0
F03	0 0	0 0	90 0	8 0	0 0	0 0	2 0	0 0	0 0	1 0	97 2	0 0	0 0	2 2	0 0	0 0	0 0	100 0	0 0	0 0	0 0
S04	0 0	0 0	90 2	5 0	0 0	3 2	2 0	0 0	0 0	11 2	89 1	0 0	1 0	0 0	0 0	0 0	10 3	87 5	0 0	3 2	1 0
F04	0 0	1 0	92 2	7 2	0 0	0 0	0 0	0 0	0 0	3 1	96 2	0 0	2 1	0 0	0 0	0 0	3 2	97 2	0 0	0 0	0 0
S05	0 0	0 0	94 2	5 2	0 0	0 0	1 0	0 0	0 0	11 4	88 4	0 0	0 0	2 0	0 0	0 0	16 7	83 9	0 0	0 0	2 1

BK=BOA KELP SW=SARGASSUM WEED RT=RED ALGAL TURF SG=SURF GRASS TW=SAND TUBE WORM
AA=AGGREGATING ANEMONE OB=OTHER BIOTA BS=BARE SUBSTRATE M=MUSSEL

Table 24. Point-Intercept Key Species Summary Data by Transect: Cardiff and Scripps.

Percent cover data for 2 index taxa (red algal turf and surf grass) at Cardiff and Scripps.

CARDIFF REEF	TURF			GRASS		
DATE	1	2	3	1	2	3
F97	79	93	75	58	80	51
S98	78	91	61	35	68	51
F98	69	85	87	75	93	89
S99	80	85	84	52	88	88
F99	72	67	93	90	98	99
S00	74	66	85	88	99	97
F00	67	67	96	95	99	94
S01	79	67	94	81	86	71
F01	75	56	87	97	72	81
S02	80	83	84	79	61	53
F02	50	70	75	81	33	30
S03	79	69	87	80	25	10
F03	32	34	26	99	62	30
S04	54	51	76	77	44	18
F04	65	52	67	59	41	7
S05	43	58	54	24	20	4

SCRIPPS REEF	TURF			GRASS		
DATE	1	2	3	4	5	6
F97	39	15	21	34	40	44
S98	48	15	22	27	26	31
F98	68	60	70	45	39	39
S99	66	51	76	41	22	34
F99	72	75	80	56	50	50
S00	66	66	84	36	32	39
F00	60	68	57	37	29	25
S01	60	58	55	29	19	12
F01	67	64	41	20	26	24
S02	74	79	61	15	20	7
F02	58	54	44	25	32	30
S03	51	70	50	19	22	23
F03	46	62	53	19	23	44
S04	35	37	40	19	23	33
F04	36	27	19	17	16	40
S05	62	59	43	10	11	24

Table 25. Point-Intercept Key Species Summary Data by Transect: Navy North and South.
Percent cover data for 2 index taxa (red algal turf and surf grass) at Navy North and Navy South.

NAVY NORTH DATE	TURF			INSHORE GRASS		OFFSHORE GRASS	
	1	2	7	3	6	4	5
S95	96	97		100	91	94	87
F95	95	99		100	99	96	95
S96							
F96	100	100		100	100	95	94
S97	100	99		100	99	93	92
F97	97	100		100	99	94	89
S98	98	98		99	93	88	70
F98	95	98		99	98	92	96
S99	96	98		100	98	93	90
F99	94	99		100	99	97	96
S00	93	98		98	99	93	83
F00	95	97		100	97	94	89
S01	95	99		99	89	89	77
F01	96	96		100	98	92	72
S02	96	99	97	99	88	93	71
F02	96	98	98	100	99	93	87
S03	95	89	96	99	96	93	83
F03	96	96	96	100	98	93	89
S04	67	68	62	98	93	92	82
F04	94	95	95	100	99	93	88
S05	93	92	94	95	92	91	80

NAVY SOUTH DATE	TURF			INSHORE GRASS		OFFSHORE GRASS	
	1	2	7	5	6	3	4
S95	93	97		96	95	85	99
F95	95	100		97	98	100	100
S96							
F96	97	100		99	99	96	100
S97	91	100		97	98	99	100
F97	90	99		100	99	99	100
S98	90	90		96	96	67	97
F98	99	98		99	99	89	99
S99	89	98		99	91	85	100
F99	89	96		100	95	96	100
S00	89	95		98	92	98	99
F00	88	93		96	98	100	100
S01	88	93		95	90	93	99
F01	84	94		99	93	91	100
S02	85	94	85	95	92	92	100
F02	94	96	91	95	98	89	100
S03	98	95	93	97	95	97	99
F03	90	89	90	99	95	100	100
S04	88	92	89	87	90	80	93
F04	94	89	93	99	93	95	99
S05	96	92	95	83	93	72	93

Table 26. Black Abalone and Ochre Seastar Summary Data.

Counts from 30 min. timed-searches at each of 4 sites.

	CARDIFF REEF		SCRIPPS REEF		NAVY NORTH		NAVY SOUTH	
	BLACK ABALONE	OCHRE SEASTAR	BLACK ABALONE	OCHRE SEASTAR	BLACK ABALONE	OCHRE SEASTAR	BLACK ABALONE	OCHRE SEASTAR
DATE								
S95					0	0	0	0
F95					0	0	0	0
S96								
F96					0	0	0	0
S97					0	0	0	0
F97	0	0	0	0	0	0	0	0
S98	0	0	0	0	0	0	0	0
F98	0	0	0	0	0	0	0	0
S99	0	0	0	4	0	0	0	0
F99	0	10	0	14	0	0	0	0
S00	0	11	0	5	0	0	0	0
F00	0	0	0	26	0	0	0	0
S01	0	9	0	0	0	0	0	0
F01	0	31	0	19	0	0	0	0
S02	0	17	0	10	0	0	0	0
F02	0	7	0	12	0	1		
S03	0	1	0	8	0	0	0	0
F03	0	32	0	39	0	0	0	0
S04	0	29	0	35	0	0	0	0
F04	0	20	0	52	0	0	0	0
S05	0	29	0	223	0	0	0	0

Table 27. Major Temporal Trends in Key Species Abundances.

1-year (Year 7 to Year 8; prior year change), 8-year (Year 1 to Year 8; since monitoring began at Cardiff and Scripps), 10.5-year (1995 to Year 8; since monitoring began at Navy North and South), Year 4 to Year 5 (before/after sand deposition up-coast of Cardiff Reef), Years 1-4 to Years 5-8 (before/after sand deposition up-coast of Cardiff Reef) comparison of major trends at the 4 sites. Data for Fall and Spring surveys were combined to remove seasonal fluctuations.

Species	Cardiff				Scripps				Navy North					Navy South				
	Year 7 to Year 8	Year 1 to Year 8	Year 4 to Year 5	Yrs 1-4 to Yrs 5-8	Year 7 to Year 8	Year 1 to Year 8	Year 4 to Year 5	Yrs 1-4 to Yrs 5-8	Year 7 to Year 8	Year 1 to Year 8	1995 to Year 8	Year 4 to Year 5	Yrs 1-4 to Yrs 5-8	Year 7 to Year 8	Year 1 to Year 8	1995 to Year 8	Year 4 to Year 5	Yrs 1-4 to Yrs 5-8
Rockweed	Absent				↓	NC	NC	↑	NC	↑	NC	NC	↑	NC	NC	NC	NC	NC
Acorn Barnacle	NC	↑	↑	↑	NC	NC	NC	NC	Uncommon					Uncommon				
Pink Thatched Barnacle	Uncommon				Uncommon				NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Goose Barnacle	NC	↓	NC	NC	NC	NC	NC	NC	NC	NC	↓	NC	NC	NC	↓	↓	NC	NC
Mussel	↓	↓	NC	NC	NC	NC	NC	↓	NC	↓	↓	NC	↓	NC	↓	↓	NC	NC
Owl Limpet	NC	↓	NC	↓	↓	NC	NC	NC	NC	NC	↑	NC	NC	NC	NC	NC	↓	↓
Red Algal Turf	NC	↓	NC	↓	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Surf Grass	↓	↓	NC	↓	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Boa Kelp	Uncommon				Uncommon				Uncommon					Uncommon				
Sargassum Weed	Uncommon				Uncommon				Uncommon					Uncommon				
Aggregating Anemone	Uncommon				Uncommon				Uncommon					Uncommon				
Sand Castle Worm	Uncommon				NC	↓	NC	NC	Uncommon					Uncommon				
Abalone	Absent				Absent				Absent					Absent				
Seastar	NC	↑	↑	↑	↑	↑	NC	↑	Absent					Absent				

↑ = Positive % cover change > 15% or counts > 10 individuals.

NC = No Change, % cover change ≤ 15% or counts ≤ 10 individuals.

↓ = negative % cover change > 15% or counts > 10 individuals.

Year 7 to Year 8 = comparison between F03/S04 and F04/S05.

Year 1 to Year 8 = comparison between F97/S98 and F04/S05.

1995 to Year 8 = comparison between S95/F95 and F04/S05.

Year 4 to Year 5 = comparison between F00/S01 and F01/S02.

Years 1-4 to Years 5-8 = comparison between F97/S01 and F01/S02.

Figure 1. San Diego County Rocky Intertidal Monitoring Sites



Figure 2. Point Loma Rocky Intertidal Monitoring Sites

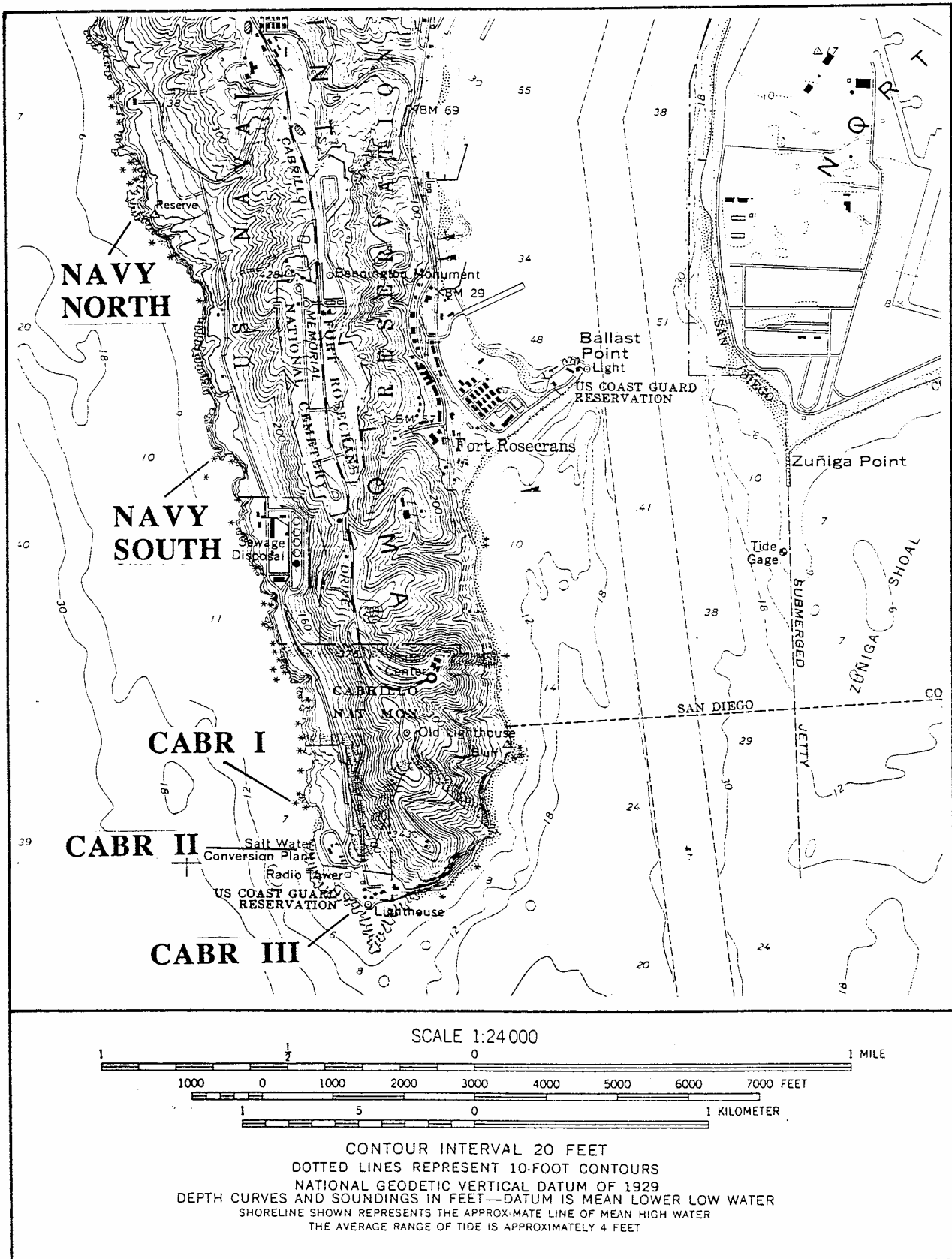


Figure 3. Cardiff Reef Map

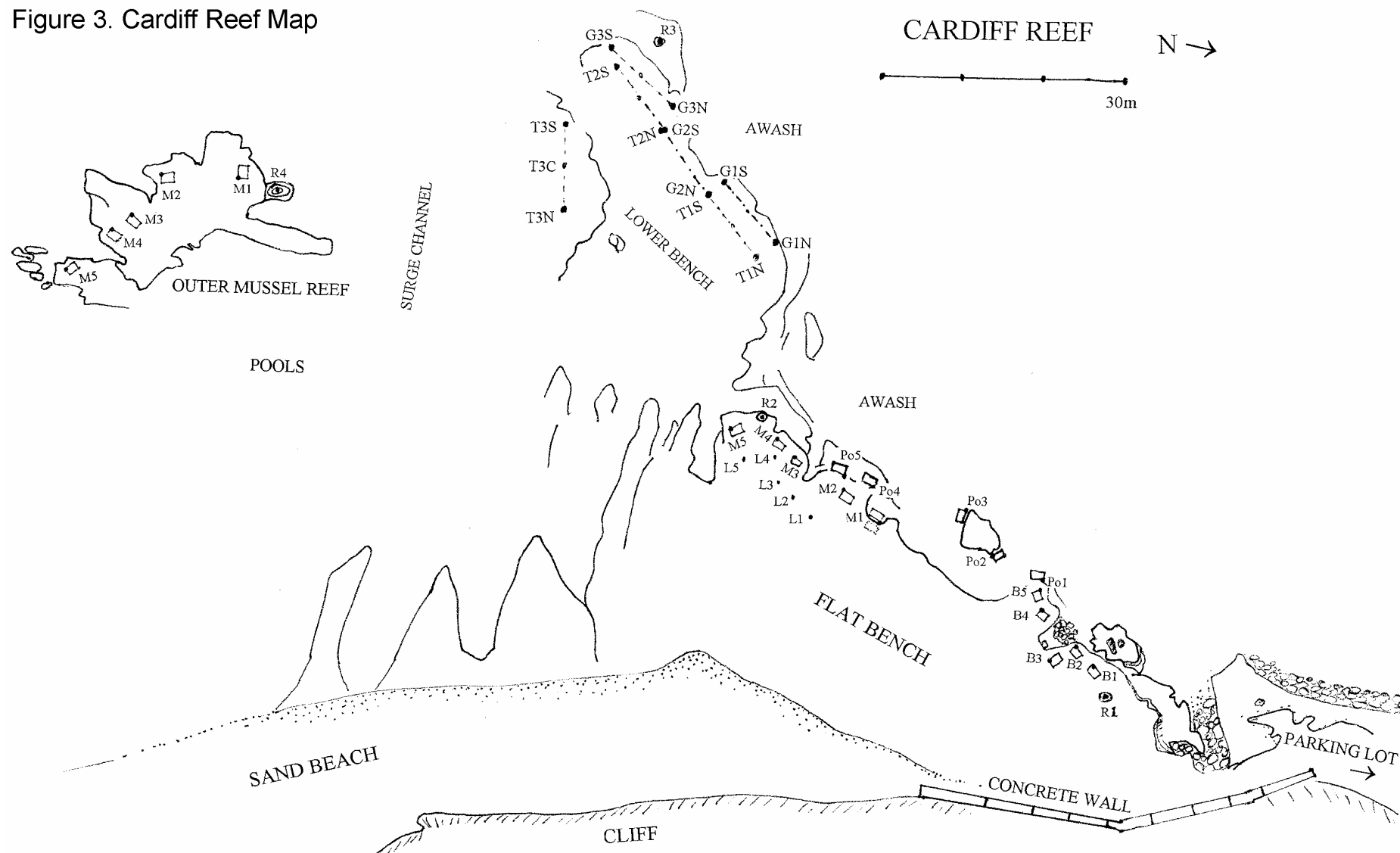


Figure 4. Scripps Reef Map

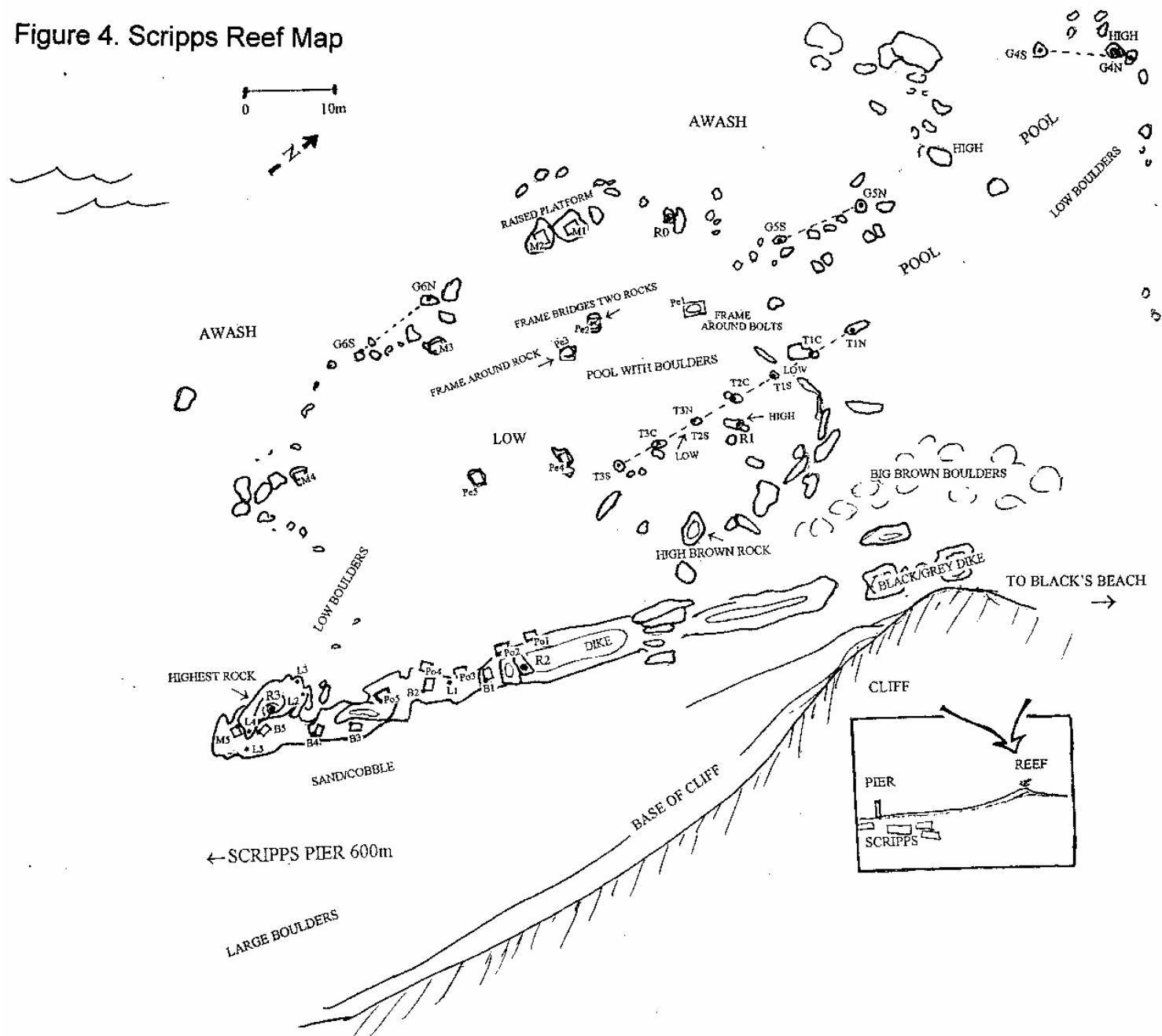


Figure 5. Point Loma Navy North Map: Overview, Area R1, Area R2

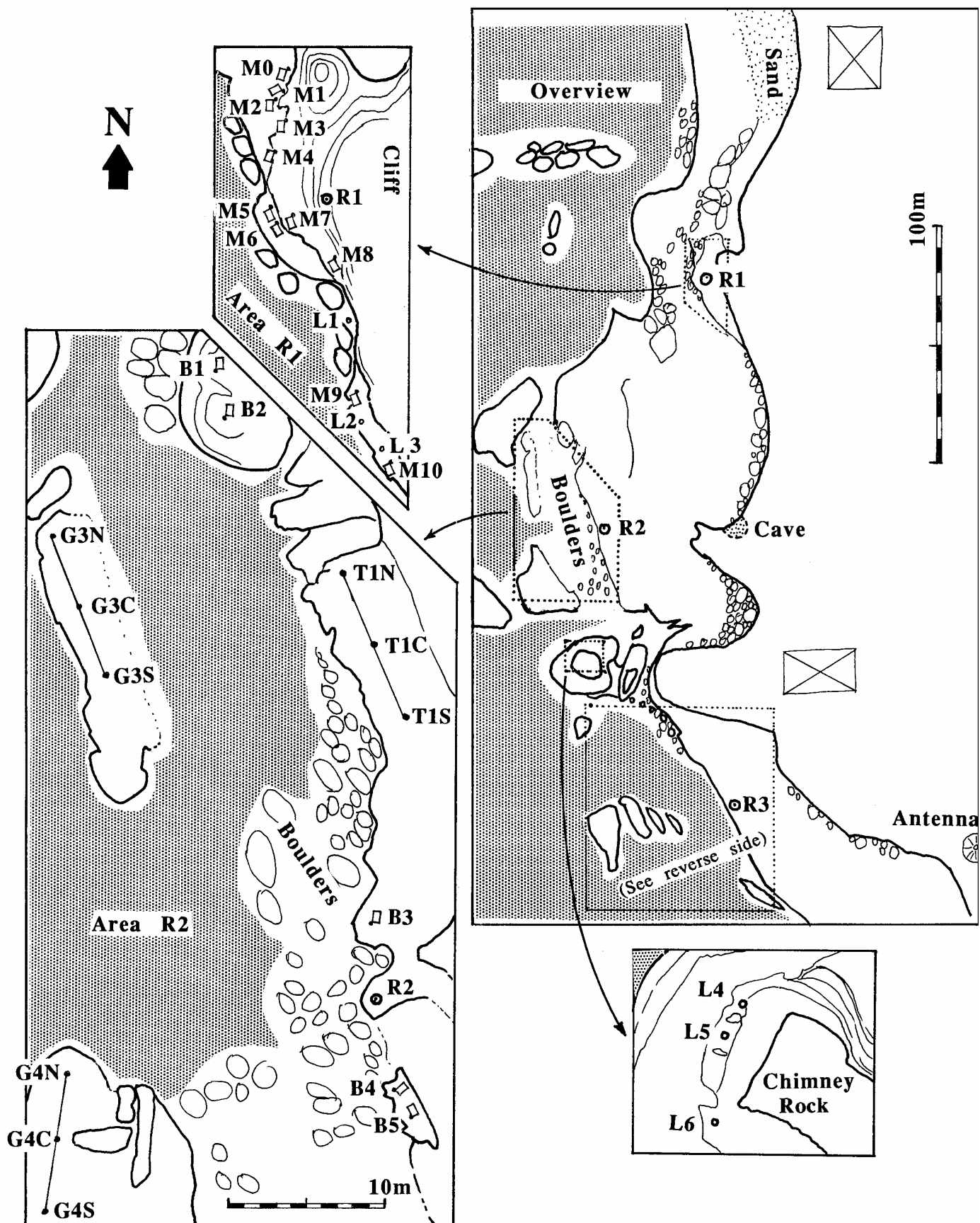


Figure 6. Point Loma Navy North Map: Area R3

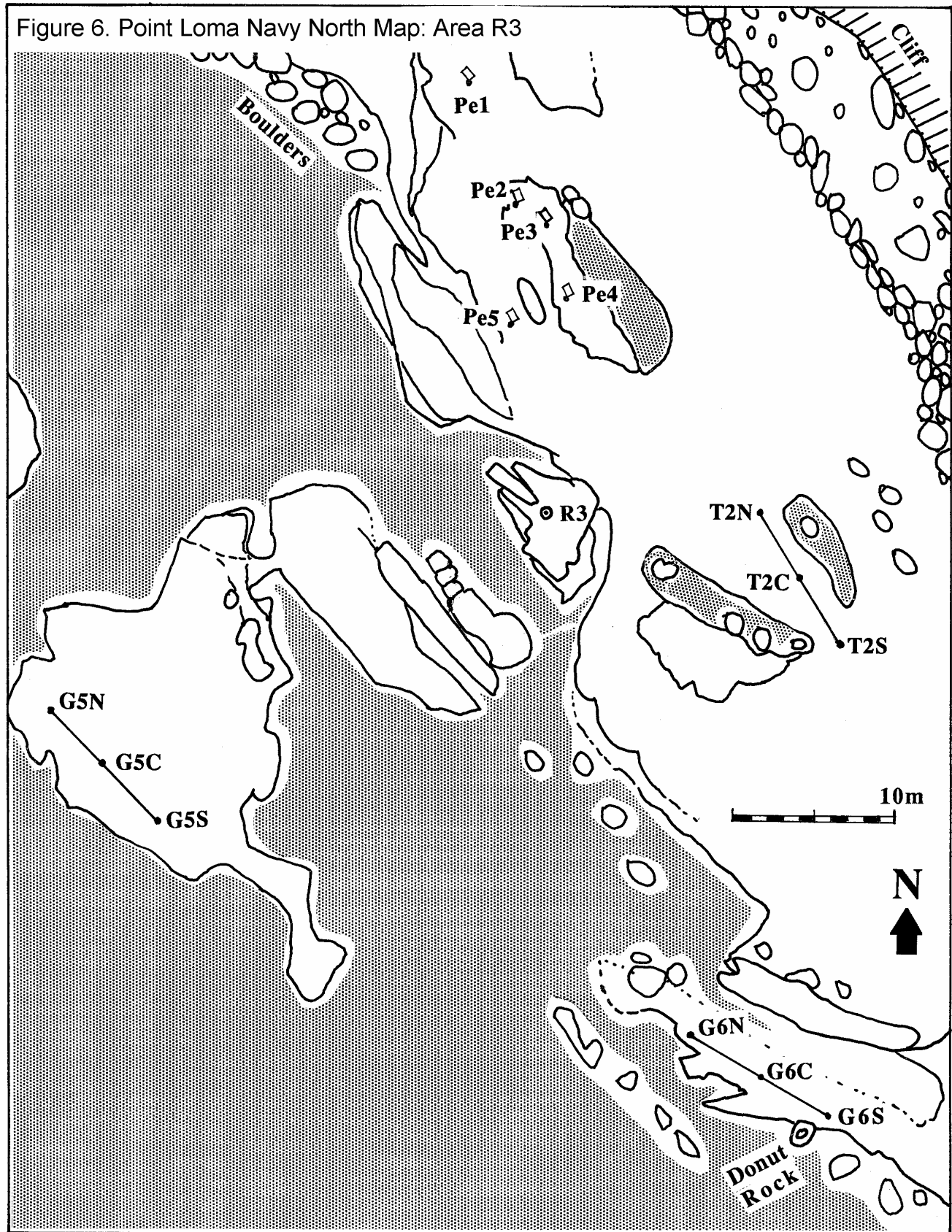


Figure 7. Point Loma Navy South Map: Overview, Area R1, Area R2

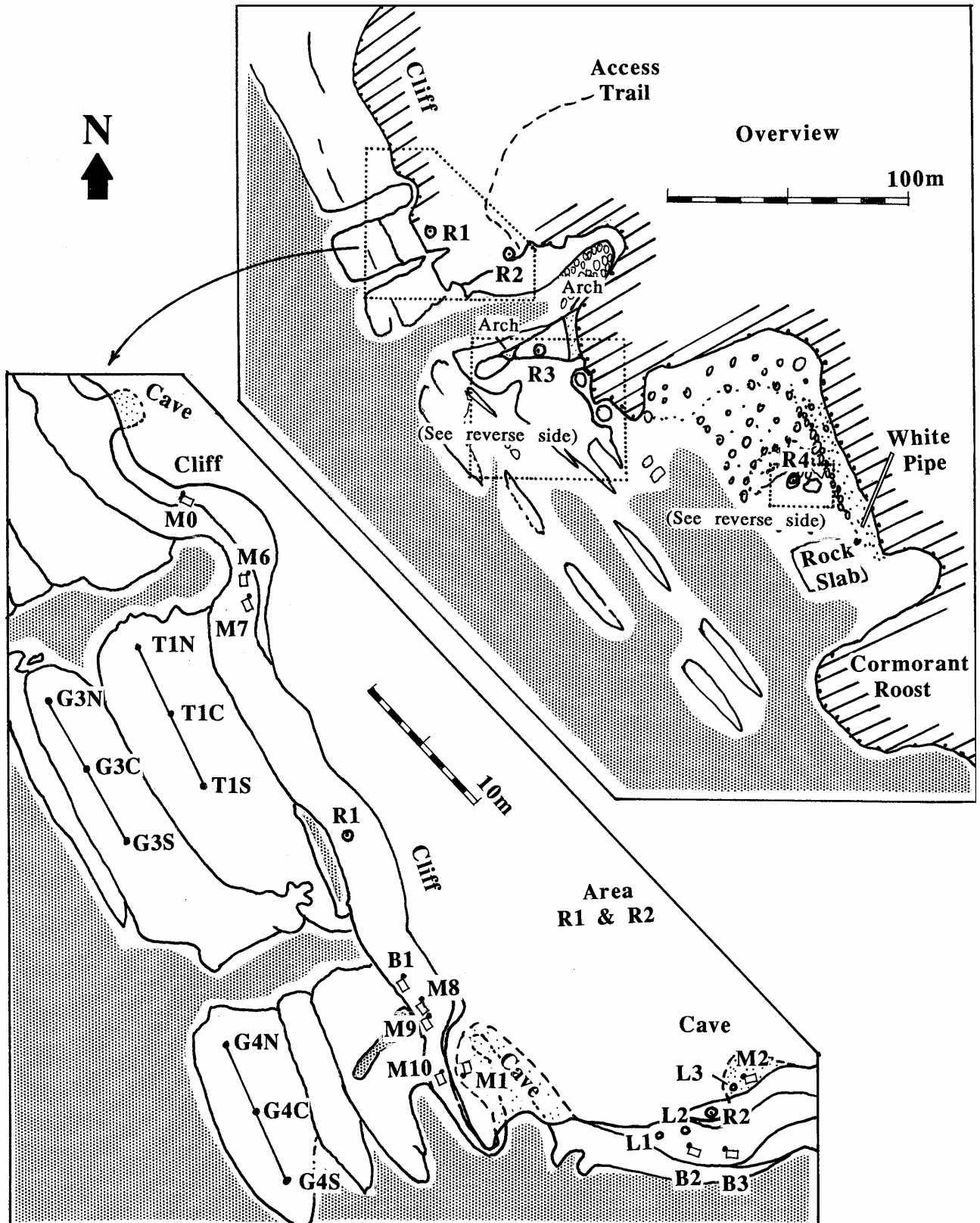
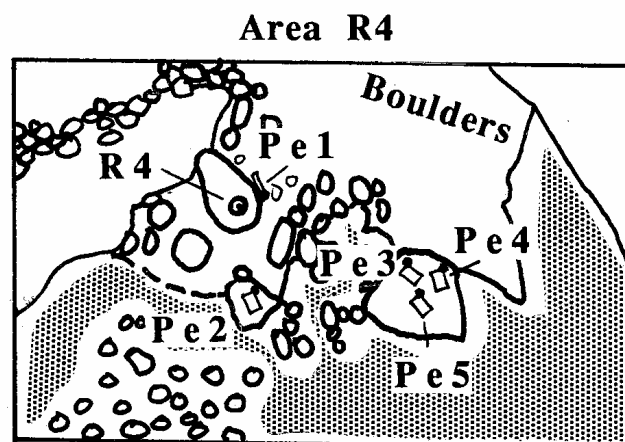
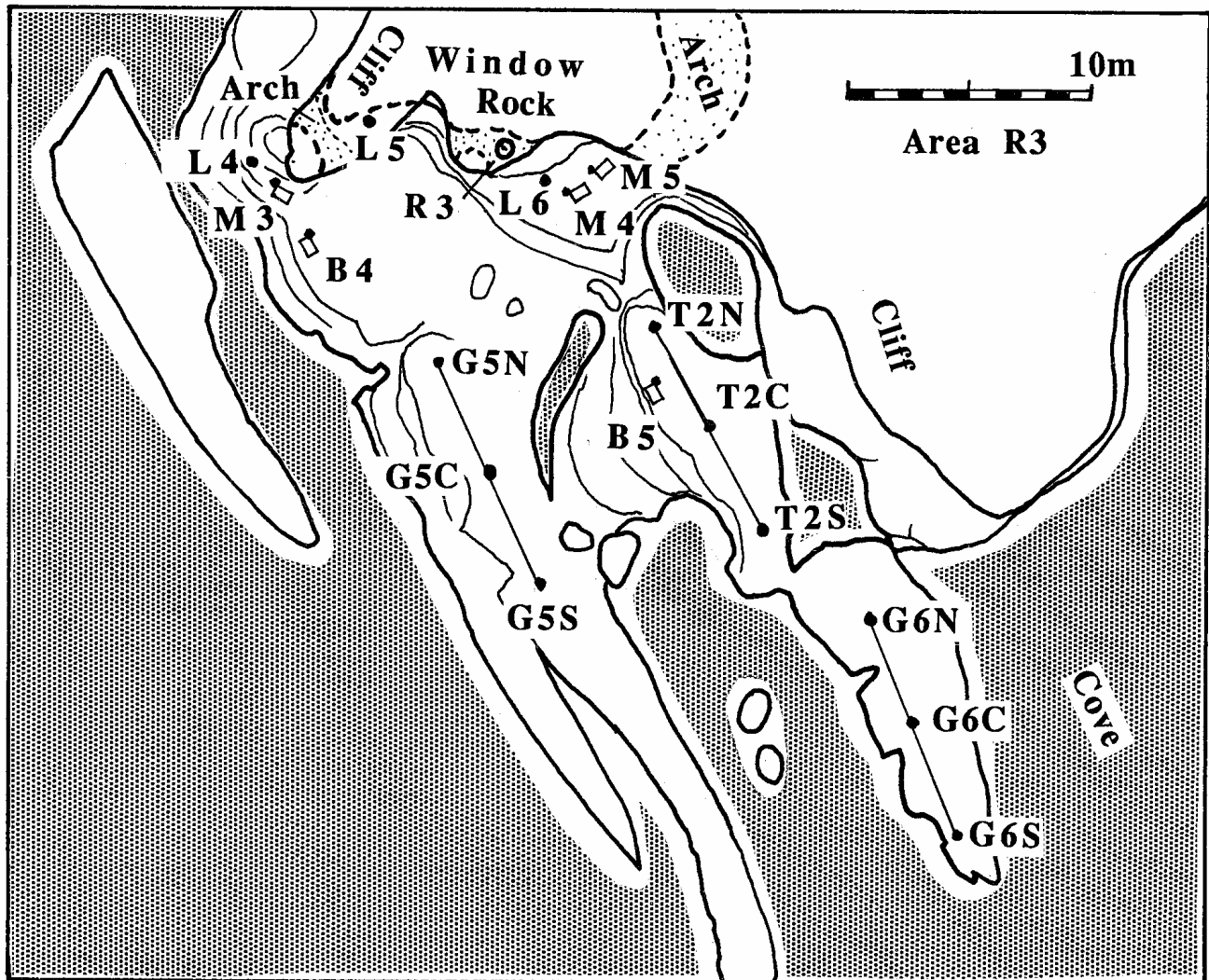


Figure 8. Point Loma Navy South Map: Area R3, Area R4



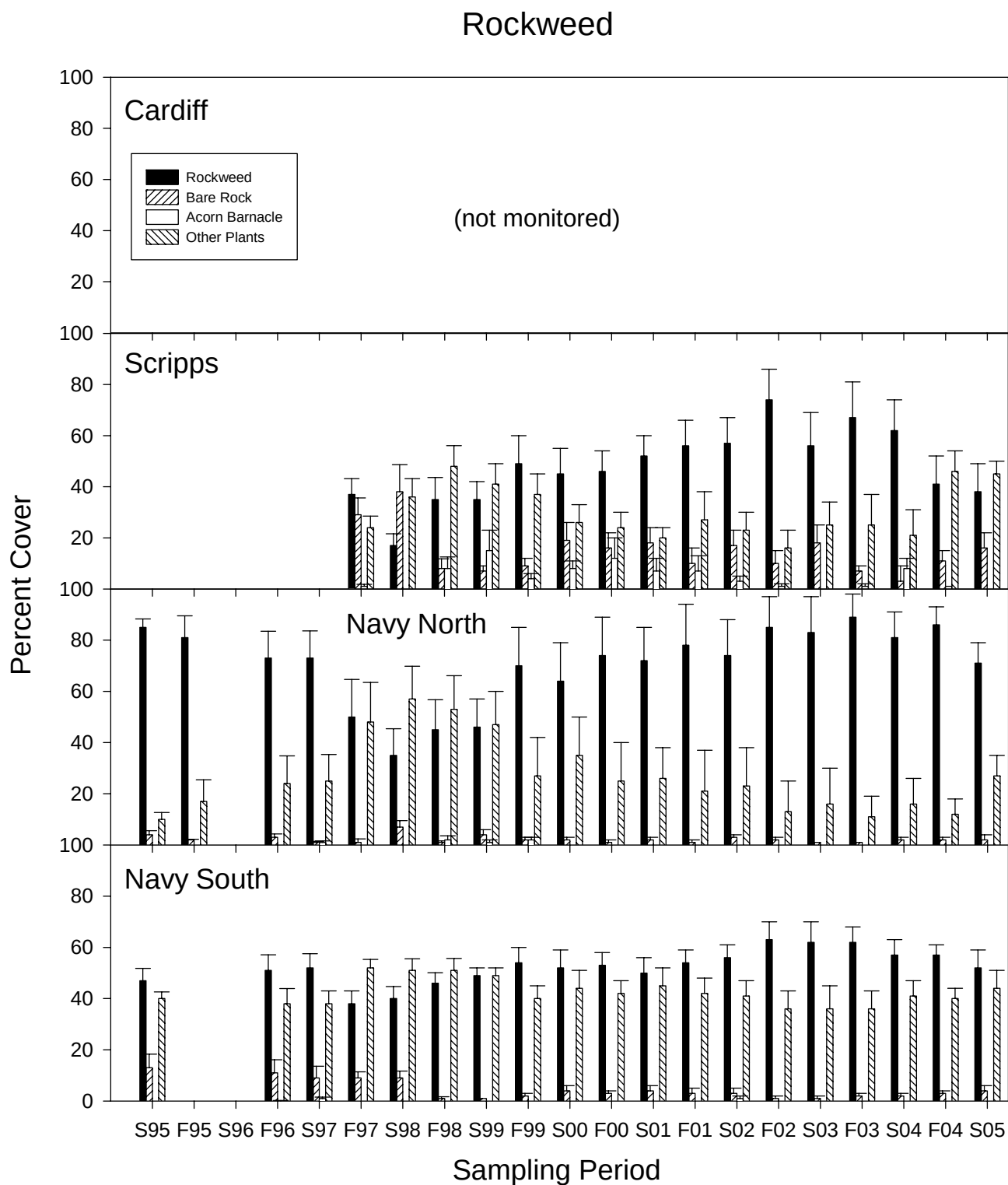


Fig. 9. Species Abundances in Rockweed Plots at 3 San Diego County Sites (n=5).

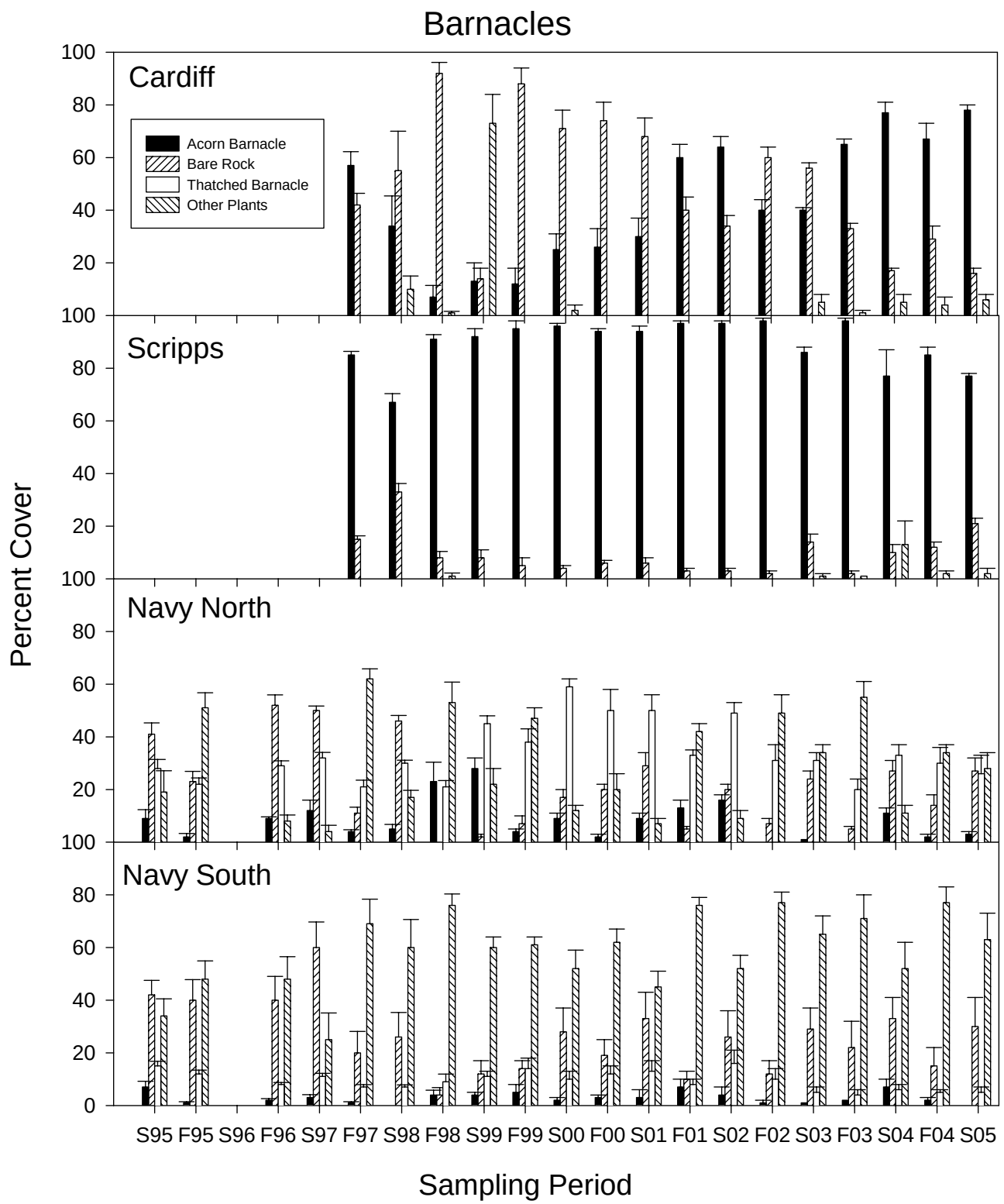


Fig. 10. Species Abundances in Barnacle Plots at 4 San Diego County Sites (n=5).

Goose Barnacles

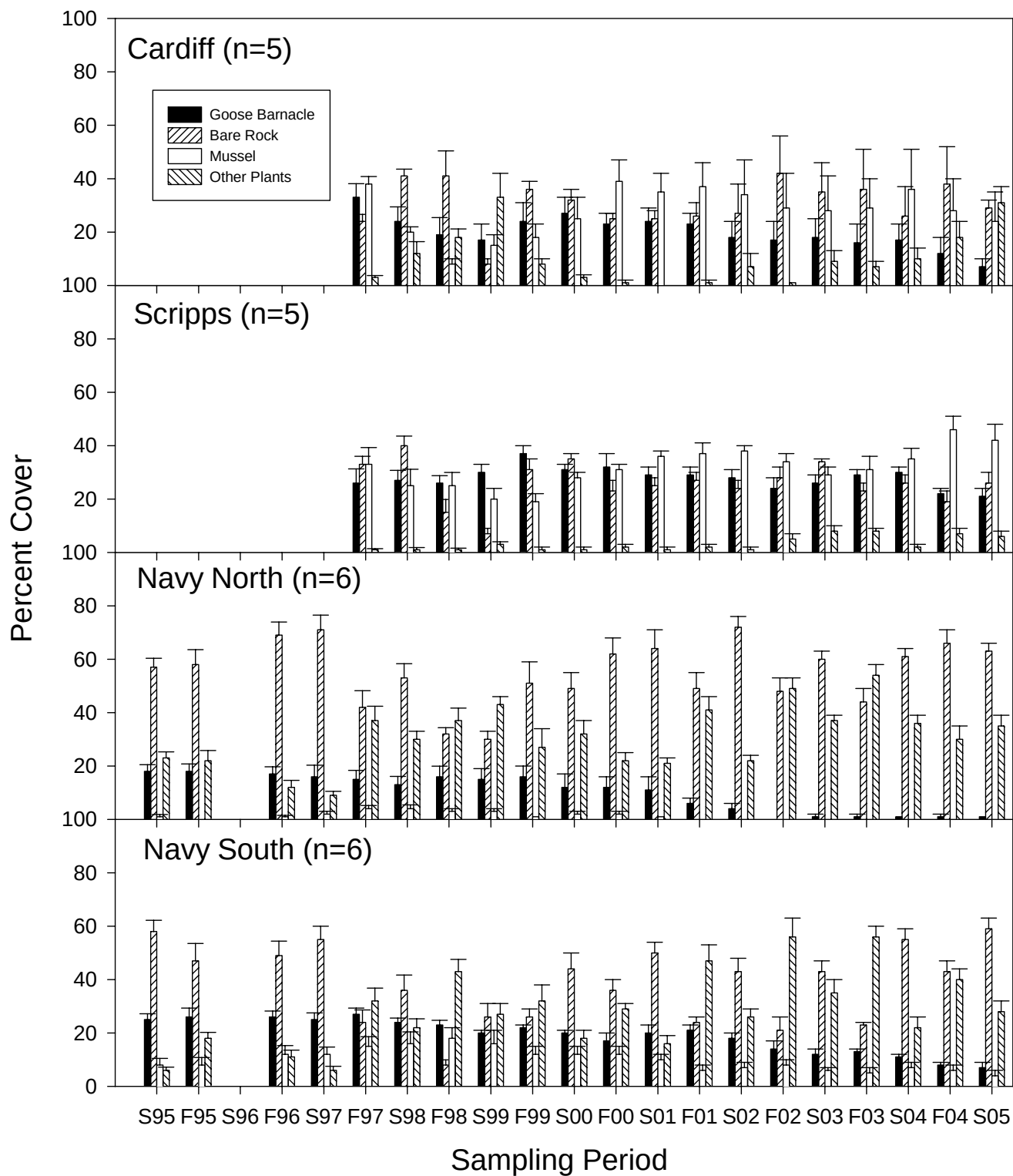


Fig. 11. Species Abundances in Goose Barnacle Plots at 4 San Diego County Sites.

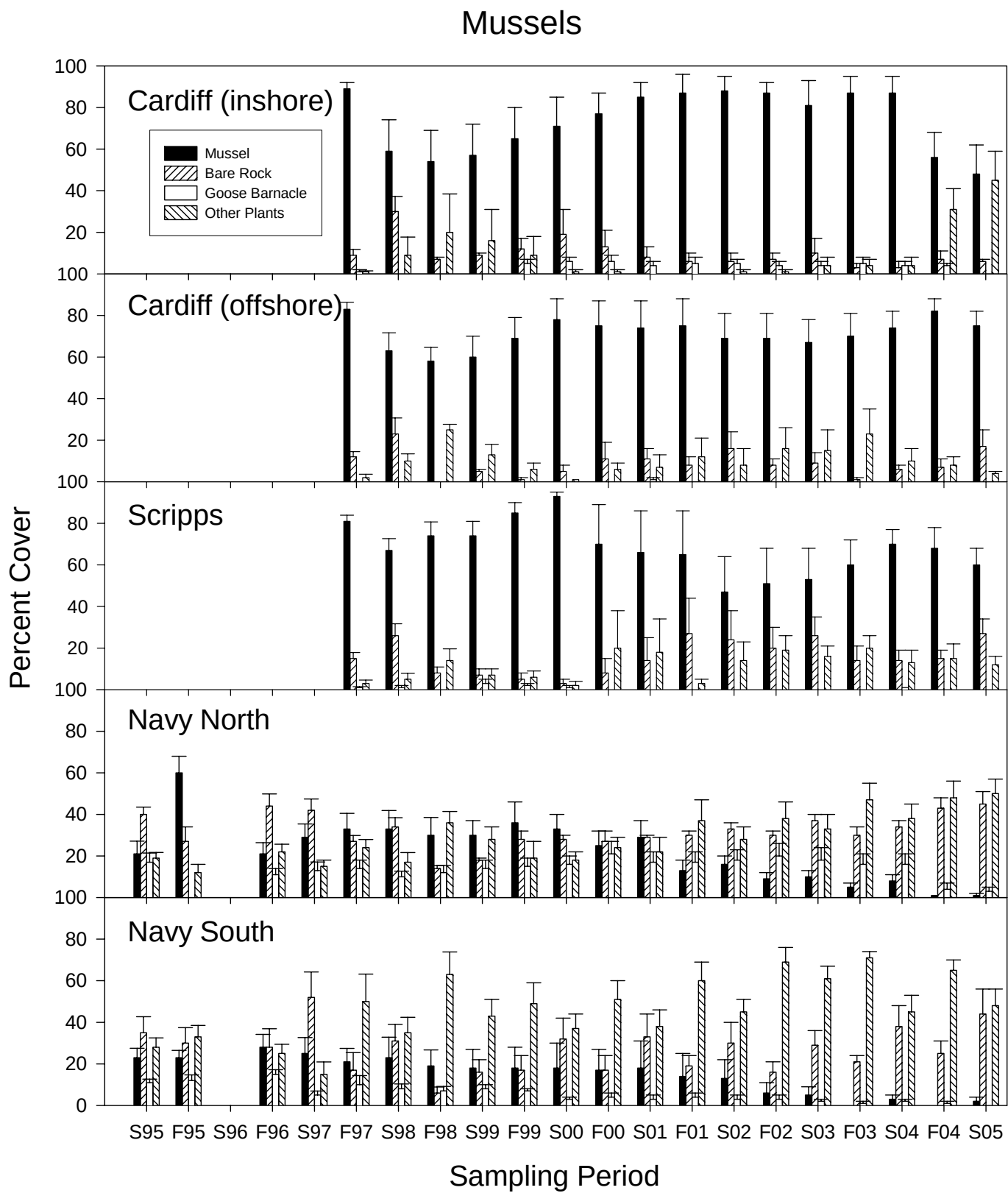


Fig. 12. Species Abundances in Mussel Plots at 4 San Diego County Sites (n=5).

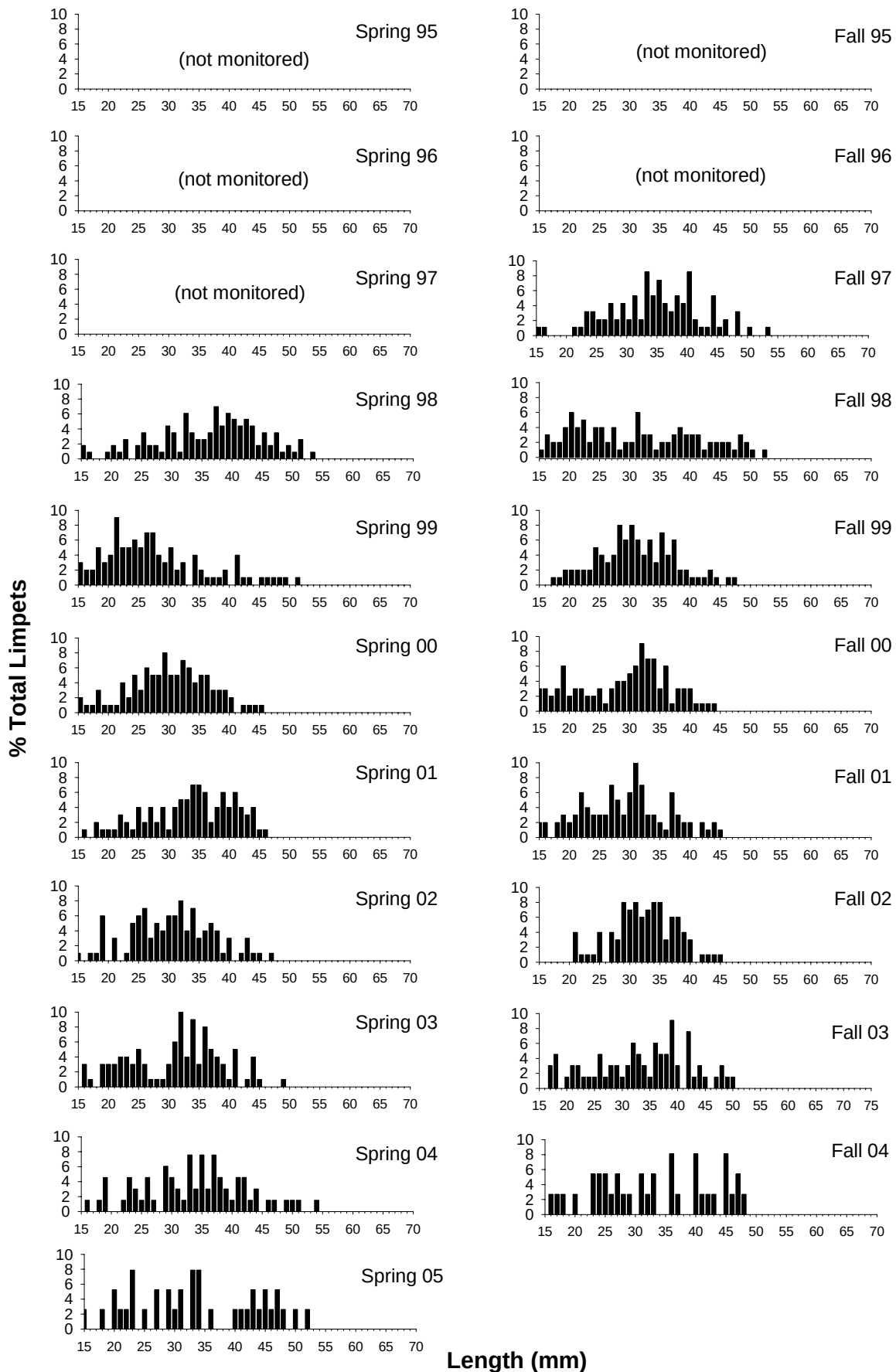


Figure 13. Owl Limpet Length Frequencies at Cardiff Reef.

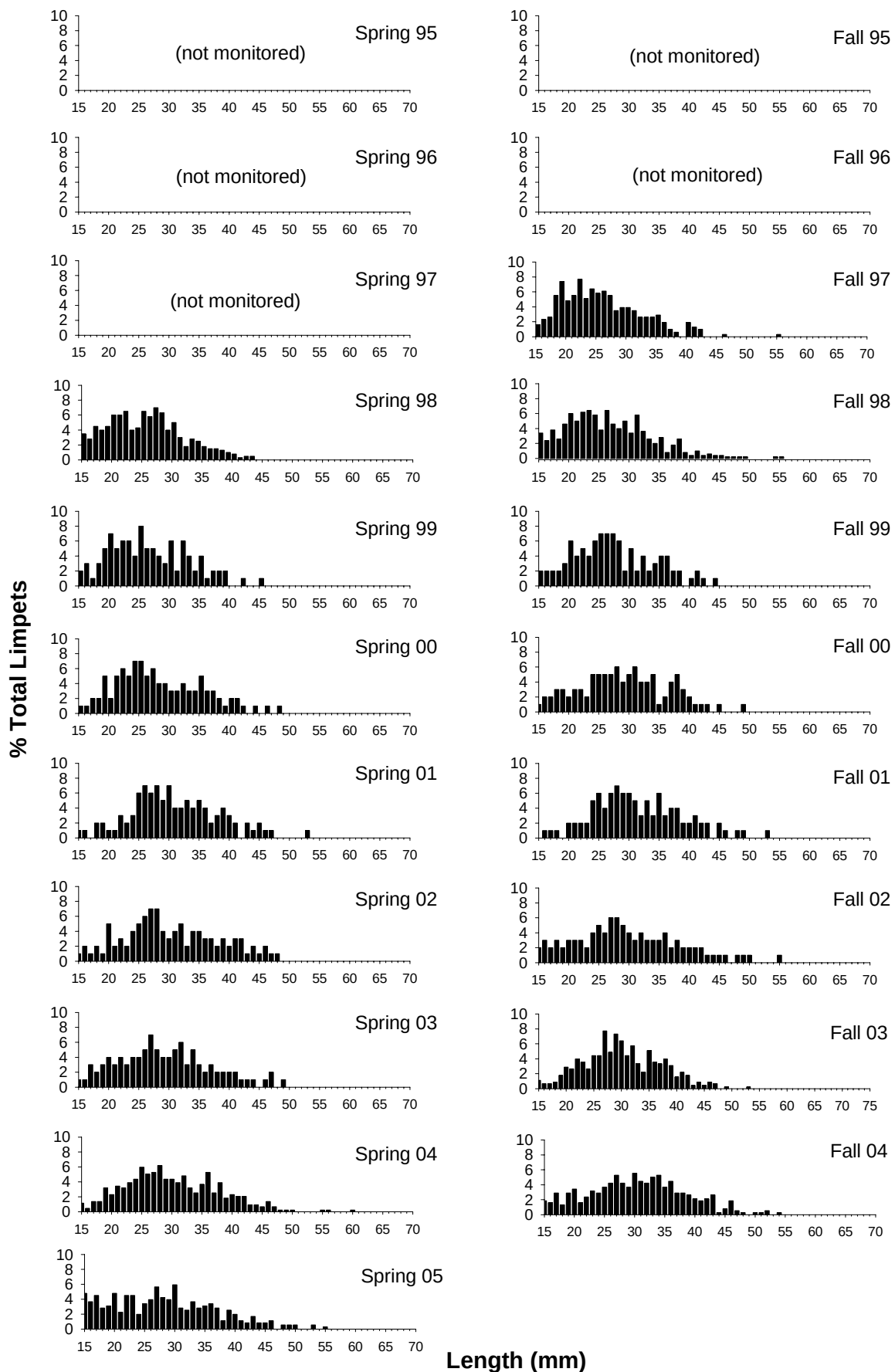


Figure 14. Owl Limpet Length Frequencies at Scripps Reef.

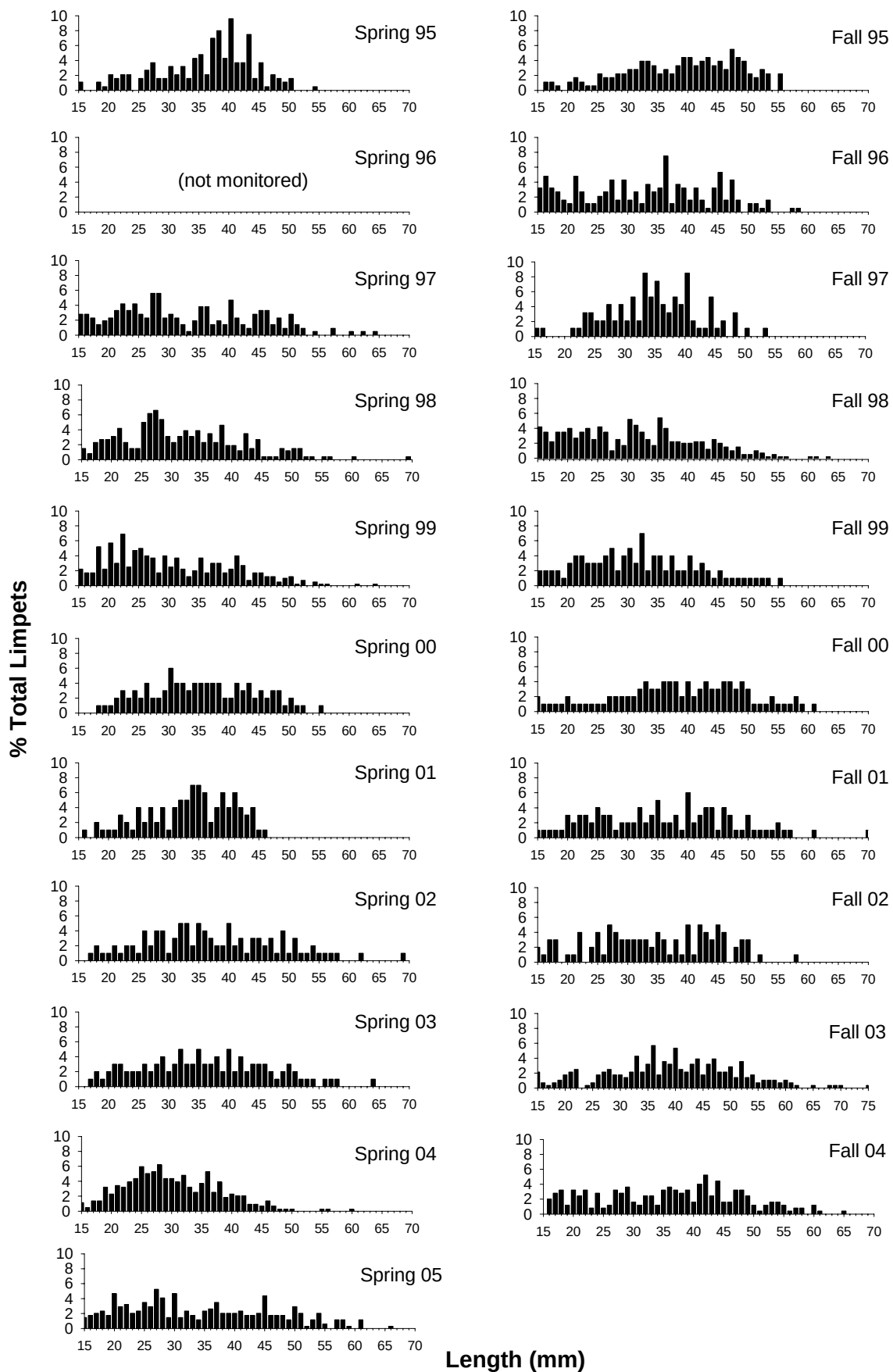


Figure 15. Owl Limpet Length Frequencies at Navy North.

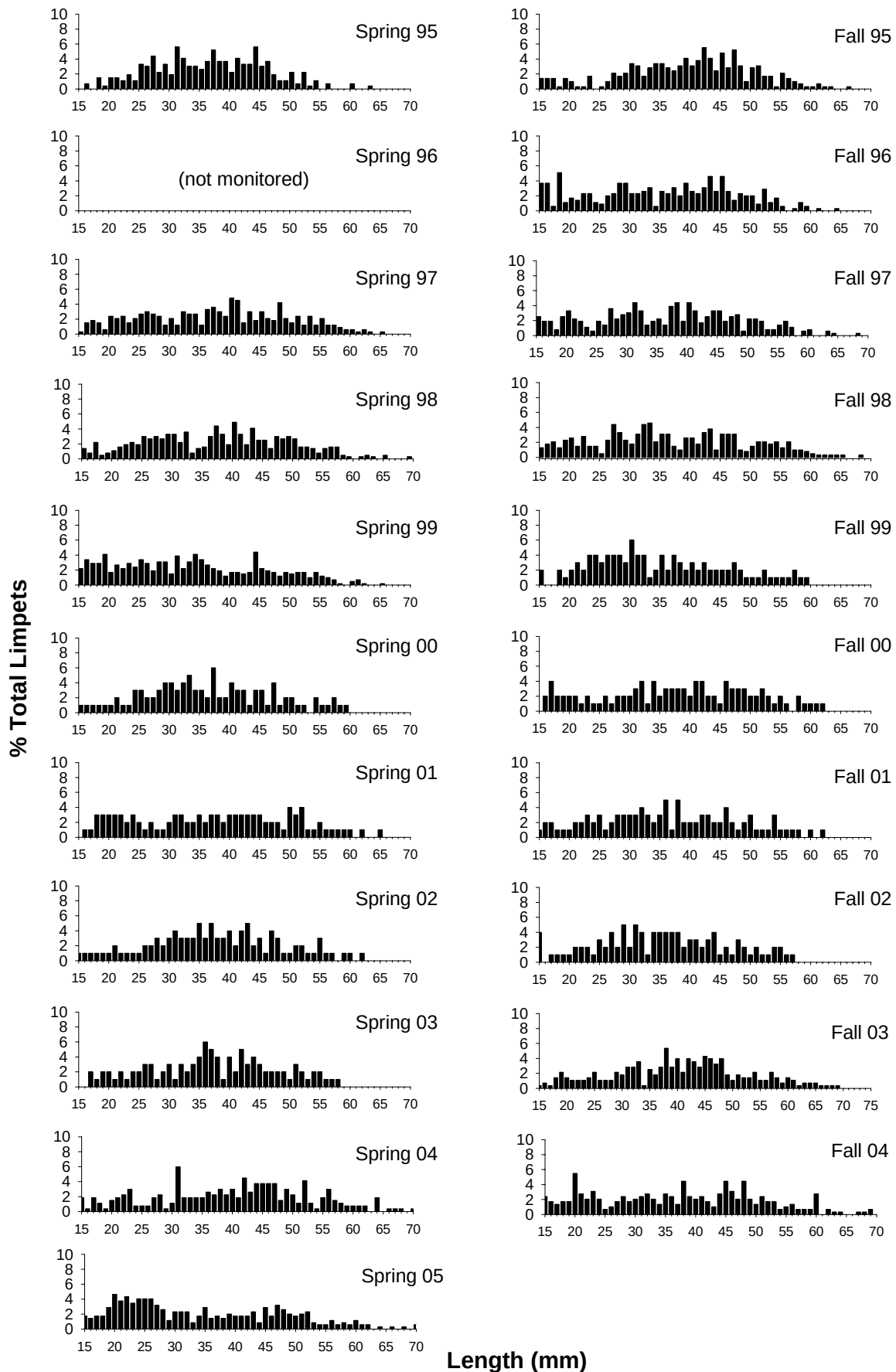


Figure 16. Owl Limpet Length Frequencies at Navy South.

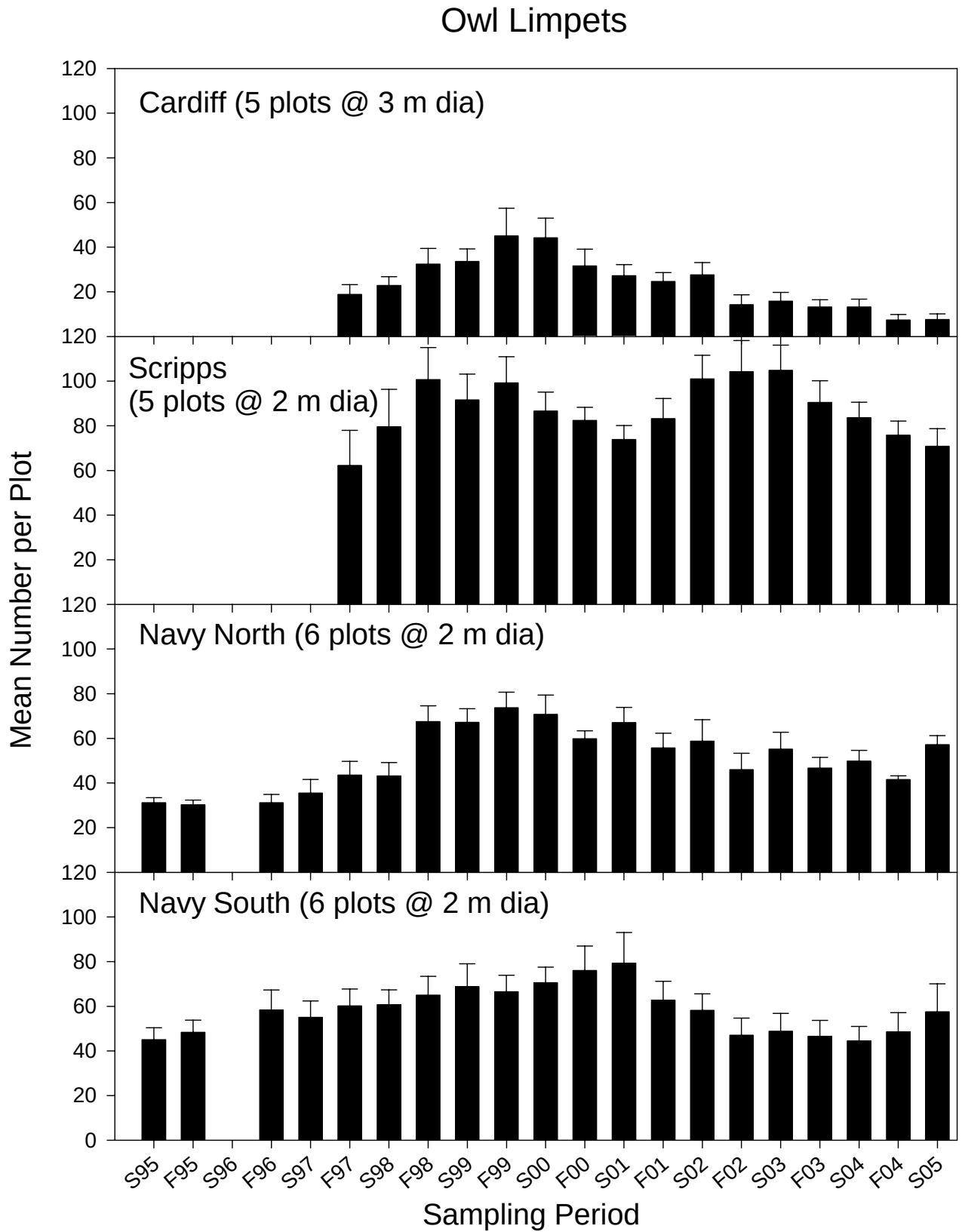


Fig. 17. Owl Limpet Abundances at 4 San Diego County Sites.

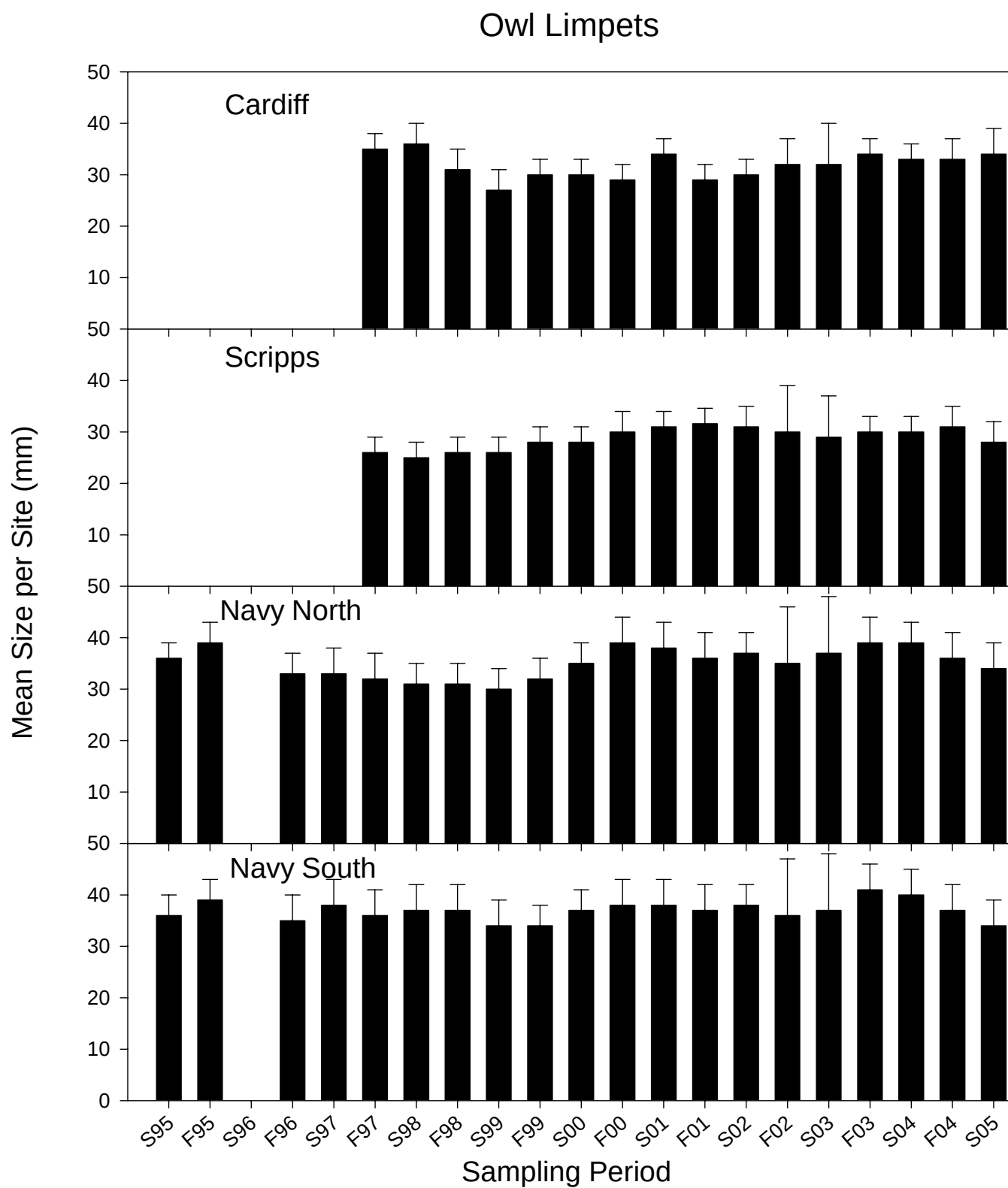


Fig. 18. Owl Limpet Sizes from 5 Plots (combined) at 4 San Diego County Sites.

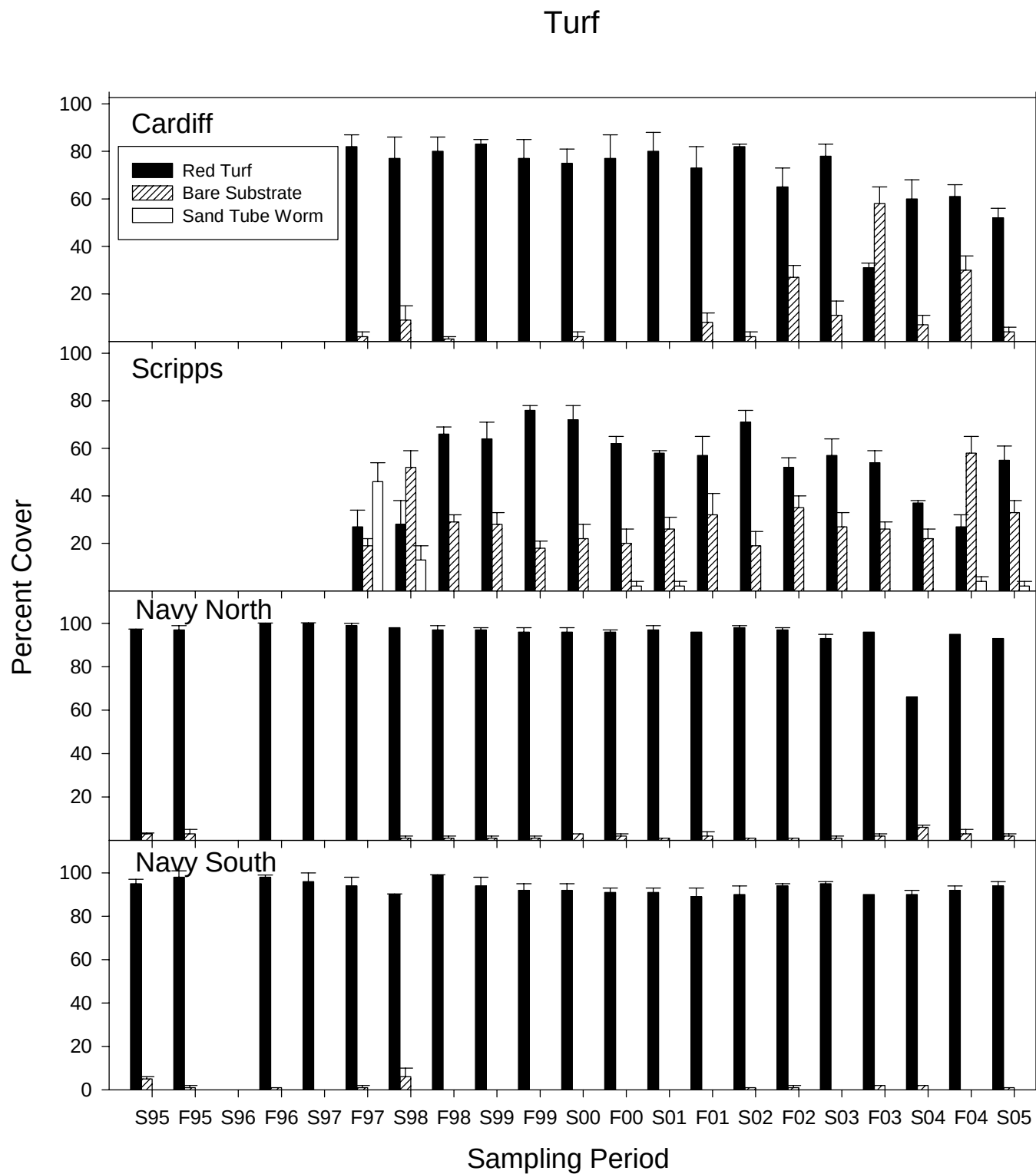


Fig. 19. Species Abundances in 3 Turf Transects (except Navy North and South S95-F01 n=2) at 4 San Diego County Sites.

Surfgrass

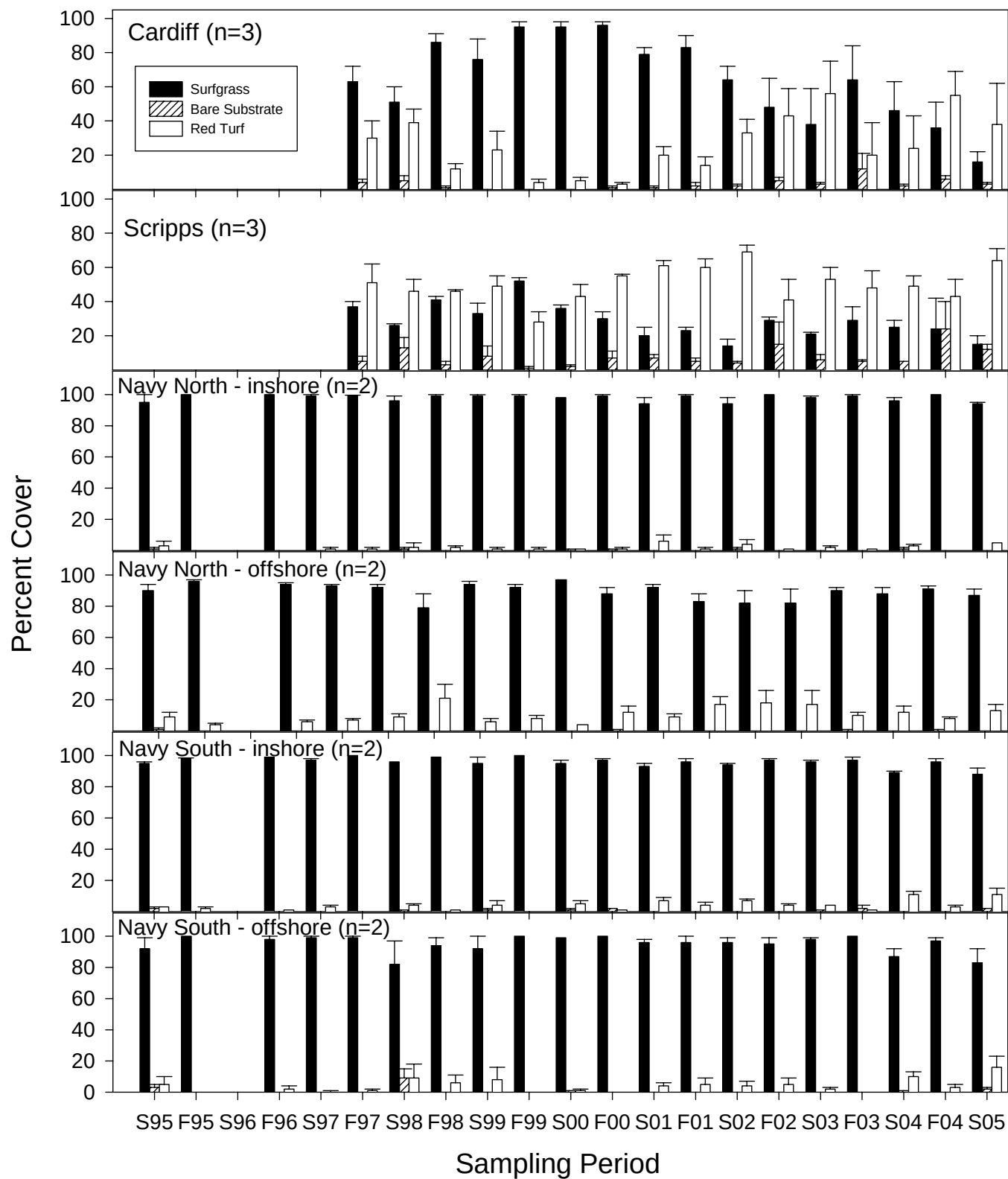


Fig. 20. Species Abundances in Surfgrass Transects at 4 San Diego County Sites.

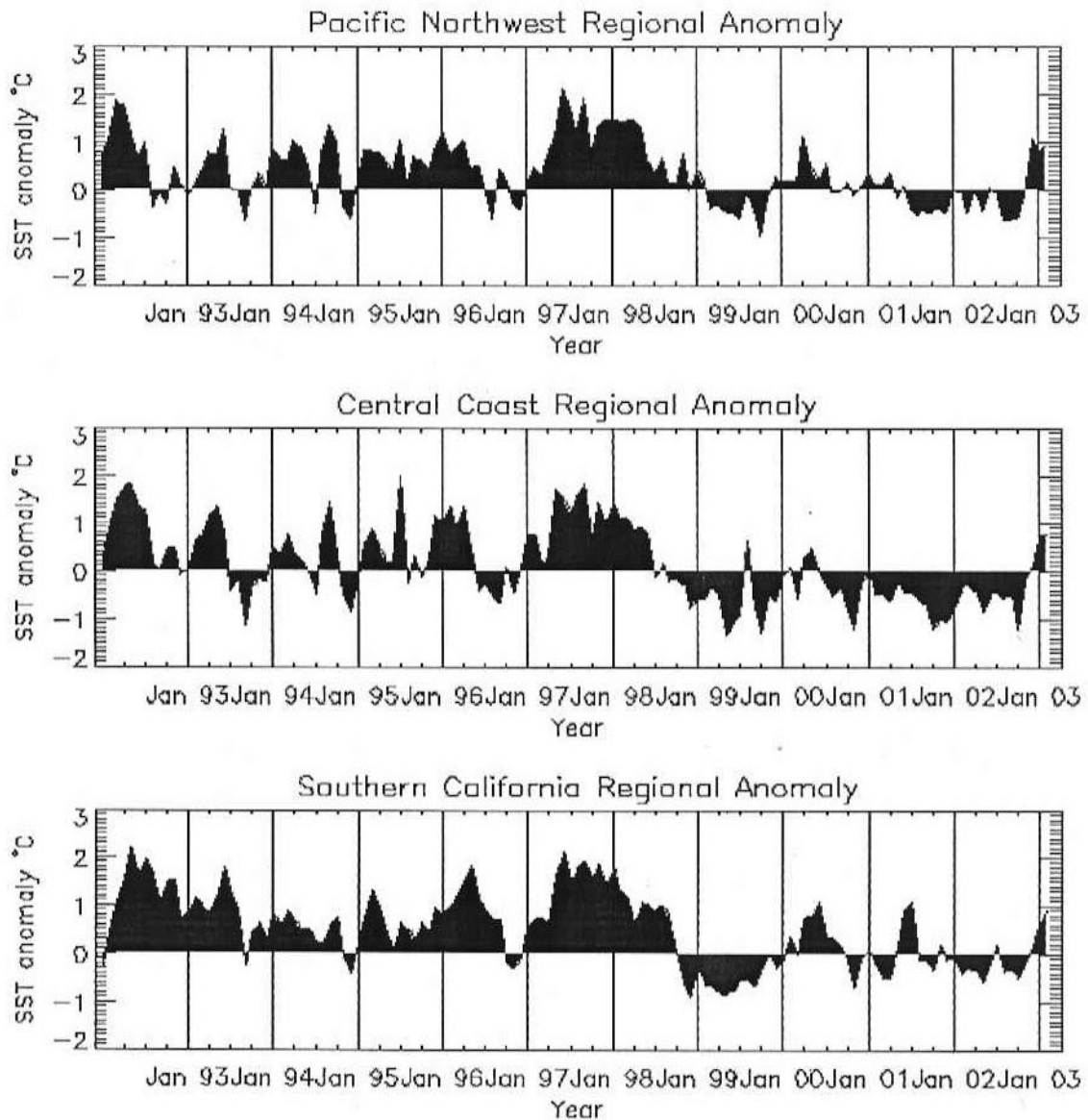


Figure 21. NOAA Sea Surface Temperature Anomalies: 1993-2003.
Graphs show the SST monthly average (NCEP data) minus the COADS 2 1950-1997 monthly mean values. (CoastWatch West Coast Regional Node, http://coastwatch.pfel.noaa.gov/time_series.html)

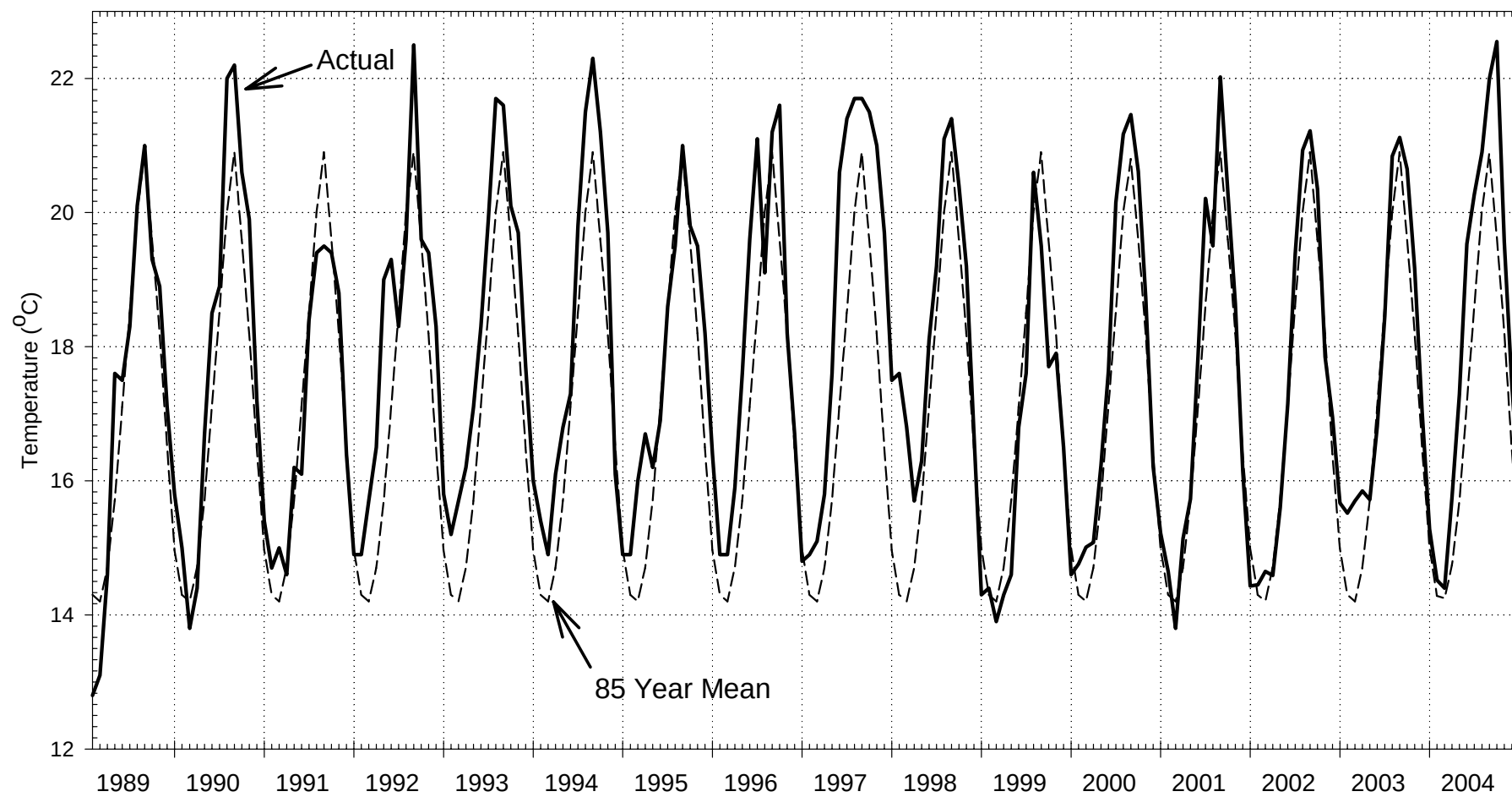


Figure 22. Scripps Pier Seawater Temperatures (1989 to 2004).