

KELP FOREST MONITORING ANNUAL REPORT 1998



CHANNEL ISLANDS NATIONAL PARK



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**KELP FOREST MONITORING
1998 ANNUAL REPORT**

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ABSTRACT

Observations and results of the 1998 Channel Islands National Park, Kelp Forest Monitoring Project are described. Population dynamics of 68 taxa, or categories, of algae, fish and invertebrates were measured at 16 permanent sites around the five Park islands. Survey techniques utilized SCUBA and surface-supplied-air, and included quadrats, 5m²-quadrats, band transects, random point contacts, fish transects, roving diver fish counts, video transects, size frequency measurements, artificial recruitment modules, and species list surveys. Temperature data was collected using remote temperature loggers. Size frequency measurements were taken from artificial recruitment modules at ten sites. In 1998, six sites had *Macrocystis pyrifera* (giant kelp) forests or developing forests, one site was barren with high siltation, and nine sites were dominated by echinoderms. Of these nine sites dominated by echinoderms, one was dominated by *Pachythyone rubra* (aggregated red sea cucumbers), one by *Strongylocentrotus franciscanus* (red sea urchins), one by both *Strongylocentrotus purpuratus* (purple sea urchins) and *Ophiothrix spiculata* (brittle stars), one by both *S. purpuratus* and *S. franciscanus*, and five by *S. purpuratus*.

EXECUTIVE SUMMARY

Channel Islands National Park has conducted long-term ecological monitoring of the kelp forests around Santa Barbara, Anacapa, Santa Cruz, Santa Rosa, and San Miguel Islands since 1982. Permanent transects were established at 16 sites between 1981 and 1986. In 1998, sites were monitored during seven five-day cruises between June and October. The 1998 kelp forest monitoring was completed at all 16 monitoring sites by 33 National Park Service (NPS) and volunteer divers completing a total of 794 dives. This annual report contains a summary of the methods used to conduct the monitoring in 1998 and a brief description of the sites along with the results. All of the data collected during 1998 can be found summarized in the Appendices.

Divers using SCUBA or surface-supply-air completed all quadrats, 5m²-quadrats, band transects, random point contacts, fish transects, roving diver fish counts, size frequencies, artificial recruitment modules (ARMS) and video transects. Transect lead line repair and bolts replacement were performed as necessary at all locations. Temperature loggers were retrieved and deployed at all sites, except at Pelican Bay, Santa Cruz Island. All proposed data collection was completed this year except for temperature data at Pelican Bay.

In 1998, *Macrocystis pyrifera* (giant kelp) forests were present at six of the 16 Kelp Forest Monitoring sites. These sites included Wyckoff Ledge at San Miguel Island, Johnson's Lee North, Johnson's Lee South and Rodes Reef at Santa Rosa Island, and Cathedral Cove and Landing Cove at Anacapa Island. Rodes Reef, Santa Rosa Island was similar to last year and can be described as a open area with a moderate amount of understory algae and few *M. pyrifera* plants, but there were notably more *M. pyrifera* plants this year. Nine sites were dominated by echinoderms. Gull Island South, Pelican Bay, and Scorpion Anchorage at Santa Cruz Island, Southeast Sea Lion Rookery and Arch Point at Santa Barbara Island were dominated by *Strongylocentrotus purpuratus*. Hare Rock, San Miguel Island, was dominated by *Strongylocentrotus franciscanus*. Cat Canyon, Santa Barbara Island, was dominated by both *S. purpuratus* and *S. franciscanus*. Admiral's Reef, Anacapa Island, was dominated by both *S. purpuratus* and the brittle star, *Ophiothrix spiculata*. Fry's Harbor, Santa Cruz Island was dominated by *Pachythyone rubra*, and had a moderate density of *S. purpuratus*, and *Astrangia lajollaensis*. Yellowbanks at Santa Cruz Island is a barren with high siltation.

Seven sites had high ($> 15/\text{m}^2$) *Strongylocentrotus purpuratus* densities this year compared to eight sites in 1997. Although densities remain high at these sites, they have mostly decreased over the last several years. *S. purpuratus* densities declined greatly at all three Santa Barbara Island sites, however these sites remained sea urchin barrens. Similar to the last several years, it appears that much of the subtidal habitat at Santa Barbara Island continues to be sea urchin barrens with high densities of *S. purpuratus* and

occasionally high densities of *S. franciscanus*. There were few canopy forming *Macrocystis pyrifera* plants at Santa Barbara Island. Similar to last year, the only notable patches of *M. pyrifera* were remnant kelp forests around Sutil Island, Cat Canyon, around the Webster point area, and some very small patches of kelp close to shore scattered around the island. At Anacapa Island, most of the south side and large portions of the north side of the middle and west parts of the island have high densities of *S. purpuratus* and little *M. pyrifera*. In contrast, most of the area inside the Anacapa Ecological Refuge on the North side of East Anacapa has healthy *M. pyrifera* forests with low densities of *S. purpuratus*. Four of the five sites on Santa Cruz Island experienced decreases in *S. purpuratus* densities, and one site increased. Three of the five sites at Santa Cruz Island had high densities ($>15/\text{m}^2$) of *S. purpuratus*, but all sites had densities over $10/\text{m}^2$.

Sea urchin wasting syndrome (Richards and Kushner, 1994) was observed at eight sites this year, similar to the last two years. Sea urchin wasting syndrome was observed on Santa Barbara, Anacapa, and Santa Cruz Islands, and was not observed on Santa Rosa and San Miguel Islands.

Sea star wasting disease (Schroeter and Dixon, 1988) was observed afflicting only one *Asterina miniata* at Southeast Sea Lion Rookery, Santa Barbara Island this year. This is significantly less than the 10 sites and four species it was observed at last year. Overall, all three species of sea stars we monitor declined this year. We believe the decline of sea star populations was a result of sea star wasting disease.

Overall, Island kelp fish, *Alloclinus holderi*, densities remained relatively high. Although their densities increased and decreased at some of the sites, they have remained high over the past year. In 1997, we observed the highest recorded densities for this species at many of the sites.

No protocol changes were implemented this year.

INTRODUCTION

The waters of Channel Islands National Park and Channel Islands National Marine Sanctuary contain one-third of southern California's kelp forests (Davies, 1968). Giant kelp, *Macrocystis pyrifera*, is the primary constituent of a southern California kelp forest, and over 1,000 species of macro flora and fauna live in this community (Woodhouse 1981, Engle pers. comm.). The kelp forest serves as food, shelter, substrate, and a nursery to resident as well as migratory species. Many species, while not residents of the kelp forest, are dependent upon the existence and productivity of kelp forests; detrital flux from kelp forests provides an important source of nutrients to nearby rocky shore, sandy beach, and estuary communities. The kelp forests are essential to California's commercial and sport fisheries as well as the recreation and tourist industries.

Channel Islands National Park consists of five of the eight California Channel Islands (San Miguel, Santa Rosa, Santa Cruz, Anacapa, and Santa Barbara) and the submerged lands and waters within one nautical mile of each of the islands. The Channel Islands National Marine Sanctuary overlaps the subtidal portions of the park, and its boundary extends six miles seaward from the Park Islands. Channel Islands National Park also bears the designation of International Biosphere Reserve and State of California Areas of Special Biological Significance. The State of California maintains jurisdiction over the resources within the Park and manages them through the California Department of Fish and Game.

The federal law which established Channel Islands National Park (16-USC-410) mandated the development of inventories and monitoring of natural resources in the Park. Kelp Forest Monitoring is part of the long-term ecological monitoring program at the Park which is designed to measure the health of the ecosystems. By determining the limits of normal variation and diagnosing abnormal conditions we hope to prescribe remedial action through management recommendations.

Following a five-year design study that began in 1982, the Kelp Forest Monitoring Program was implemented in 1987 by the Park's resource management division, using the protocol established during the design phase (Davis and Halvorson, 1988). Preliminary results and specific design considerations can be found in reports written by Davis (1985, 1986). Richards et al. (1997), describe monitoring efforts and results for 1982-1989. Richards et al. (1993a), Richards et al. (1993b), Richards and Kushner (1994), Kushner et al. (1995a), Kushner et al., (1995b), Kushner et al. (1997a), Kushner et al. (1997b), Kushner et al. (1999) describe the 1990, 1991, 1992, 1993, 1994, 1995, 1996, and 1997 monitoring efforts and results respectively. A review of the kelp forest Monitoring program was conducted in 1995 (Davis et al., 1996).

This report summarizes the monitoring efforts and results from 1998, our seventeenth year of monitoring. It is hoped that these reports will provide some insight into kelp forest dynamics and stimulate further

research into the long-term trends and changes in this near-shore ecosystem. We have highlighted some of the most important observations, and tried to provide a characterization for each site. Organisms are referred to by genus and species, except in the abstract and executive summary where both scientific and common names are used. Common names are cross referenced to their scientific names in Table 1. Since the design of the kelp forest monitoring project, several genera and species names have been changed. For the most part, the new and the old genus are listed together in this text. The new names are cross-referenced in Table 1.

METHODS

Abundance and, in some cases, age structure of 68 taxa or categories of algae, fish, and invertebrates (Table 1) were measured at 16 permanent sites (Table 2) around the five Park islands (Figure 1). Site and species selection criteria, and sampling protocol are described in the Kelp Forest Monitoring Handbook (Davis et al., 1999). Sites were monitored between June 15th and October 2nd 1998.

Each site is marked by a 100 m long transect affixed to the seabed. The sampling techniques employed to gather patterns of abundance and age structure are summarized in Table 3. At each station, 24 paired 1 m x 1 m quadrats that are systematically arranged along the transect with a random start, 40 continuous and adjacent 1 m x 5 m quadrats, and 24 paired 3 m x 10 m band transects that are systematically arranged along the transect with a random start, were used to determine densities and distribution of discrete benthic organisms; 600 random non-adjacent points (random point contacts - RPCs) are used to determine percent cover of encrusting invertebrates, algae and substrate composition; four 2 m x 3 m x 50 m fixed transects were used to determine fish abundance; roving diver fish count with a timed count and estimated abundance; video taped transects provide a record of the site appearance; and size frequency measurements were collected to determine age structure and recruitment cohorts. All animals measured for the natural size frequency distributions were located using a band transect type search method. A general species list was established for each site, noting presence/absence and relative abundance for all recognizable species. Artificial recruitment modules (ARMs) in place at ten of the sites to measure recruitment and population structure of indicator species within the ARMs. A complete description of the monitoring protocols can be found in Davis et. al, 1999.

STOWAWAYTM temperature loggers were deployed at all sites. Loggers were encased in underwater housings and attached to stainless steel thread rods cemented to the bottom at each site. HOBOTEMPTM temperature loggers were also deployed at each site as a backup in case of unit failure. The HOBOTEMPTM loggers were programmed to record temperature every 4.8 hours, and the STOWAWAYTM loggers programmed to record the mean temperature of 100 temperature readings per hour.

STATION RESULTS

Sampling was completed at all 16 monitoring sites and a summary of the 1998 status of each site is presented in Table 4. Thirty three divers (Table 5) collected data on seven five-day cruises between June and October. A total of 794 dives with 626 hours of bottom time were completed.

A brief description of each site is included with the station results below. Complete data summaries from the sampling protocol are listed in the appendices. Means for 1-m² quadrats (Appendix A) represent average counts obtained from 24 paired 1 m x 1 m quadrats systematically arranged along the transect

with a random start. Means for 5m²-quadrats (Appendix B) represent average counts obtained from 40 continuous and adjacent 1m x 5m quadrats. Note that when adult, subadult and juvenile densities for *Macrocystis pyrifera* are listed in the station descriptions, the adult and subadult densities are derived from the 5m²-quadrats, and the juvenile densities from the quadrat data unless otherwise noted.

Means for band transects (Appendix C) represent average counts obtained from 24 paired 3 m X 10 m transects systematically arranged along the transect with a random start. Means for random point contacts (Appendix D) represent average percent cover for a given organism, group of taxa, or substrate at 15 quadrats systematically arranged along the transect with a random start. Forty points from each quadrat (600 points total) are used to determine percent cover of selected organisms and substrate within one meter of the bottom. Percent cover may total more than 100% due to layering, Davis et al., 1999.

Means for fish transects (Appendix E) represent the average of four adjacent and continuous 2 m X 3 m X 50 m transects along the line. It should be noted that this is different from previous years when fish transects were 2m x 3m x 100m. Cases listed refer to the total number of passes over the transect made during sampling. All counts were conducted between 0900 and 1500 hours unless otherwise noted.

The Roving Diver Fish Count data are presented in Appendix F. The first page of this Appendix contains the number of observers that sampled and the total number of species observed for each sampling date and site. The following pages contain the average timed score and estimated abundance of each sampling date and site.

Natural habitat size frequency distributions for invertebrates other than gorgonians and *Stylaster (Allopora) californica* are in Appendix G. *Macrocystis pyrifera* size frequency distributions are in Appendix H. Gorgonian and *Stylaster (Allopora) californica* size frequency distributions are in Appendix I. Size frequency measurements taken from the Artificial Recruitment Modules were kept separate from the natural habitat measurements and their distributions are in Appendix J. Species lists for all locations are in Appendix K. Video transects were completed for all locations, and the video tapes are stored at the Park's headquarters in Ventura.

Temperature data were collected at all 16 sites using STOWAWAYTM and HOBOTEMPTM temperature loggers. One of each type of logger was deployed at each site, but only data from the STOWAWAYTM were used, unless the unit failed, then data from the HOBOTEMPTM were used. The temperature data is collected from the loggers during our regular sampling season June – September. To expedite report writing we will present 12 months of temperature data from June 1, 1997 to May 31, 1998(Appendix L). Temperature data was collected from all 16 sites except for the following due to temperature logger failures: data is missing from 7/1/97 - 7/21/97 at Gull Island, Santa Cruz Island, from 7/24/97 onward at Pelican Bay, Santa Cruz Island, 6/1/97 - 6/17/97 for Southeast Sea Lion at Santa Barbara Island, 6/1/97 -

6/17/97 and 9/23/97 - 5/31/98 for Arch Point at Santa Barbara Island, and 5/22/98 - 5/31/98 for Cat Canyon at Santa Barbara Island.

This year, as with previous years, sampling at the monitoring sites typically occurs over at least two separate dates, often several weeks to months apart. Separate sampling dates enables us to conduct fish transects at two different dates at least two weeks apart. During our first visit we attempt to conduct all of the abundance estimate techniques (quadrats, 5m²-quadrats, band transects, random point contacts, fish transects, and roving diver fish count). During the second visit, fish transects and any remaining size frequencies are conducted. Occasionally abundance techniques are not completed during our first visit, and are subsequently finished during our second visit. If the time span between samplings appears to have impacted abundance estimates (due to changes in populations) this is noted in the results section below. Occasionally, a second sampling is conducted to document these changes. In the text we report numbers to two significant digits.

Location: Wyckoff Ledge, San Miguel Island

1998 sampling dates: 7/7, 7/8, 9/15.

1998 status: Mature kelp forest with dense understory of red and brown algae.

Overall, this site appeared similar to previous years and has remained a healthy mature kelp forest. On July 7th, *Macrocystis pyrifera* canopy cover was estimated at 90% and was thick. Most of the *M. pyrifera* plants and blades appeared healthy. Both adult and subadult *M. pyrifera* density decreased from last year to 0.11/m² and 0.11/m² respectively. Juvenile *M. pyrifera* density was the highest its ever been recorded at this site, 4.5/m². Coverage of *M. pyrifera* on the bottom decreased to 22%. Understory red algae was abundant only on the western end of the transect and consisted mostly of *Callophyllis* spp. Overall, red algae was less abundant than usual for this site. Coverage of miscellaneous red algae and *Gigartina* spp. were at their lowest levels since 1988, their coverages were 38% and 0.0% respectively. Understory brown algae was abundant and diverse. *Desmarestia* sp. was moderately abundant, covering 18% of the bottom, and consisted mostly of small plants. *Cystoseira* sp. covered 8.7% of the bottom. On RPCs, *Pterygophora californica* was recorded at its highest coverage (10%) since we began monitoring this species separately in 1993. Adult and juvenile *P. californica* density was 0.083/m² and 1.9/m² respectively; when combined, this is the highest recorded density at this site since monitoring began in 1982. Adult *Laminaria farlowii* was present along the transect, but none were observed in quadrats. Juvenile *L. farlowii* density was 0.21/m². The brown algae, *Dictyoneuropsis reticulata* was common. Articulated and encrusting algae covered 15% and 46% of the bottom respectively, similar to previous years. Bare substrate covered 20% of the bottom.

The most notable change at this site during our second visit in September was a the large increase in juvenile and small adult/subadult *Pterygophora californica* along the transect between 50-100 meters. The remainder of the site changed little and most of the *Macrocystis pyrifera* appeared healthy.

Similar to last year, the most common miscellaneous invertebrates on RPCs were hydroids and the worm, *Pista elongata*. This category covered 12% of the bottom. *Diopatra ornata* were common covering 7.2% of the bottom. *Phragmatopoma californica* were common in the holdfasts of adult *M. pyrifera*, but were rare elsewhere, their coverage along the transect was 0.5%. Miscellaneous bryozoans were common covering 8.2% of the bottom. Tunicates coverage has decreased over the last four years, this years coverage was 0.17%. *Tethya aurantia* were abundant with a density of 0.16/m², the highest recorded at this site. *Urticina (Telia) lofotensis* were abundant on the tops and sides of rocks with a density of 0.33/m². *Styela montereyensis* were more abundant than last year with a density of 0.29/m², and many were small.

As usual for this site, the red rock crab, *Cancer antennarius* were relatively abundant. Although these are not one of our monitored species, we counted them on band transects, but this data was not entered in the database. We observed nine *C. antennarius* on band transects for a density of 0.013/m². There were four traps we believe were targeting crabs around the site, and many traps were present in the Wyckoff Ledge area. Similar to last year, no kelp curler amphipods, *Amphithoe humeralis*, or “giant” caprellid amphipods were observed on *Macrocystis pyrifera* stipes or blades.

Asterina (Patiria) miniata were moderately abundant with a density of 2.1/m², similar to last year. Leather stars, *Dermasterias imbricata*, were present, but did not appear as abundant as last year. As usual for this site, *Pisaster giganteus* were common on the rocky outcrops within the sampling area, but few stars were present directly along the transect where they are counted. Their densities on quadrats and 5-meter quadrats were 0.083/m² and 0.03/m² respectively. Both small and large *Pycnopodia helianthoides* were observed, and their density was 0.013/m². *Strongylocentrotus franciscanus* and *S. purpuratus* were common but confined to crevices, as is usual for this site. Their densities on quadrats were 1.5/m² and 0.5/m² respectively. The density for *S. franciscanus* was the highest recorded since 1990. However, as has been noted before, *Strongylocentrotus spp.* are very aggregated at this site. Of the 36 *S. franciscanus* observed on quadrats this year, 31 were in one quadrat. No sea star or sea urchin wasting disease was observed this summer.

Kelletia kelletii were abundant and counted on both quadrats and band transects, and their densities were 0.71/m² and 0.30/m² respectively, both higher than last year. Many of the *K. kelletii* were half buried in the sand making them difficult to observe. Small *K. kelletii* were common, and overall are relatively small compared to other sites, this years mean size this year was 87mm. Eggs of *K. kelletii* were abundant and

we observed one area of about 3X3 meters that was virtually solid egg cases. *Lithopoma (Astraea) gibberosa* were relatively abundant with a density of 0.42/m², the highest density recorded at this site. *Haliotis rufescens* were common with a density of 0.015/m², a decrease from last year. We located 48 *Haliotis rufescens* within the transect for size frequency measurements. *H. rufescens* shells were collected around the transect, measured and disposed of off the transect. Only several *Aplysia californica* were observed, all were notably large. We observed a *Pycnopodia helianthoides* eating a *Parastichopus parvimensis*. *Navanax inermis* were common, but not as abundant as at Hare Rock.

Fish were more abundant on the western end of the transect, as is usual for this site. Juvenile *Sebastes* spp. were common in the kelp canopy, but appeared less abundant than last year. Small schools of juvenile and separate schools of adult *Aulorhynchus flavidus* (Tubesnouts) were common. However, *A. flavidus* were less abundant than last year. Several large *Sebastes miniatus* were observed, however only one was observed during the roving diver fish count. Juvenile *Sebastes* spp. were common, but not as abundant as last year. Both *Embiotoca Jacksoni*, and *E. lateralis* were common. Large male and female *Semicossyphus pulcher* were common, and two juveniles were observed. *Oxyjulis californica* were common and during our last visit in September we observed many small individuals (<3cm) in both small and large schools. Juvenile painted greenlings, *Oxylebius pictus*, were relatively abundant. On July 7th, roving diver fish count was conducted with five divers observing 22 species. On September 15th roving diver fish count was conducted with eight divers observing 25 species.

The temperature logger was working properly, and we successfully downloaded 12 months of temperature data for this site.

Location: Hare Rock, San Miguel Island

1998 sampling dates: 7/8, 9/15.

1998 status: *Strongylocentrotus franciscanus* barrens.

Except for an increase in brown filamentous diatoms, this site was similar to previous years and continues to be dominated by *Strongylocentrotus franciscanus*. Miscellaneous plants consisted entirely of filamentous brown diatoms, and covered 58% of the bottom. This is by far the highest coverage recorded for this category at this site. Overall, there was little macroalgae, except for some small *Ulva* sp. on the cobble, and a small amount of *Desmarestia* sp. and *Gigartina corymbifera* on the tops of rocks. There was a moderate amount of drift *Desmarestia* sp. that the *Strongylocentrotus* spp. were feeding on. No macroalgae was observed on quadrats. Other than coralline algae and other plants, algae covered only 1.5% of the bottom. Articulated coralline algae was uncommon and none was observed on RPCs. Encrusting coralline algae continued to increase and was recorded at its highest coverage for this site,

73%. Bare substrate coverage was relatively low at 8.5%, its lowest coverage for this site. Rock substrate coverage decreased to 78% (about a 10% decrease), while sand increased to 11% (about a 10% increase). Cobble remained about the same as last year at 11% coverage.

Almost all of the miscellaneous invertebrates counted on RPCs were the worm *Dodecaceria fewkesi*. This category covered 7.7% of the bottom, similar to last year. Terebellid worms were moderately abundant in the cobble areas around the transect, but few were encountered on RPCs this year. *Corynactis californica*, coverage was recorded at 1.3%, this is their lowest coverage since 1984. *Balanophyllia elegans* coverage remained relatively low for this site at 0.83%. *Astrangia lajollaensis* coverage was 1.0%. *Pandalus danae* were common in the cobble areas of the transect and most were small, typical for this site.

Strongylocentrotus franciscanus were abundant and dominated the site with a density of 12/m². As usual for this site, the *S. franciscanus* were observed to have notably long and brittle spines. *S. purpuratus* were common and were recorded at their highest density since 1989, 3.3/m². The *S. purpuratus* were very difficult to see on quadrats because most were almost completely covered with cobble and shell debris, and were small. Juvenile *S. purpuratus* were uncommon, similar to last year. Along the west end of the transect there is a large cobble area that had an abundance of juvenile *S. franciscanus*. Most of these were estimated to be 5-15mm, indicating recent recruitment, but this was the only area where we observed large numbers of juveniles. All of the *Strongylocentrotus* spp. were out in the open and not confined to crevices, typical for this site.

Asterina (Patiria) miniata were common along the transect but notably less abundant this year with a density of 0.13/m². This is the lowest density recorded at this site since monitoring began in 1982. Their lower abundance may have been a result of mortality caused by sea star wasting disease that was observed last year. *Pisaster giganteus* remained moderately abundant with only a small decrease in density to 0.21/m² on quadrats. *P. giganteus* density was similar on 5-meter quadrats, 0.15/m². Quadrats and 5-meter quadrats were sampled on different dates this year. Small and large *Pycnopodia helianthoides* were common, but less abundant than previous years with a density of 0.028/m². This is the lowest density recorded for this species since 1990. We observed a *P. helianthoides* feeding on a *Aplysia californica*. *Parastichopus parvimensis* were uncommon (only one was observed on quadrats), but were very large. This year is the first year that we have noticed *Ophiothrix spiculata* in moderate numbers. Most of the *O. spiculata* were observed in areas of the transect that had cobble or near/in crevices.

Few small fresh *Haliotis rufescens* shells were found along the transect this year. This indicates either low mortality and/or less recruitment. Little time was spent turning over small rocks to look for live juveniles as we often do at this site. One small live *H. rufescens* was observed on band transects (0.0014/m²).

Kelletia kelletii were uncommon with a density of 0.0056/m². *Aplysia californica* were relatively abundant at this site with a density of 0.12/m². This is the highest density recorded for this species since monitoring began at this site in 1982. *Cypraea spadicea* were common as usual for this site with a density of 0.63/m². One juvenile *Lithopoma (Astraea) undosum* was observed on quadrats this year, this is a rare sighting for San Miguel Island. Notably abundant at this site were the nudibranch, *Navanax inermis* and during our visit in September we observed many small (<10mm) ones. *Haminoea vesicula* and their eggs were common, these are one of the preferred foods for *N. inermis*.

Overall, fish were common and similar to previous years. Adult *Sebastes mystinus*, *S. serranoides*, *S. atrovirens*, *S. chrysomelas*, *Oxylebius pictus* and *Coryphopterus nicholsii* were the most common fish at this site. Juvenile *Sebastes* spp. were moderately abundant along the bottom. Juvenile *O. pictus* were relatively abundant, consistent with observations at other sites this year. *Chromis punctipinnis* were common. A small group of *Damalichthys vacca* was observed. One lingcod, *Ophiodon elongatus* and at least two Cabezon, *Scorpaenichthys marmoratus* were observed. Several females, no males, and one juvenile *Semicossyphus pulcher* were observed. *Oxyjulis californica* were uncommon. *Coryphopterus nicholsii* were common with a density of 0.33/m². Roving diver fish count was conducted on July 8th with seven divers observing 23 species, and on September 15th with six divers observing 20 species of fish.

The Stowaway temperature logger was working, and we downloaded a full year of temperature data from the site.

As usual for this site, there were many breaks in the lead line. We propose to place more eyebolts along this transect and only maintain the parts of the lead line not destroyed on an annual basis. With additional eyebolts, the transect should remain easy to locate.

Location: Harris Point, San Miguel Island

1998 sampling dates: 9/15.

1998 status: Strongylocentrotus franciscanus barrens/kelp forest.

We conducted a survey dive with the purpose of gathering size frequency distribution for *Haliotis rufescens*. Divers using calipers to measure and chalk to mark abalone (so they were not measured more than once) searched the area from a depth of 13 meters to about 2 meters. Peter Haaker, California Dept of Fish and Game Marine Biologist led this dive. Calif. Dept. of Fish and Game has been using this site to monitor *H. rufescens* population over the last several years, and this site has shown high recruitment in previous years. This year there was little recruitment. Most of the adult *H. rufescens* were found in shallow (<20ft). In the shallow areas, *Macrocystis pyrifera* and *Egregia menziesii* were common,

as well as understory foliose algae that consisted mostly of articulated coralline and miscellaneous red algae. Peter Haaker has the data collected from this dive.

Location: Johnson's Lee North, Santa Rosa Island

1998 sampling dates: 7/9, 8/27, 9/16, 10/1.

1998 status: Developing kelp forest.

Over the entire summer this site maintained a very high abundance of *Macrocystis pyrifera* plants. Adult, subadult and juvenile *M. pyrifera* densities were 0.095/m², 7.2/m² and 11/m² respectively, and covered 67% of the bottom. This is the highest overall density and coverage recorded for this site since monitoring began in 1982. However, adult *M. pyrifera* density (on 5-meter quadrats) was lower than the previous two years when we implemented this procedure. This indicates that most of the adult *M. pyrifera* plants died or were torn out since last year. There was no canopy over the site for the entire summer. On our first visit in July, many of the plants reached about 5 meters from the surface and in early October they were within a meter of the surface. Although, the plants appeared healthy throughout the summer, this suggests relatively slow growth for *M. pyrifera*. The abundance of *M. pyrifera* made swimming and sampling difficult.

A moderate amount of understory brown algae was present. Although densities of *Laminaria farlowii* were low, plants were still common near the transect. Adult and juvenile densities were recorded at 0.0/m² and 0.042/m² respectively, and a coverage of 2.0%. Adult and juvenile *Pterygophora californica* densities were 0.25/m² and 1.3/m² respectively and covered 11% of the bottom. *Eisenia arborea* were rare. *Cystoseira* spp. covered 12% of the bottom. Miscellaneous red algae coverage was 39%, similar to last year. *Gigartina* spp. was more abundant than last year, covering 6.8% of the bottom. Articulated and encrusting coralline algae covered 8.8% and 11% of the bottom respectively, similar to last year. Bare substrate covered 14% of the bottom, the second year this category has declined.

Similar to the previous several years, the most common miscellaneous invertebrates on RPCs were hydroids. This category covered 14% of the bottom. Coverages of tunicates and sponges were lower than last year, 3.0% and 1.3% respectively. *Phragmatopoma californica* was notably more abundant than last year, covering 16% of the bottom and were common in the *Macrocystis pyrifera* holdfasts. Bryozoans covered 22% of the bottom, and no *Diaperoecia californica* were found on RPCs. *Tethya aurantia* density was 0.075/m². *Styela montereyensis* density was 0.92/m², similar to last year.

Strongylocentrotus franciscanus were common in crevices, and their density along the transect was 0.79/m². *S. purpuratus* density increased to 24/m², a large increase since last year, and the highest

density since 1987. Upon first glance few *S. purpuratus* were apparent, but upon closer observation they were more abundant hidden in small depressions/crevices throughout the transect. A large increase in *S. purpuratus* abundance in the ARMs was also evident (see below paragraph on ARMs). It was difficult to measure *S. purpuratus* and *S. franciscanus* at this site because they were hidden in crevices and difficult to access without harming the animals. The divers measuring the sea urchins for size frequencies found that 23% of the *S. franciscanus* and 76% of the *S. purpuratus* were not accessible for measurement. This may have resulted in a sampling bias if a disproportionate number of large or small urchins were not accessible to be measured.

Sea star density notably decreased at this site. *Asterina (Patiria) miniata* were rare with only several observed around the entire transect. None were observed on quadrats, $0.0/\text{m}^2$, this was the lowest density recorded for this species at this site. *Pisaster giganteus* also decreased in density with the lowest density recorded on quadrats since 1985, and the lowest on 5-meter quadrats since we began using this protocol in 1996. *P. giganteus* density on quadrats and 5-meter quadrats were $0.13/\text{m}^2$ and $0.005/\text{m}^2$ respectively. *Pycnopodia helianthoides* were rare with a density of $0.0014/\text{m}^2$, the lowest recorded since 1985. No leather stars, *Dermasterias imbricata*, were observed this year, they were common for at least the past several years. *Parastichopus parvimensis* density was $0.17/\text{m}^2$.

Similar to past years *Cypraea spadicea* density has changed little, their density this year was $0.5/\text{m}^2$. Several very large *Lithopoma (Astraea) undosum* were observed, but were rare at this site as usual with a density of $0.083/\text{m}^2$. *Kelletia kelletii* were rare as usual for this site with a density of $0.0014/\text{m}^2$. *Megathura crenulata* were common on the rocky outcrops with a density of $0.0069/\text{m}^2$. No *Haliotis rufescens* were observed during band transects. We searched the entire transect for *H. rufescens* for size frequency measurements, and only 10 were found, all were under ledges or in deep crevices. No abalone were found in the area about one meter east of the 73 m mark that was mentioned in previous reports as having abalone. Abalone shells were collected, measured and disposed of off the transect. Two fresh *Haliotis rufescens* shells measuring 125mm and 180mm were found, indicating recent mortality. One *H. rufescens* with a withered foot was observed during size frequency measurements. This abalone measured 185mm and all other abalone observed appeared healthy.

Overall, fish were abundant and diverse at this site, however no fish of significant (large) size were observed. *Girella nigricans*, *Oxyjulis californica*, rainbow surfperch (*Hypsurus caryi*), kelp surfperch (*Brachyistius frenatus*), sardines (*Sardinops sagax*) and smelt, were common in the kelp canopy and midwater. Adult and juvenile *Embiotoca jacksoni* and *E. lateralis* were common. Female *Semicossyphus pulcher* were common and juveniles were relatively abundant for this site, while males were rare. The resident *Hypsypops rubicundus* at 73 m along the transect was present as usual, and at least one other adult was observed along the transect this year. Several juvenile *H. rubicundus* were observed, these are

rare on Santa Rosa Island. *Paralabrax clathratus* appeared more common than usual for this site. *Sebastes serranoides* were common. Roving diver fish count on was conducted on July 9th with seven divers observing 27 species and on September 16th with seven divers observing 25 species of fish.

Similar to the other south facing sites, the ARMs moved and some were damaged, probably a result of the large south swell events that occurred during the past year. In the North end group of ARMs, only one ARM (#2406) and many scattered bricks were located. This ARM was mangled and could not be sampled; therefore, no ARMs were sampled at the North group. Only one ARM was found intact in the middle group. This ARM, #2414 was sampled for all indicator species and broken bricks were replaced with intact ones from other ARMs that were destroyed. Another ARM (#2398) from the middle group was found about 20 meters east of its original placement. Although this ARM was mangled with many bricks broken we still were able to sample it for all indicator species. This ARM was rebuilt, so two ARMs remain at the middle group (#2398 and #2414). Four ARMs were located at the south group, #2392, 2397, 2394, and 2411. Two of these were upside down (#2394 and 2397). All four ARMs from this group were sampled for all indicator species. Cages were replaced or repaired on all of the remaining ARMs. In summary, there are seven intact ARMs at this site, one at the north end, two in the middle and four at the south end.

In past years there has been differences in the numbers of some indicator species in the ARMs from the three different groups, and we have tried to sample equal numbers of ARMs from the three groups. Since, this will not be true for this year as well as next, the data maybe biased compared to previous years in relation to the number of ARMs sample from each group.

Only two *Haliotis rufescens* were found in the 7 ARMs this year. The *H. rufescens* were found in the same two ARMs where we found abalone in 1997. However, from the sizes, only one of the abalone was likely to be the same one found last year. This one measured 157mm and was in ARM # 2411, in 1997 this abalone measured 156mm. The other *H. rufescens* (found in #2398) was 37mm. One *H. corrugata* measuring 20mm was found in ARM #2392. Four *Crassedoma (Hinnites) giganteum* were found in the seven ARMs, 0.57/ARM. *Asterina (Patiria) miniata* were rare, but more were found than last year even with the small number of ARMs sampled. A total of five were found, 0.71/ARM, and all were small, less than 34mm. Six *Pisaster giganteus* (0.86/ARM) and two *Pycnopodia helianthoides* (0.29/ARM) were found, both are higher densities than the last two years. *Cypraea spadicea* density was 3.9/ARM. Similar to what we saw in the quadrats, *Strongylocentrotus purpuratus* densities increased dramatically. This years density was 25/ARM (compared to 3.6/ARM in 1997). The density of *S. franciscanus* decreased to 9.3/ARM.

The Stowaway temperature logger worked well and we downloaded a full year of temperature data from the site.

Location: Johnson's Lee South, Santa Rosa Island

1998 sampling dates: 7/9, 8/3, 8/26, 8/27.

1998 status: Mature kelp forest.

Overall, this site appeared similar to past years, and there was no notable change over the course of the summer. The site is described as a mature kelp forest, however there were less adult and more subadult *Macrocystis pyrifera* than last year, similar to the Johnson's Lee North site. Juvenile *M. pyrifera* were also more abundant than last year. Adult, subadult, and juvenile *M. pyrifera* densities were $0.13/\text{m}^2$, $0.32/\text{m}^2$, and $1.8/\text{m}^2$ respectively. *M. pyrifera* covered 30% of the bottom on RPCs, and canopy cover was estimated to be 50% at slack tide. *M. pyrifera* abundance at this site appeared to represent most of the Johnson's Lee area well. Most of the *M. pyrifera* appeared healthy. Adult and juvenile densities of *Laminaria farlowii* were similar to previous years, $0.38/\text{m}^2$ and $0.67/\text{m}^2$ respectively. No *L. farlowii* was observed on random point contacts this year, this is unusual with respect to its density. Adult and juvenile *Pterygophora californica* densities were $0.17/\text{m}^2$ and $0.33/\text{m}^2$ respectively, and its coverage was 1.7%. No adult *Eisenia arborea* were observed on quadrats, however there were some adult plants on the tops of rocks. Coverage of *E. arborea* was 0.67%, and juveniles were rare with a density of $0.042/\text{m}^2$. Miscellaneous red algae coverage was 53%, higher than last year. Coverage of *Gigartina* spp. was also higher than last year with a coverage of 9.3%. Articulated and encrusting coralline coverage's were higher than last year, they were recorded at 6.8% and 20% respectively. Bare substrate covered 26% of the bottom. Rock substrate increased to 87% and sand decreased to 13%. Cobble coverage was low (0.0%) as usual for this site. There was notably less sand at the north (zero meter) end of the transect than in previous years. This area is now large rocks interspersed with sand.

Similar to the last two years, hydroids (mostly *Aglaophenia latirostris*) were the most common miscellaneous invertebrate on RPCs. This category decreased to 8.2%. Sponges were recorded at their highest coverage for this site, 11%, and tunicate coverage decreased to 0.83%, their lowest since 1988. The observer who conducted random point contacts said they were sure about their identification of tunicates and sponges. *Balanophyllia elegans* coverage was relatively low at this site, similar to last year with coverage of 2.0%. Bryozoans, *B. elegans*, *Astrangia lajollaensis*, and *Corynactis californica* were all abundant on the rocky outcrops but less abundant along the transect where RPCs are conducted. *Diopatra ornata* abundance decreased from last years high coverage. This may have been in part due to a larger proportion of rock versus sand substrate sampled this year as mentioned above. Bryozoans decreased in coverage to 8.2%. *Styela montereyensis* continued to increase for the second year and many were small, this years density was $0.92/\text{m}^2$, the highest since 1993. *Tethya aurantia* were abundant

with a density of 0.20/m². *Lophogorgia chilensis* were moderately abundant with a density of 0.11/m². *Tealia lofotensis* density was 0.074/m².

Similar to past years at this site, *Strongylocentrotus franciscanus* and *S. purpuratus* were common in crevices, but their overall densities were low at 2.6/m² and 4.6/m² respectively. Similar to Johnson's Lee North, it was difficult to measure *S. purpuratus* and *S. franciscanus* at this site because they were often hidden in crevices and difficult to access without harming the animals. The divers who measured the sea urchins for size frequencies found that 62% of the *S. franciscanus* and 95% of the *S. purpuratus* were not accessible for measurement. This could have created sampling bias if a disproportionate number of large or small urchins were not accessible to be measured.

Both large and small *Pycnopodia helianthoides* were present, but were less abundant than last year with a density of 0.017/m². *Asterina (Patiria) miniata* density declined to 0.71/m², the lowest density recorded at this site since 1984. *Pisaster giganteus* density also declined and was recorded at their lowest density (0.042/m²) for this site since monitoring began. Their density on 5-meter quadrats was similar at 0.075/m². *Parastichopus parvimensis* density was 0.29/m².

Similar to last year, only two *Haliotis rufescens* were observed during band transects, 0.0028/m². Abalone shells were collected, measured and disposed of off the transect, one fresh *H. rufescens* shell was found. During size frequency measurements for abalone, we were only able to locate five *Haliotis rufescens*, this is the lowest number since 1991. Similar to other sites this year, *Aplysia californica* were relatively abundant for this site with a density of 0.056/m², the highest density since 1983. *A. californica* are typically rare at this site. *Kelletia kelletii* were relatively abundant for this site with a density of 0.025/m².

Fish were abundant and diverse at this site. Adult and juvenile *Embiotoca jacksoni*, adult *E. lateralis*, *Damalichthys vacca*, *Rhacochilus toxotes*, *Brachyistius frenatus*, *Oxyjulis californica*, *Medialuna californiensis*, *Girella nigricans*, *Sebastes atrovirens*, female and male *Semicossyphus pulcher* were all common. Juvenile and small female (presumably one year old) *S. pulcher* were relatively abundant for this site. Several *Paralabrax clathratus* and *Sebastes carnatus*, and one *Heterodontus francisci* and *Scorpaenichthys marmoratus* were observed. One juvenile *Hypsypops rubicundus* was observed. Jack Mackerel, *Trachurus symmetricus*, were observed. In late August we observed schools of small transparent juvenile *Oxyjulis californica*. On July 9th we conducted roving diver fish counts with seven divers observing 25 species, and on September 16th with six divers observing 23 species of fish. A school of sardines were observed after the fish count.

Several of the ARMs moved since last summer, and only four were intact enough to sample. These were sampled for all indicator species. Two of the ARMs were on their sides and had moved, these were turned upright and repaired but need to be moved to more stable locations.

Overall, there were few indicator species in the ARMs, this appears to be normal for this site. No *Haliotis* spp. were found in the ARMs. Sea stars were less abundant than last year. *Asterina (Patiria) miniata* abundance was 3.5/ARM, *Pisaster giganteus* 0.75/ARM, and there were no *Pycnopodia helianthoides*. *Strongylocentrotus purpuratus* were uncommon with 2.8/ARM. *S. franciscanus* abundance in the ARMs was similar to last year with a mean of 26/ARM. Small (<15mm) *Strongylocentrotus* spp. were rare, indicating little recruitment.

The Stowaway temperature logger worked well and we downloaded a full year of temperature data from the site.

Location: Rodes Reef, Santa Rosa Island

1998 sampling dates: 7/6, 7/7, 8/14.

1998 status: Developing kelp forest with a moderate amount of understory red algae.

Although there was no *Macrocystis pyrifera* canopy directly over the transect, some canopy forming plants were present just outside the transect, including a patch of dense canopy about two hundred meters to the south. *M. pyrifera* plants within the transect were less abundant this year with only 10 plants found during size frequencies compared to 77 found last year. In the areas just outside the transect, there appeared to be more adult *M. pyrifera* plants. Adult, subadult, and juvenile *M. pyrifera* densities were 0.0/m², 0.0/m², and 1.4/m² respectively. This is the highest density for juvenile *M. pyrifera* since 1990. On RPCs, *M. pyrifera* covered 0.33% of the bottom. Most of the *M. pyrifera* appeared healthy and no kelp curler amphipods, *Amphithoe humeralis*, were observed this year. On our second visit to the site (five weeks later), most of the *M. pyrifera* plants were notably larger, and we estimated canopy cover at 5%.

There were notably less understory algae this year. *Desmarestia* sp. cover decreased to 5.8% of the bottom, and was mostly present along the eastern half of the transect. On our second visit on August 14th (five weeks from conducting random point contacts), there was a notable increase in *Desmarestia* sp. *Laminaria farlowii* was common covering 1.3% of the bottom, and adult and juvenile densities were 0.25/m², and 0.13/m² respectively. The brown algae, *Dictyoneuropsis reticulata* was common. No *Eisenia arborea* was observed on quadrats this year. *Cystoseira* sp. covered 2.5% of the bottom on RPCs, and large reproductive plants were common along the transect. Many of these plants were up to approximately 7 meters tall. Miscellaneous brown algae covered 2.7% of the bottom. Miscellaneous red

algae with a coverage of 27%, was less abundant than last year, and the lowest since 1991. Although there were several species of red algae, the most common was *Acrosorium* sp., and this was mostly on the eastern end of the transect. Articulated coralline was uncommon, and encrusting coralline algae covered 56% of the bottom. Bare substrate coverage was lower than last year at 11%.

The most common miscellaneous invertebrates on RPCs were hydroids. This category covered 9.8% of the bottom, an increase from last year. The parchment tube worm, *Chaetopterus variopedatus*, appeared to be similar in abundance to last year. *Diopatra ornata* coverage remained low at 0.83%, its lowest coverage since 1987, but similar to last year. *Astrangia lajollaensis* and *Balanophyllia elegans* were more abundant on the western/rocky end of the transect and covered 5.2% and 0.83% of the bottom respectively. Bryozoans were less abundant than last year, covering 2.8% of the bottom combined. *Telia lofotensis* were common (0.039/m²) on the tops of rocks. *T. coriacea* and *T. colombiana* were also common as usual for this site. *Lophogorgia chilensis* were rare with a density of 0.0028/m². *Styela montereyensis* density was 0.42/m². *Tethya aurantia* were abundant at 0.18/m². The bright orange encrusting tunicate we observed last year was still present, but appeared not as abundant.

Strongylocentrotus franciscanus were moderately abundant with a density of 6.4/m². The *S. franciscanus* were notably larger than last year. Their mean size increased to 50mm (from 37mm in 1997) and there was a noticeable shift in size cohorts. *S. purpuratus* increased in density this year to 6.8/m², this is the highest density since 1987 at this site. There were more *S. franciscanus* and *S. purpuratus* along the eastern half of the transect than previously observed. Unlike last year, *Lytechinus anamesus* were relatively common for this site. Most were along the flatter, eastern half of the transect, and were recorded at their highest density (0.70/m²) since 1986. The *L. anamesus* were difficult to see because they were small and most were covered with pebbles or shell debris. Similar to past years, large *Parastichopus parvimensis* were present on the western/rocky half of the transect, however none were observed on quadrats, and only nine were found in the transect area for size frequencies.

Sea stars were notably less abundant at this site which usually has a high diversity and abundance. *Asterina (Patiria) miniata* were recorded at their lowest density since 1985. This year's density was 0.42/m² (compared to 3.0/m² in 1997). *Pisaster giganteus* also decreased in density. Their density on quadrats was 0.13/m², also the lowest density recorded since 1985, and on 5-meter quadrats their density was 0.075/m². *Pycnopodia helianthoides* were rare with none observed on band transects. This is the first time since 1984 that this site has recorded a 0.0/m² density. *P. helianthoides* has gradually declined over the last three years. No *Mediaster aequalis* (red sea star), and only one *Dermasterias imbricata* (leather star) were observed on July 6th. *Henricia* sp. (blood stars), and *Orthasterias koehleri* (rainbow stars) were common. *Pisaster brevispinus* (short spined sea star) were relatively abundant along the eastern half of the transect.

Kelletia kelletii density was 0.013/m², similar to last year. Several *Lithopoma (Astraea) undosum* and *Lithopoma (Astraea) gibberosum* were observed along the transect. Their density in quadrats was 0.13/m² and 0.042/m² respectively. *Megathura crenulata* were common on the western/rocky end of the transect, with a density of 0.019/m². *Aplysia californica* density was 0.0069/m². One fresh *Haliotis rufescens* shell measuring 27mm was found along the transect.

As usual, fish were more abundant at the western end of the transect. Large male *Semicossyphus pulcher* were abundant as usual for this site. Large female *S. pulcher* were common and one juvenile was observed during the roving diver fish count. One *Damalichthys vacca* was observed on July 6th. *Rhacochilus toxotes* (rubberlip surfperch), *Sebastes mystinus*, *Embiotoca jacksoni*, *E. lateralis*, large *Paralabrax clathratus*, and *Sebastes serranoides* were all common. *Sebastes atrovirens* were common, but did not appear as abundant as last year. *Rathbunella hypoplecta* (stripefin ronquil) were abundant along the rocky western half of the transect. Adult *Oxylebius pictus* (painted greenlings) were common, and juveniles relatively abundant, consistent with observations at many of the other monitoring sites this year. As usual for this site, parasitic copepods were abundant on the larger *S. pulcher*. Two *Alloclinus holderi* were observed on quadrats (0.083/m²). During our second visit to this site, we observed more *Oxyjulis californica*. The roving diver fish count on July 6th was conducted with six divers observing 20 species, and on August 4th, with six divers observing 25 species.

The Stowaway temperature logger stopped recording on June 16, 1997, however the Hobotemp backup logger continued to record data. Temperature data was successful downloaded from this site.

There was one commercial fishing boat on July 6th, and two on July 7th fishing sea urchins approximately 150-200 meters to the south and east of the transect.

Location: Gull Island South, Santa Cruz Island

1998 sampling dates: 7/20, 7/21, 8/27.

1998 status: *Strongylocentrotus purpuratus* barrens.

At first appearance, this site appeared to be less barren than last year. However, this was only due to a abundance of filamentous diatoms that covered much of this site. Without these diatoms, the site would have appeared as barren as the previous three years. However, there were several small patches of juvenile and subadult *Macrocystis pyrifera* plants within the transect. Several adult *M. pyrifera* plants were observed just east of the transect. Overall, this site continues to be mostly dominated by *Strongylocentrotus purpuratus*. On the other side of Gull Island, between Gull Island and Santa Cruz

Island, there was a large stand of canopy forming *M. pyrifera*. On July 21st Kelco was harvesting *M. pyrifera* in this area.

Except for filamentous diatoms, little algae was present at this site. There were several small subadult and juvenile *M. pyrifera* within 10 meters of the transect, but none were observed in quadrats, 5-meter quadrats or random point contacts. The brown algae, *Colpomenia* spp. was common on the tops of rocks, and several small clumps of *Dictyota/Pachydictyon* were noticed along the transect. Several adult and juvenile *Eisenia arborea* were observed within the transect area. Red algae were relatively uncommon for this site, and was recorded at its lowest coverage at this site (2.2%). Algae combined, not including miscellaneous plants or coralline algae covered 3.7% of the bottom. Miscellaneous plants, mostly consisting of filamentous diatoms covered 56% of the bottom, by far the highest coverage recorded for this category at this site. Articulated coralline algae was rare covering 0.5% of the bottom. Encrusting coralline algae was abundant, covering 77% of the bottom, its highest coverage at this site. Bare substrate was lower than last year with coverage of 3.8%.

On RPCs, the most common miscellaneous invertebrates were the parchment tube worm *Chaetopterus variopedatus*, *Lophogorgia chilensis*, and hydroids. This category covered 11% of the bottom. *Corynactis californica* was common covering 2.3% of the bottom. *Balanophyllia elegans* and *Astrangia lajollaensis* covered 2.3% and 2.3% of the bottom respectively. *Diopatra ornata* were present in the low-lying sandy areas of the transect, but were rare directly along the transect where they are monitored on RPCs. Bryozoans combined covered 1.7% of the bottom. *Stylaster (Allopora) californica* density was similar to previous years, 0.049/m², with both small and large colonies present. *Lophogorgia chilensis* were abundant as usual with a density of 0.18/m². *Tethya aurantia* were more common on the northern half of the transect, but were difficult to see because they were covered with filamentous diatoms and/or sediment. Their density was recorded at 0.015/m².

Strongylocentrotus franciscanus and *S. purpuratus* densities continue to be relatively high (5.5/m² and 31/m² respectively), and have remained virtually the same since 1995. *S. purpuratus* were more abundant on the northern end of the transect, as is usual for this site. Similar to the last several years, juvenile *S. franciscanus* and *S. purpuratus* were rare. *Lytechinus anamesus* were less abundant than last year with a density of 0.35/m² on band transects. On July 21st, 1 of 156 (0.64%), *L. anamesus* was observed with wasting syndrome.

Sea star density declined at this site. *Asterina (Patiria) miniata* density was 0.25/m², the lowest recorded since 1985 at this site. *Pisaster giganteus* were common and counted on both quadrats and 5-meter quadrats. Their respective densities were 0.083/m² and 0.13/m², the lowest recorded for this site. Many sea stars were observed with wasting disease in 1997 and this was probably the cause of their decline.

No *Pycnopodia helianthoides* were observed along the transect this year. No sea star wasting disease was observed this summer. One *Mediaster aequalis* was observed and *Henricia* sp. were common. *Parastichopus parvimensis* were common with a density of 0.50/m². *Pachythyone rubra* were common on the northern half of the transect.

On August 27th we collected *Parastichopus parvimensis* for size frequency measurements. When we began measuring them on the deck of the "Pacific Ranger", they began eviscerating even without touching them. Almost all of the 30 plus *P. parvimensis* eviscerated. Due to this we were unable to collect size frequency measurements. An eviscerated *P. parvimensis* will not give an accurate size frequency measurement.

Cypraea spadicea density was 0.46/m². *Lithopoma (Astraea) undosum* were uncommon as usual for this site with a density of 0.83/m². *Megathura crenulata* density was 0.11/m², the highest recorded since 1990. *Kelletia kelletii* were more common than last year with a density of 0.044/m². Similar to most of the kelp forest monitoring sites this year, *Aplysia californica* were abundant. Their density was recorded at 0.96/m², by far the highest recorded density at this site. One fresh abalone shell identified as a threaded abalone, *Haliotis assimilis*, was found. One live abalone also believed to be *H. assimilis* was found in the ARMs. Both of these measured 42mm, however the latter was not positively identified. No other abalone were observed. *Crassidoma (Hinnites) giganteus* were common, and fresh shells were more common than usual. Nudibranchs in general were moderately abundant and diverse. *Hermisenda crassicornis* were abundant. No *Navanax inermis* were observed.

The most notable change in fish populations at this site since last year was the increase in Juvenile *Semicossyphus pulcher*. One diver (David Kushner) counted 23 juveniles during the 30-minute roving diver fish count. On July 20th when the roving diver fish count was conducted, only several female *S. pulcher* and no males were observed. On the next day (July 21st) we observed more female and several male *S. pulcher*. Several adult and two juvenile treefish, *Sebastes serriceps*, were observed. *S. atrovirens* were rare. *Paralabrax clathratus* were relatively uncommon. *Oxyjulis californica* were common, but not as abundant as past years. *Chromis punctipinnis* were common. Adult *Oxylebius pictus* (painted greenlings) were common and juveniles were abundant, similar to what we have observed sites. *Girella nigricans* and *Damalichthys vacca* were common. Several stripefin ronquils, *Rathbunella hypoplecta*, were observed. There has been some dispute over the identification of the ronquils, so we are entering them into the data base as ronquil sp.. Only one *Alloclinus holderi* was observed along the transect, and none were observed in quadrats this year. *Coryphopterus nicholsii* density was 0.33/m². Roving diver fish count was conducted on July 20th with five divers observing 18 species of fish, and on August 27th with seven divers observing 19 species of fish.

There are three groups of five ARMs at this site. The ARMs have been very stable at this site since they were deployed, however this year many were damaged or were empty cages next to a pile of bricks. In the south end group, ARM #2329 and #2331 were monitored for all indicator species. Another ARM with no number tag was monitored for all indicator species, a new number tag (#2439) was placed on this ARM. The remaining two ARMs in this group were missing their cages and the bricks were scattered about the bottom. Three new cages were deployed in the south group, and all have new number tags; #2439 mentioned above, and #2440 and #2441, which contain the bricks that were scattered about the bottom. By mistake, the new ARM cages were built slightly too tall and several of the ARMs were filled with an extra layer of bricks, while other ARMs were short some bricks. In the middle group of five ARMs, two ARMs (#2324, #2328) were intact, #2325 was on its side with about five bricks that had fallen out. The remaining two ARMs cages were missing with an associated pile of bricks. The two ARMs #2324 and #2328 were sampled for all indicator species. Four new cages were deployed on July 21st, and there are enough bricks for another ARM. The new number tag that replaced one of the missing cages is #2438. In the North group of ARMs, ARM #2321 was reassembled from the pile of bricks found. The other four ARMs (#2319, 2320, 2322, and 2323) were sampled for all indicator species. Cages were replaced on all ARMs. It is very possible that if we had time last year to replace all of the ARM cages, not as many would have been destroyed this year.

A total of nine ARMs were monitored at this site, eight for all indicator species and one for all indicator species except *Cypraea spadicea*. No *Haliotis rufescens* or *H. corrugata* were observed in the ARMs this year. One *H. assimilis* (mentioned above) was found in a ARM. *Cypraea spadicea* were common with similar numbers to previous years (5.4/ARM). Two small *Megathura crenulata* were found this year (0.22/ARM). *Asterina (Patiria) miniata* were similar in abundance to last year with 4/ARM. *Pisaster giganteus* were rare with only two found in the ARMs, 0.22/ARM. This is the lowest number we have found in the ARMs at this site. Two small *Lithopoma (Astraea) undosum* were found in the ARMs (0.22/ARM), these are typically rare at this site. *Strongylocentrotus franciscanus* density in the ARMs was lower, and *S. purpuratus* were similar to last year, with 15/ARM and 47/ARM respectively. *Centrostephanus coronatus* were relatively abundant in the ARMs this year, 0.67/ARM. All six found were small (<25mm). This was the first year we have found *C. coronatus* in the ARMs at this site.

In an ARM we found one black urchin, *Arbacia incisa*. This urchin are more commonly found south and we believe this is the furthest north this species has been found, increasing its range.

The temperature logger worked well at this site, and all 12 months of data were successfully downloaded, however 18 days of temperature data are missing from July, 1997. This occurred due to logger malfunction.

Location: Fry's Harbor, Santa Cruz Island

1998 sampling dates: 7/22, 8/4.

1998 status: Open area with high densities of aggregating red sea cucumbers, *Pachythyone rubra*, and moderate densities of *Astrangia lajollaensis* and *Strongylocentrotus purpuratus*.

The overall appearance of this site has changed little from previous years. However there have been decreases in some of the most dominating invertebrates. Specifically, *Ophiothrix spiculata*, *Astrangia lajollaensis*, *Strongylocentrotus purpuratus*, *Pachythyone rubra*, and *Diaperoecia californica*.

Macrocystis pyrifera was absent, and there continues to be little other foliose algae along the transect. Similar to previous years, several adult *Eisenia arborea* plants were observed on top of the large boulder at the north end of the transect, but none were in quadrats. There were also adult and juvenile *E. arborea* on top of the giant boulder in the middle of the transect on the south side. However, there was less than last year and no *Laminaria farlowii*. Off the transect, *E. arborea* was common along the wall in shallow water. Miscellaneous red algae covered 5.2% of the bottom and consisted entirely of filamentous red algae. Similar to most of the kelp forest monitoring sites this year; brown filamentous diatoms were relatively abundant. Diatoms were counted as miscellaneous plants and were the sole constituent of this category. Coverage of miscellaneous plants was 11%, the highest coverage ever recorded at this site. Articulated coralline algae were rare (0.33%). Encrusting coralline algae covered 39% of the bottom. Bare substrate coverage was relatively high for this site at 20%.

The most common miscellaneous invertebrates on RPCs were barnacles and *Spirobranchus spinosus*. This category covered 15% of the bottom. For the last two years, the brittle star, *Ophiothrix spiculata*, has been relatively abundant, this year none were observed during RPCs. In 1996 and 1997, *O. spiculata* were recorded covering 16% and 9.7% respectively. *Astrangia lajollaensis* remained relatively abundant compared to other sites, but decreased in coverage to 7.7%. This is the lowest coverage recorded at this site. *Corynactis californica* also decreased in coverage and was recorded at its lowest coverage, 0.12%. *Lophogorgia chilensis* were abundant on the deeper side of the transect, their density was 0.19/m². *Diaperoecia californica* was much less abundant than last year. This years coverage was 1.3%, which was the lowest since 1985. Last year it was recorded at its highest coverage. Miscellaneous bryozoans covered 2.8% of the bottom. *Tethya aurantia* density was 0.04/m², the highest recorded at this site.

Pachythyone rubra continued to decline for the second year, and was recorded at 11%. Although there is a notable decrease in *P. rubra*, it appears that *P. rubra* abundance may not have decreased as much as the data suggest. This year it appeared that there were less *P. rubra* directly along the transect line, and more several meters above the line, so the decrease could be in part due to their movement. Similar to past years, *P. rubra* are easily disturbed and we were careful not to disturb the bottom before conducting

RPCs along the transect. *P. rubra* were most abundant along the north and south thirds of the transect, while in the middle third they were less abundant.

As mentioned above, no *Ophiothrix spiculata* were observed on RPCs this year. However, in several small areas they were common amongst the cobble/shell substrate, but relatively uncommon compared to last year. *Parastichopus parvimensis* density remained relatively low for this site, 0.17/m².

Strongylocentrotus franciscanus were common with a density of 1.8/m². *S. purpuratus* density (14/m²) continued to decline for the second year. No *Centrostephanus coronatus* were observed on quadrats this year. Juvenile *C. coronatus* were present at this site, but were not as abundant as other sites. *Lytechinus anamesus* were common on the southern end of the transect, but their density was relatively low for this site at 0.15/m². Overall, juvenile *L. anamesus*, *S. franciscanus*, and *S. purpuratus* were rare. Whole *L. anamesus* and *S. purpuratus* tests were common on the southern end of the transect. Both *Pisaster giganteus* and *Asterina (Patiria) miniata* densities declined, similar to what we have observed at other sites. *P. giganteus* were counted on both quadrats (0.0/m²) and 5-meter quadrats (0.02/m²). *Asterina (Patiria) miniata* density decreased to 0.042/m², ending their gradual increase over the last several years. This years density was the lowest recorded since 1985. No sea star wasting disease was observed. Sea urchin wasting syndrome was only observed in three *S. purpuratus* at this site.

Cypraea spadicea continued to decline for the third consecutive year. This years density was 0.13/m², the lowest recorded since 1992, however they remain relatively abundant in the ARMs. *Lithopoma (Astraea) undosum* density declined for the second year, and were notably less abundant along the transect making them relatively difficult to locate for size frequencies. This years density was 0.042/m², the lowest since 1992. *Megathura crenulata* density was similar to the last two years, and again was relatively low at 0.04/m². *Aplysia californica* were relatively abundant for this site (but rare compared to other sites) with a density of 0.021/m², the highest recorded density at this site since monitoring began in 1984. Nudibranchs were relatively abundant. *Hermissenda crassicornis*, *Navanax inermis*, and *Flabellina iodinea* were all common. *Diaulula sandiegensis* were notably abundant on the large rock in the middle of the transect, and were observed mating with eggs present.

Adult *Chromis punctipinnis* were notably less abundant than previous years. On July 22nd about 20 young of year *C. punctipinnis* were observed, this was our first observation of these this year. Juvenile *C. punctipinnis* were more abundant on August 4th. Adult *Paralabrax clathratus* were common and several juveniles were observed. Juvenile and female *Halichoeres semicinctus* were common. Only a few *Oxyjulis californica* were observed. Female and juvenile *Semicossyphus pulcher* were common and several males were observed. Several *Embiotoca jacksoni* and *Damalichthys vacca* were observed. Several rubberlip surfperch, *Rhacochilus toxotes*, were observed on the northern end of the transect as we have observed in past years. Adult and juvenile *Oxylebius pictus* were common, however juveniles

were not as abundant relative to other sites. *Coryphopterus nicholsii* were notably less abundant than the last two years with a density of 0.33/m². *Alloclinus holderi* were common, and relatively abundant for this site with a density similar to last year, 0.71/m². Stripefin ronquils, *Rathbunella hypoplecta*, were common, and could possibly be confused with *Alloclinus holderi*. However, the people conducting quadrats were sure of their identifications. *Lythrypnus dalli* were more abundant than last year with a density of 0.63/m². *Lythrypnus zebra* were relatively abundant. Roving diver fish counts were conducted on July 22 with six divers observing 22 species of fish, and on August 4th with five divers observing 25 species.

All seven ARMs were intact and sampled for all indicator species. Several of the ARMs had moved, and we relocated one to a more stable location. One *Haliotis corrugata* measuring 34mm was found in the seven ARMs. *Crassedoma (Hinnites) giganteum* were more common than last year with 2.4/ARM. *Cypraea spadicea* were common with a mean of 9.3/ARM. *Megathura crenulata* were also relatively common, 1.1/ARM. *Pisaster giganteus* were less abundant than usual with only one found in the ARMs (0.14/ARM), the lowest number since 1994. Although *Asterina (Patiria) miniata* were less abundant than last year, they were still abundant in the ARMs, 9.0/ARM. *Strongylocentrotus franciscanus* abundance was similar to last year (17/ARM) and there was relatively little recruitment. The number of *S. purpuratus* continued to decrease for the fourth consecutive year to 38/ARM. Recruitment of *S. purpuratus* was also low. *Centrostephanus coronatus* density in the ARMs was 0.57/ARM, the highest recorded for this site.

Both the Stowaway and the Hobotemp loggers were working. We compared the data from both units, and the Stowaway was consistently recording 1°C higher than the Hobotemp. This is above the error specifications of the temperature loggers (+/- 0.2 °C). The units were sent to be calibrated by Onset Computer Corp., and the Stowaway was recording data accurately. Only the temperature data from the Stowaway logger was used.

Location: Pelican Bay, Santa Cruz Island

1998 sampling dates: 7/10, 8/5.

1998 status: *Strongylocentrotus purpuratus* barren.

The most notable change at this site was the abundance of “snot weed”, *Acinetospora nicholsoniae*. This filamentous brown algae covered the bottom on the deeper side of the transect, but decreased in abundance immediately along and on the inshore side of the transect line. Miscellaneous brown algae consisting of mostly *A. nicholsoniae* covered 15% of the bottom. Except for *A. nicholsoniae*, the site continues to be barren and dominated by *Strongylocentrotus purpuratus*. The only other macroalgae present was a small amount of the brown algae *Colpomenia* sp. on the tops of rocks and several small patches of *Dictyota/Pachydictyon*. No algae were recorded on quadrats. Articulated coralline algae were

rare covering 0.67% of the bottom. Encrusting coralline algae increased from last year with a coverage of 50%, the highest coverage recorded at this site. Much of the encrusting coralline algae appeared dead, and may not have been counted in previous years. Inversely to encrusting coralline algae coverage, bare substrate coverage declined to 29%.

Barnacles that were abundant on tops or rocks last year were mostly dead. The most abundant miscellaneous invertebrates on RPCs were hydroids. This category covered 2.0% of the bottom, the lowest coverage since 1983. Terebellid worms were common, and were mostly on the deeper side of the transect. *Astrangia lajollaensis* covered 5.0% of the bottom, a decrease in coverage from the last several years. *Serpulorbis squamigerus* were common on the tops of large rocks, however they are typically rare directly along the transect with a coverage of 0.33%. Bryozoans were rare directly along the transect, but were common on the steep sides of large rocks and consisted of mostly *Diaperoecia californica* and *Bugula neritina*. Most of the *Lophogorgia chilensis* were present on the deeper/offshore side of the transect, and small individuals were common, similar to last year. Their density was 0.089/m², similar to previous years.

Strongylocentrotus purpuratus were abundant and dominated the site with a density of 26/m². Their density has remained high for the past five years, but has declined since 1996. *S. franciscanus* density was 2.3/m², similar to previous years. *S. purpuratus* were mostly out in the open, while *S. franciscanus* were confined to crevices. *Lytechinus anamesus* were notably rare along the transect, with only two observed on July 10th. None were observed on band transects this year. Similar to last year, juvenile *Strongylocentrotus* spp. and *L. anamesus* were rare. Large *Centrostephanus coronatus* were common along the transect, and small juveniles were relatively abundant in small crevices in the rocky outcrops. This is the first year they have been observed on quadrats (0.29/m²) since we began monitoring them in 1996. On July 10th, we observed sea urchin wasting disease in 2 of 169 (1.2%) *S. purpuratus*.

There were notably less *Asterina (Patiria) miniata* and *Pisaster giganteus* this year. *A. miniata* density decreased to 0.042/m², their lowest density since 1988. No *P. giganteus* were observed on quadrats, and their density on 5-meter quadrats was 0.005/m². The sea star, *Linckia columbiae*, were common. *Parastichopus parvimensis* were common with a density of 0.21/m².

Crassedoma (Hinnites) giganteus were common with a density of 0.096/m². *Aplysia californica* were less common than last year with a density of 0.0028/m². *Lithopoma (Astraea) undosum* density declined to 0.42/m², the lowest density since 1992. *Kelletia kelletii* density was 0.021/m².

Chromis punctipinnis were abundant. Female and juvenile *Semicossyphus pulcher* were common, but no males were observed. Juvenile and female *Halichoeres semicinctus* were common, but only one male

was observed. No juvenile *Paralabrax clathratus* were observed, but small adults were common and several larger adults were seen. *Rhacochilus toxotes* (rubberlip seaperch) were relatively abundant with both large and medium sized individuals present. *Lythrypnus dalli* were more abundant than last year with a density of $0.75/\text{m}^2$. *Lythrypnus zebra* were common. *Coryphopterus nicholsii* continued to decrease in abundance for the second year, their density was $1.0/\text{m}^2$. *Alloclinus holderi* were relatively abundant with a density of $0.71/\text{m}^2$, similar to last year. The roving diver fish counts were conducted on July 10th with nine divers observing 22 species and on August 5th with six divers observing 20 species.

All six ARMs were sampled for all indicator species. Several of the ARMs cages were deteriorated and were replaced. Similar to past years, the ARMs were relatively bare, except for an abundance of *Spirobranchus spinosus* along the sides. No *Haliotis spp.* were found in the ARMs. *Cypraea spadicea* were common with a mean of 8.5/ARM. Juvenile *Crassedoma (Hinnites) giganteum* were notably more abundant than last year with a density of 6.2/ARM, most were very small measuring less than 20mm. *Asterina (Patiria) miniata* density was 1.8/ARM, a large decrease from last year. No *Pisaster giganteus* were found in the ARMs this year, this the first time since we began monitoring the ARMs here in 1994. The number of *Strongylocentrotus franciscanus* was similar to the past several years with a mean of 17/ARM. Unlike last year most of the *S. franciscanus* were juvenile less than 15mm, indicating recent recruitment. This is the first significant sign of *S. franciscanus* recruitment we have observed at the monitoring sites this year. The number of *S. purpuratus* was similar to last year with a mean of 24/ARM. Juvenile *S. purpuratus* were also more abundant than last year, but less so than *S. franciscanus*. *Centrostephanus coronatus* were relatively abundant with a mean of 2.7/ARM, this is the highest density recorded in the ARMs at this site.

The temperature loggers were missing so there is no temperature data for this site. The housing D-ring was still attached the stake, and was bent slightly. This is the second time the temperature logger has disappeared from this site. We have decided not to replace it this year because of the high public use this area receives.

The lead line and many of the eyebolts at this site need repair.

Location: Scorpion Anchorage, Santa Cruz Island

1998 sampling dates: 8/5, 9/14.

1998 status: *Strongylocentrotus purpuratus* barrens.

This area continues to be barren, dominated by *Strongylocentrotus purpuratus*, and having virtually no macroalgae. On top of the rock towards the 100 meter end of the transect, there were several juvenile

Macrocystis pyrifera, and one subadult nearby. Several small patches of *Dictyota/Pachydictyon*, *Colpomenia*, and *Laurencia pacifica* were observed, but overall these were rare. Aside from coralline algae, and miscellaneous plants, no algae were recorded on RPCs. Miscellaneous plants covered 6.2% of the bottom, and consisted of filamentous brown diatoms. Although this coverage is relatively low compared to other sites, it is the highest coverage recorded at this site for this category. During our second visit on September 14th, the most notable change was an increase in small *Sargassum muticum* plants along the transect. Articulated and encrusting coralline algae covered 1.3% and 67% of the bottom respectively. Bare substrate covered 21% of the bottom. There was no notable deposit of silt at this site that may have been a result of the flooding at Scorpion's Anchorage last winter.

The most common miscellaneous invertebrate on RPCs was the Christmas tree worm, *Spirobranchus spinosus*. This category covered 9.2% of the bottom. *Serpulorbis squamigerus* were common, covering 1.3% of the bottom. Overall, bryozoans were uncommon directly along the transect (0% coverage this year). However, on the sides of large rocks, the bryozoans *Phidolopora pacifica* and *Diaperoecia californica* were common. *Lophogorgia chilensis* were rare, as usual for this site with only several observed along the transect. *Tethya aurantia* density was 0.014/m². The *T. aurantia* were difficult to see because they were covered with silt, discoloring them. Small patches of sandcastle worms, *Phragmatopoma californica*, were common. The small anemone, *Sagartia/Cactosoma* were common.

Strongylocentrotus purpuratus were abundant with a density of 30/m², this is the second year of decline. *S. franciscanus* were common with a density of 1.3/m², similar to the past three years. Few *Lytechinus anamesus* were observed along the transect. None were observed on band transects and only one on quadrats (0.042/m²). *Strongylocentrotus spp.* were out in the open and not confined to crevices. Juvenile *S. franciscanus* and *S. purpuratus* were rare. No active sea urchin wasting disease was observed, however purple urchins that appeared to be re-growing spines (recovering from disease (Richards and Kushner, 1994)) were common. *Asterina (Patiria) miniata* were less abundant than last year with a density of 0.083/m², most were large. This is the lowest density recorded since 1990. *Pisaster giganteus* were rare with none observed on quadrats and 5m-quadrats. *Parastichopus parvimensis* density was 0.083/m², the lowest recorded density at this site since monitoring began in 1982.

Aplysia californica were relatively abundant at this site with a density of 0.42/m. *Megathura crenulata* were much less abundant than previous years, with a density of 0.011/m², the lowest ever recorded for this site. Adult and juvenile *Lithopoma (Astraea) undosum* were abundant with a density of 2.6/m². *Crassedoma (Hinnites) giganteum* were common with a density was 0.079/m². *Panulirus interruptus* were common, and one was observed on band transects (0.0014/m²). By mistake, one of the observers on band transects counted *Ceratostoma nuttalli*. They were counted on 11 of the 12 band transects only on the inshore side of the line. Their density was calculated to be 0.36/m². Below is the raw data:

Transect #	1	2	3	4	5	6	7	8	9	10	11	12
# of <i>Ceratostoma nuttalli</i>	3	26	3	14	18	13	13	3	5	3	13	null

Overall, fish were uncommon at this site. *Chromis punctipinnis*, *Oxyjulis californica*, *Paralabrax clathratus*, *Halichoeres semicinctus*, and adult and juvenile *Hypsypops rubicundus* were all common. Only one male, one female, and one juvenile *Semicossyphus pulcher* were observed. *Coryphopterus nicholsii* were much less abundant than the last several years, and were recorded at their lowest density ($0.083/\text{m}^2$) since 1985. *Alloclinus holderi* were relatively abundant with a density of $0.42/\text{m}^2$, similar to last year. There was evidence of predation on *Lithopoma (Astraea) undosum* that was probably from bat rays, *Myliobatis californica* or horn sharks, *Heterodontus francisci*. Several of the latter were observed. The roving diver fish counts were conducted on August 5th, with six divers observing 17 species, and on September 14th with eight divers observing 22 species of fish. The latter count relatively high diversity for a site that is sea urchin barrens, however most of the fish species were low in abundance.

Six ARMs were sampled for all indicator species. The ARMs were relatively bare and had few indicator species in them. *Cypraea spadicea* were abundant with a mean of 18/ARM, similar to last year. The number of *Crassedoma (Hinnites) giganteum* increased from last year with a density of 4.8/ARM. About 59% were less than 20mm. *Asterina (Patiria) miniata* were rare with only two found in the six ARMs (0.33/ARM). No *Pisaster giganteus* were observed in the ARMs. The mean number of *Strongylocentrotus franciscanus* per ARM was similar to last year at 4.2/ARM. The mean number of *S. purpuratus* continued to decline with a mean of 10/ARM this year. Juvenile (less than 15mm) *S. purpuratus* and *S. franciscanus* were rare indicating little recruitment. One *Centrostephanus coronatus* was found this year.

The temperature logger worked well, and temperature data was downloaded successfully.

Location: Yellowbanks, Santa Cruz Island

1998 sampling dates: 8/3, 8/24, 8/25, 9/17, 9/18.

1998 status: Barren area with high siltation.

This site has changed notably since last year. It is now a ghost forest of dead *Pterygophora californica* and *Eisenia arborea* stalks with mostly a barren bottom. An abundance of silt covered most of the bottom along the transect, and in some areas was several cm. thick. On August 3rd we attempted to locate the site, but were unsuccessful due to zero visibility conditions created by a combination of large south swell and the abundance of silt. Other than a few juvenile *M. pyrifera* plants growing on the tops of the *P. californica*/*E. arborea* stalks, the transect was devoid of *M. pyrifera*. However, on the next reef ridge about

25 meters south of the transect, adult and juvenile *M. pyrifera* were common, but small with none reaching the surface. Most of these plants appeared unhealthy with tattered blades. Several *M. pyrifera* and *E. arborea* plants were present just east of the transect.

No adult or subadult *Macrocystis pyrifera* were observed on 5-meter quadrats. On quadrats, both adult and juvenile *M. pyrifera* were recorded at their lowest density since 1987. Their densities were $0.0/\text{m}^2$ and $0.083/\text{m}^2$ respectively. Only a few live adult *Pterygophora californica* and *Eisenia arborea* plants were within the transect, and only a few juvenile *P. californica* were observed. Adult and juvenile *P. californica* densities were both $0.042/\text{m}^2$, and adult and juvenile *E. arborea* densities were both $0.0/\text{m}^2$. These densities were the lowest since 1987, similar to *M. pyrifera*. No *Laminaria farlowii* was observed along the transect, this is the first year since monitoring began at this site in 1986 that this alga was absent. There were no *M. pyrifera*, *P. californica*, *E. arborea*, or *L. farlowii* recorded on RPCs this year, these were the lowest coverages recorded on RPCs for these algae since monitoring began at this site. *Cystoseira* sp. covered 2.3% of the bottom, its lowest coverage recorded at this site, however it was still common in areas several meters off the transect. Patches of the brown algae *Dictyota/Pachydictyon* were also common. Miscellaneous red algae covered 0.17% of the bottom, also its lowest coverage. Miscellaneous plants was the most abundant plant/algae on the bottom covering 20% of the bottom. This category consisted of diatom film that was present both on rock and silt substrate. Articulated and encrusting coralline algae covered 1.2% and 4.0% of the bottom respectively, the lowest coverages recorded for this site. Encrusting coralline algae dropped from 50% coverage in 1997. Bare substrate was abundant covering 72% of the bottom, by far its highest coverage recorded at this site. Rock substrate coverage increased to 91% and cobble decreased to 1.5%. We think that scouring from large swells created this higher coverage of rock substrate. As mentioned above there was a large amount of siltation at this site.

Miscellaneous invertebrates on RPCs were recorded at 1.2%, their lowest coverage for this site. There were no particular species that composed the majority of this category. Bryozoans were rare and were recorded at their lowest coverage since monitoring began at this site. Miscellaneous bryozoans and *Diaperoecia californica* covered 0.12% and 0.0% of the bottom respectively. *Tethya aurantia* density was recorded at $0.047/\text{m}^2$, the highest recorded for this site. *Lophogorgia chilensis* were more abundant along the southern side of the transect, their density was $0.040/\text{m}^2$. *Muricea californica* and *M. fruticosa* densities were $0.0125/\text{m}^2$ and $0.0028/\text{m}^2$ respectively. Tunicates were rare covering 0.17% of the bottom, the lowest coverage since 1986. Sponges were also rare covering 0.17% of the bottom, their lowest recorded coverage at this site.

Strongylocentrotus franciscanus and *S. purpuratus* densities were similar to last year, $1.9/\text{m}^2$ and $11/\text{m}^2$ respectively. *S. franciscanus* were more common out in the open than last year when they were mostly observed in crevices. Adult *Centrostephanus coronatus* were rare, however small juveniles were

common. *C. coronatus* density was $0.29/\text{m}^2$, the highest density since we began monitoring this species in 1996. *Lytechinus anamesus* were common, and were counted on band transects. Their density was $0.53/\text{m}^2$, and many of them were difficult to see because they were small (mean size 11mm), and most were covered with debris. On August 24th we observed 3 of 133 (2.3%) *L. anamesus* with wasting disease, and on September 17th, two *S. purpuratus* were observed with wasting disease.

Both *Pisaster giganteus* and *Patiria miniata* notably declined in abundance along the transect and were rare with none observed on quadrats and/or 5-meter quadrats. Only one *P. giganteus* and several *A. miniata* were observed over the entire transect. However, in the ARMs both *P. giganteus* and *A. miniata* were common. *Parastichopus parvimensis* were relatively rare for this site. None were found on quadrats ($0.0/\text{m}^2$) and we were only able to find 13 for size frequency measurements. This was the lowest density for this species recorded at this site. No sea star wasting disease was observed this year..

Lithopoma (Astraea) undosum density was $0.33/\text{m}^2$ with both large and small individuals present. *Kelletia kelletii* were relatively abundant with a density of $0.11/\text{m}^2$, the highest recorded density for this site. Many of the *K. kelletii* counted were small, showing a recruitment cohort. *Megathura crenulata* and *Crassedoma (Hinnites) giganteum* densities were $0.0069/\text{m}^2$ and $0.0056/\text{m}^2$ respectively. Two *Haliotis corrugata* were observed on band transects ($0.0028/\text{m}^2$), and five were found during size frequency measurements.

Overall, fish were not very abundant. *Coryphopterus nicholsii* and *Paralabrax clathratus* were the most abundant fish. *C. nicholsii* density was $0.17/\text{m}^2$. *Alloclinus holderi* were rare with a density of $0.042/\text{m}^2$. Very small (probably one year old) female and juvenile *Semicossyphus pulcher* were common. Several *Embiotoca jacksoni*, *Chromis punctipinnis*, *Sebastes atrovirens*, male and female *Halichoeres semicinctus*, *Oxyjulis californica*, *Girella nigricans*, *Damalichthys vacca*, and *Oxylebius pictus* were observed. Roving diver fish count was conducted on August 24th with five divers observing 15 species of fish with good visibility, 13 meters secci. The fish count was also conducted on September 17th with four divers observing 17 species of fish.

Similar to Gull Island, this was the first year that the ARMs at this site have been damaged since they were deployed in 1989. Many of the ARMs were turned over, and had broken bricks. The damage was probably caused by large south swells that affected the southern sides of the Islands during the past year. ARMs that were mostly intact were sample for all indicator species, some with the exception of sea urchins. ARMs that were damaged, but not completely destroyed were sampled for abalone. Destroyed ARMs were rebuilt and cages needing repair were replaced this year.

In the East end group of ARMs, two (#2355 and #2351) were sampled for all indicator species, and three (#2352, #2353, and #2354) were sampled for all indicator species except sea urchins. In the middle

group, three ARMs (#2367, #2369, and #2370) were sampled for all indicator species, the other two ARMs were not intact enough to be sampled. In the West end group of ARMs, three (#2362, #2363, and #2364) were sampled for all indicator species, and two (#2361, and #2365) were sampled for only abalone. Of the five ARMs east of the east end group (off the transect), only two (#2358 and #2360) were intact, these were monitored for abalone. In summary, a total of eight ARMs were monitored for all indicator species (two from the west end, Three from the middle, and three from the west end), and three were monitored for all but sea urchins. Two additional ARMs from the group east of the transect were monitored for only *Haliotis* spp., the remaining three from this group were destroyed.

Three small *Haliotis corrugata* (15, 26, and 27mm) were found in the 15 ARMs monitored for *Haliotis* spp. *Cypraea spadicea* abundance was 5.7/ARM, lower than last year. The mean number of *Crassidoma* (*Hinnites*) *giganteus* was 2.7/ARM, higher than the last several years. Most of the *C. giganteus* were less than 30mm. Small *Pisaster giganteus* were common with a mean of 1.8/ARM, similar to last year. The mean number of *Asterina* (*Patiria*) *miniata* was similar to previous years, 3.4/ARM. *Strongylocentrotus franciscanus* density was similar to the last several years, with a mean of 34/ARM. *S. purpuratus* density declined in the ARMs to a mean of 82/ARM. Within and between the groups of five ARMs, there was high variability in the number of *Strongylocentrotus* spp. in each ARM. This scenario was similar to past years, and we feel that the eight ARMs from the three groups that were sampled for *Strongylocentrotus* spp. provided a good representation of their population in the ARMs. Small *Centrostephanus coronatus* were relatively common with a mean of 0.88/ARM. This is the first year we have observed this species in the ARMs at this site.

Location: Admiral's Reef, Anacapa Island

1998 sampling dates: 6/18, 8/6.

1998 status: *Strongylocentrotus purpuratus* and *Ophiothrix spiculata* (brittle star) barrens.

Overall, this site appeared similar to last year and there has been little change over the past four years. The most notable change occurred along the western 30 meters, which was considered a "kelp forest" last year. This year there was notably less macroalgae than last year. In particular, there were no *Macrocystis pyrifera*, and fewer *Eisenia arborea*. There were no adult or subadult *M. pyrifera* plants within 10 meters of the transect, but just outside of this area, *M. pyrifera* were present in small numbers. Several small patches of juvenile *M. pyrifera* were observed on tops of rocks within the transect, but overall were rare. This is the first year since monitoring began at this site where no *M. pyrifera* was recorded on quadrats, 5-m quadrats, or RPCs. *E. arborea* abundance also decreased this year. No plants were observed on quadrats and coverage on RPCs was only 1.5%. Although, adult *E. arborea* density declined, plants remained common at the western end of the transect on the tops of rocks, and several juveniles were

observed. No *Laminaria farlowii* were observed along the transect, and *Agarum fimbriatum* was absent from the site. *Cystoseira* sp. was rare along the transect, and none was observed during RPCs. Miscellaneous brown and red algae coverage was low, covering 4.5% and 5.2% of the bottom, respectively. Miscellaneous plants covered 7.5% of the bottom and consisted of filamentous diatoms. All algae combined, excluding encrusting coralline algae, covered 20% of the bottom. This is a decrease from last year, and was mostly a result of a decrease in miscellaneous red algae. Articulated and encrusting coralline algae covered 0.67% and 26% of the bottom respectively. Bare substrate was recorded at its highest coverage (38%) for this site since monitoring began. It appears that there has been a decrease in the amount of sand along the transect. Sand decreased to 6.8% (from 14% in 1997), while cobble increased to 12% (from 0.33% in 1997).

The kelp forest located just inshore of the transect, on top of the reef, still had an abundance of *Macrocystis pyrifera* and a moderate understory. However, there was notably less algae this year than in previous years.

The most common miscellaneous invertebrates encountered on RPCs were *Ophiothrix spiculata*, *Spirobranchus spinosus*, hydroids, and gorgonians (mostly *Eugorgia rubens*). *O. spiculata* was counted separately and then added to the miscellaneous category on RPCs. Their abundance noticeably decreased since last year. Miscellaneous invertebrates covered 21% of the bottom, of this only 8.5% were *O. spiculata*, and 12% were other invertebrates. This is a considerable decrease from 1997 when *O. spiculata* covered 34% of the bottom. As usual, the purple gorgonian, *Eugorgia rubens*, was abundant along the transect. Juveniles (<10cm) appeared to be more abundant than usual. *Lophogorgia chilensis*, *Muricea fruticosa*, and *M. californica* were all relatively common with densities of 0.11/m², 0.026/m² and 0.014/m² respectively. *Corynactis californica*, and *Astrangia lajollaensis* were common, covering 1.0% and 1.5% of the bottom respectively. Bryozoans combined covered 2.3% of the bottom.

Similar to the last three years, *Strongylocentrotus purpuratus* and the brittle star, *Ophiothrix spiculata*, dominated the eastern 2/3rds of the transect. Although *S. purpuratus* densities have remained similar over the last three years, *O. spiculata* abundance declined this year as mentioned above. *S. franciscanus* density was 5.1/m² and have declined for the past two years. Juvenile *S. franciscanus* and *S. purpuratus* were very rare indicating little recruitment. On June 18th, we observed several *S. purpuratus* spawning aboard the Pacific Ranger while conducting size frequency measurements on collected animals. *Lytechinus anamesus* were rare with only 2 (0.0028/m²) observed during band transects. This is the lowest density recorded at this site since 1984. *Centrostephanus coronatus* adults were common and juveniles were relatively abundant with a density of 0.96/m², the highest recorded density since we began monitoring this species in 1996. The large number of juveniles present implies high recruitment this year. Sea urchin wasting syndrome was observed in *S. purpuratus* and *S. franciscanus* on both our visits this

summer. During size frequency measurements we calculated that 4.7% (18/382) of the *S. purpuratus* and 4.9% (13/267) of the *S. franciscanus* showed signs of wasting syndrome. Whole *S. purpuratus* and *S. franciscanus* tests were common indicating recent mortality, likely caused by wasting syndrome.

Pisaster giganteus were rare, and density decreased, with only one observed on the 5-m quadrats ($0.0050/\text{m}^2$). *Asterina (Patiria) miniata* density also decreased, but were still common with a density of $0.25/\text{m}^2$. *Parastichopus parvimensis* density has decreased over the last two years, this years density was $0.96/\text{m}^2$.

Crassedoma (Hinnites) giganteus were common on the steep inshore side of the transect, their density on band transects was $0.11/\text{m}^2$. *Megathura crenulata* were rare along the transect, and their density declined to $0.0028/\text{m}^2$, this is the lowest since 1993. *Aplysia californica* were abundant with a density of $0.29/\text{m}^2$, most were small. This was the highest density for *A. californica* recorded at this site since monitoring began. *Kelletia kelletii* density was $0.0083/\text{m}^2$. No *Haliotis corrugata* were observed during band transects, this is the fourth consecutive year that none were found. We conducted a good search for *Haliotis spp.* size frequencies, and none were observed within the transect. This is the first year we have been unable to find live *Haliotis spp.* on this transect. Only one *H. corrugata* was observed in the shallower areas above the transect. Three *Panulirus interruptus* were found during band transects ($0.0042/\text{m}^2$).

Overall, fish did not appear as diverse and abundant as last year at this site. *Chromis punctipinnis*, *Medialuna californiensis* and *Girella nigricans* were all common. *Oxyjulis californica* were observed in small groups, usually less than 10. Similar to last year, during the roving diver fish count conducted on June 18th, no one observed more than one hundred *O. californica*, but they were more abundant on August 6th. Female *Halichoeres semicinctus* were moderately abundant but were small and probably young of year. They were often observed in small groups of about 10, and only one male was observed. Female *Semicossyphus pulcher* were common but no one observed more than 10 during the roving diver fish counts. Two small males were observed, and juveniles were more abundant than in previous years. After the fish counts were conducted we observed at least seven juvenile *S. pulcher* around the ARMs during sampling. One *Gymnothorax mordax* (California moray eel) was observed. Both adult and juvenile Painted greenlings, *Oxylebius pictus*, were common. *Coryphopterus nicholsii* were notably less common with a density of $0.25/\text{m}^2$. *Alloclinus holderi* were relatively abundant for this site with a density of $0.63/\text{m}^2$, similar to last year. Three *Lythrypnus dalli* were observed on quadrats ($0.13/\text{m}^2$). Several adult yellowtail, *Seriola lalandi* were observed near the bottom and nine juveniles were observed near the surface. One giant black sea bass, *Stereolepis gigas*, was observed. The latter two fish were not observed during the roving diver fish count. The Roving diver fish count was conducted on June 18th with five divers observing

17 species, and on August 6th with five divers observing 19 species. This is a relatively low diversity of fish for this site.

Similar to the other sites on the south sides of the Islands, the ARMs moved around presumably by large south swells over the past year. Two of the ARMs were upside down, these were righted, two were intact and upright, two appeared as if they were smashed by a large object, and will need to be rebuilt, and one ARM case was missing with its bricks scattered about the bottom. Five ARMs were monitored for all indicator species, one ARM was rebuilt, and another ARMs worth of bricks are scattered about the bottom. We did not have enough materials to repair the latter ARM.

The mean number of *Cypraea spadicea* was 3.2/ARM, higher than last year. The mean number of *Crassidoma (Hinnites) giganteum* was 2.6/ARM. The mean number of *Asterina (Patiria) miniata* per ARM ended its gradual increase over the past three years. This year's density was 8.2/ARM, about half of last year. No *Pisaster giganteus* were found in the ARMs, similar to last year. The number of *Strongylocentrotus franciscanus* ended its decline and increased to 33/ARM. Juveniles were common with 37% less than 15mm. The number of *S. purpuratus* continued to decline in the ARMs with 26/ARM this year. Juvenile *S. purpuratus* were less abundant than juvenile *S. franciscanus* with 20% less than 15mm. *Centrostephanus coronatus* were abundant in the ARMs with 4.4/ARM, the highest density recorded at this site. One black urchin, *Arbacia incisa*, measuring 10mm was found in a ARMs.

The temperature loggers were working, and we successfully downloaded 12 months of temperature data.

Location: Cathedral Cove, Anacapa Island

1998 sampling dates: 6/19, 7/23.

1998 status: Developing kelp forest / open area.

During the summer, this site was the most barren it has been in years. No *Macrocystis pyrifera* canopy cover was present over the transect. However, just southeast of the southeastern end of the transect there were canopy forming *M. pyrifera* plants in moderate numbers. Overall, the northwestern half of the transect was more barren than the southeastern half. Adult, subadult, and juvenile *M. pyrifera* densities were 0.045/m², 0.21/m², and 0.33/m² respectively, and coverage was 1.0%. All of these densities and coverage were at or near their lowest levels recorded for this site since monitoring began in 1984. Subadult and juvenile *M. pyrifera* were more abundant along the southeastern half of the transect. No adult or juvenile *Laminaria farlowii* were observed on quadrats this year, however adults were common along the deeper side of the transect. *L. farlowii* coverage on RPCs was 0.5%, the lowest since 1990. *Cystoseira Spp.* was less abundant than last year, covering 2.3% of the bottom, the lowest coverage since

1990. Miscellaneous brown algae covered 5.0% of the bottom. Much of this category was *Dictyota/Pachydictyon* and *Colpomenia spp.* Miscellaneous plants covered 23% of the bottom, by far the highest coverage recorded at this site. This entire category consisted of the filamentous brown diatoms that have been abundant at many of the other kelp forest monitoring sites this year. Articulated coralline algae were less abundant than the last four years, covering 17% of the bottom. Encrusting coralline algae covered 50% of the bottom. Bare substrate covered 27% of the bottom. The large cobble area inshore of at about 30 meters along the transect was mixed barren and developing kelp forest.

The most common miscellaneous invertebrates on RPCs were *Spirobranchus spinosus*. This category, decreased from last year, and covered 3.7% of the bottom. Bryozoans were less common than last year, combined they covered 1.0% of the bottom, the lowest coverage since 1986. Only two *Lophogorgia chilensis* were observed along the entire transect (not unusual for this site), one was observed in band transects (0.0014/m²).

Strongylocentrotus franciscanus and *S. purpuratus* densities were 3.3/m² and 3.0/m² respectively. Only one small *S. franciscanus* was observed with wasting syndrome. Overall, *S. franciscanus* were relatively large at this site, with a mean size of 79mm. Juvenile *S. franciscanus* and *S. purpuratus* were rare. During our June 19th visit we observed a small “front” of *S. purpuratus* and *S. franciscanus* feeding on *M. pyrifera* holdfasts. These plants were gone during our July 23rd visit, and no *Strongylocentrotus spp.* fronts were observed. Juvenile *Centrostephanus coronatus* were relatively common for this site. One was observed in quadrats (0.042/m²). Although densities were already low, there were notably less *Asterina (Patiria) miniata* than last year. None were observed on quadrats this year. Similar to previous years Juvenile *A. miniata* were common under rocks and in the ARMs. *Pisaster giganteus* were rare. *Parastichopus parvimensis* density was 1.7/m².

Panulirus interruptus density was of 0.0083/m², and many of the *P. interruptus* were relatively large (larger than the legal harvestable size of 3.25”). Large and small (juvenile) *Lithopoma (Astraea) undosum* were abundant with a density of 4.1/m². This site and Landing Cove are the only two sites where we have observed large numbers of juvenile *L. undosum*. *Crassedoma (Hinnites) giganteum* density was 0.074/m², and were mostly along the inshore side of the transect. *Aplysia californica* were relatively abundant for this site with a density of 0.083/m², the highest recorded density at this site since monitoring began in 1984. Four large black sea hares, *Aplysia vaccaria*, were observed this year. They were observed mating and laying eggs. Two *Haliotis corrugata* were observed on band transects (0.0028/m²). There were less *H. corrugata* this year, and we only found four during size frequency measurements even though a good search effort was conducted along the entire transect was conducted. We found two small (approximately 30 mm) *Haliotis cracherodii* shells that appeared relatively fresh, indicating some recruitment probably in the mussel beds above the transect. On July 23rd, we found five *H. corrugata*

shells along the transect. These were measured, but information regarding the age of the shells was not recorded, so we decided to record all of the shells as old when they were entered in the database.

One *Polycera alabe* (a nudibranch) was found along the transect. This species of nudibranch is a more southern species who's range usually doesn't extend north of Isla Cedros, Baja California (Bertsch, 1973). We video taped this nudibranch for documentation, as this may be a range extension for this species. The nudibranch, *Navanax inermis*, and bubble snail, *Haminoea sp.*, were relatively abundant.

Girella nigricans, *Paralabrax clathratus*, adult and juvenile *Chromis punctipinnis*, adult and juvenile *Embiotoca jacksoni*, adult and juvenile *Hypsypops rubicundus*, male, female and juvenile *Halichoeres semicinctus* and female *Semicossyphus pulcher* were all common along the transect. One male and several juvenile *S. pulcher* were observed. Small groups (<15) of female/juvenile *Halichoeres semicinctus* were common in the shallower areas of the transect. No tagged *Hypsypops rubicundus* were observed this year. Several *Sebastes atrovirens* were observed. *Coryphopterus nicholsii* were uncommon with a density of 0.042/m². *Alloclinus holderi* were relatively abundant for this site with a density of 1.8/m². This is the highest density recorded at this site since monitoring began for this species in 1985. One California moray eel, *Gymnothorax mordax*, was observed. *Heterodontus francisci* (horn sharks) and *Cephaloscyllium ventriosum* (swell sharks) were common. Overall, there was a moderate amount of diversity of fish, but their abundance appeared relatively low for this site. The roving diver fish count was conducted on June 19th with seven divers observing 19 species of fish, and on July 23rd with seven divers observing 23 species of fish.

The ARMs moved around a little during the past year, and at least one was upside down. This is not uncommon for this site. We sampled six ARMs for all indicator species. The seventh ARM was not sampled due to disrepair. Only one *Haliotis corrugata* measuring 31 mm was found in the six ARMs. The number of *Crassedoma (Hinnites) giganteum* in the ARMs was the lowest since 1993, this year there were 1.7/ARM. *Cypraea spadicea* density was 8.8/ARM. *Lithopoma (Astraea) undosum* were common at 4.3/ARM. *Asterina (Patiria) miniata* were less abundant than last year with 5.8/ARM. Most of the *A. miniata* were small with a mean size of 23mm. Similar to other sites with ARMs, *Pisaster giganteus* were less abundant than past years with 0.33/ARM. These were also small with a mean size of 29mm. *Strongylocentrotus franciscanus* and *S. purpuratus* were much less abundant in the ARMs than last year. Their mean per ARM was 24/ARM and 44/ARM respectively. Juveniles of both species were relatively uncommon. *Centrostephanus coronatus* were relatively abundant with 1.8/ARM, their highest recorded abundance in the ARMs at this site.

One Black urchin, *Arbacia incisa*, measuring 10 mm was found in an ARM. This species of sea urchin is a more southern species.

The temperature loggers were working and we successfully downloaded approximately 11 months of data.

Location: Landing Cove, Anacapa Island

1998 sampling dates: 7/23, 7/24, 8/7, 8/28.

1998 status: Open kelp forest.

Except for the deeper area in the middle of the transect, there were fewer *Macrocystis pyrifera* plants than the past several years. However, the high density along this part of the line resulted in an overall increase of *M. pyrifera* density. Few *M. pyrifera* plants were large enough to reach the surface, creating no canopy cover above the transect. Lack of canopy cover is not uncommon at this site due to heavy boat traffic in the Cove. Adult, subadult and juvenile *M. pyrifera* densities were 0.12/m², 0.79/m², and 0.92/m² respectively, and covered 22% of the bottom. There was noticeably less *M. pyrifera* on top of the reef at the eastern end of the transect. On August 7th, about two weeks after our first visit, we observed that the adult and subadult *Macrocystis pyrifera* were notably less healthy, with most plants having tattered fronds. There also appeared to be fewer single blade *M. pyrifera* recruits. This years *M. pyrifera* data from this site is a good example how the 5-meter quadrat protocol works well to show demographics of *M. pyrifera*. If only the quadrat data was available, it would appear as if there is an abundance of adult *M. pyrifera* at the site. However, the 5-meter quadrats indicate that most of these plants over one meter tall are subadults/recent recruits and not adult plants.

Eisenia arborea at this site is usually most abundant on top of the reef at the eastern end of the transect, this year there were notably less. Adult and juvenile *E. arborea* densities were 0.25/m² and 0.13/m² respectively, and covered 15% of the bottom. Adult and juvenile *Laminaria farlowii* were also less abundant this year with densities of 0.21/m² and 0.46/m² respectively, and a coverage of 4.0%. This is the lowest coverage recorded at this site since 1984. Miscellaneous brown algae covered 16% of the bottom, it highest coverage since 1984. The diver who conducted RPCs could not remember the species of algae that composed this category. *Cystoseira* spp. covered 5.8% of the bottom. *Gelidium* spp. (mostly *G. purpurescens*) coverage was 17%. This entire category was on top of the reef at the eastern end of the transect. Miscellaneous plants were relatively abundant (similar to other sites this year) covering 24% of the bottom, the highest coverage recorded at this site. This category consisted entirely of filamentous brown diatoms. Articulated and encrusting coralline algae covered 22% and 61% of the bottom respectively. This was the highest coverage for encrusting coralline algae since 1985. Bare substrate covered 18%, similar to past years.

The most common miscellaneous invertebrate on RPCs was *Spirobranchus spinosus*. This category covered 14% of the bottom. Bryozoans were common growing epiphytically on the *Gelidium purpurescens* and the other red algae on top of the shallow/eastern end of the transect. Bryozoans combined, covered

2.7% of the bottom, a decrease from last year. Tunicates, and *Corynactis californica* were present mostly on the shallow/eastern end of the transect, and covered 1.7% and 1.8% respectively.

Asterina (Patiria) miniata were rare as usual for this site with none observed in quadrats this year. *Pisaster giganteus* were also rare and were counted on both quadrats and 5-meter quadrats, their respective densities were 0.0/m² and 0.0050/m². *Strongylocentrotus franciscanus* and *S. purpuratus* were common with densities of 3.3/m² and 1.7/m² respectively. Juvenile *S. purpuratus* and *S. franciscanus* were rare. *Parastichopus parvimensis* were common with a density of 0.67/m². No sea star wasting disease or sea urchin wasting syndrome were observed at this site.

Lithopoma (Astraea) undosum were common with a density of 1.1/m². *Crassedoma (Hinnites) giganteum* were abundant along the vertical walls as is usual for this site, their density was 0.45/m². Similar to other sites this year, *Aplysia californica* were relatively abundant with a density of 0.040/m², the highest recorded density at this site.

Haliotis corrugata were less abundant than last year with a density of 0.097/m². This is the second lowest density recorded at this site. It is possible this was an artifact of sampling caused by patchiness, however, fewer *H. corrugata* were found along the transect for size frequency measurements than in previous years. A good search effort was made for size frequency measurements within the transect area, only 13 were found. On July 24th three fresh *H. corrugata* shells (37, 169, and 170mm) and on August 28th three fresh shells (41, 158, and 173mm) were found along the transect, indicating recent mortality. On July 24th, we found eight *H. corrugata* shells along the transect. These were measured, but information regarding the age of the shells was not recorded, we believed that most or all of the shells were “old”, and all were entered as “old” in the database.

Fish were moderately abundant and often large as is usual for this site. Adult *Chromis punctipinnis*, adult and juvenile *Hypsypops rubicundus*, adult *Paralabrax clathratus*, adult *Medialuna californiensis*, and adult *Girella nigricans* were all common, especially on top of the reef at the eastern end of the transect. Last year, we observed many juvenile *H. rubicundus* in this area, it appears that many of these survived, but there has been some mortality or emigration. Several of the *P. clathratus* were notably large. Several male and female *Semicossyphus pulcher* were observed. Small *S. pulcher* females were common that appear to have recently lost their juvenile markings, and there were only a few juveniles present. Juvenile *Heterostichus rostratus* were common among the *M. pyrifera* fronds. One yellowtail, *Seriola lalandi*, and one ocean whitefish, *Caulolatilus princeps* were observed. *Coryphopterus nicholsii* were common in the deeper areas of the transect with a density of 0.17/m². *Alloclinus holderi* were abundant with a density of 1.8/m², the highest recorded density for this site. *Lythrypnus dalli* and *Lythrypnus zebra* were relatively abundant along the wall, several meters from the transect line. No *L. dalli* were observed on quadrats. Roving diver fish

counts were conducted on July 23rd with six divers observing 23 species and on August 7th with six divers observing 25 species.

During both of the fish counts, two Guadalupe cardinal fish, *Apogon atricaudus*, were observed in a “shallow cave” at the base of the reef at about the 30 meter mark on the southeastern end of the transect.

Several of the ARMs moved about 20 meters away from where they were last year, but were still intact although several were upside down. All seven of the ARMs were monitored for all indicator species. No *Haliotis* spp. were found in the ARMs. We found at least seven small (<20mm) *Kelletia kelletii* in the ARMs. Unfortunately, we initially did not think these were *K. kelletii*, and instead another species, consequently they were not measured. *Crassedoma (Hinnites) giganteum* mean abundance in the ARMs was 2.1/ARM, and most were small (<20mm). *Cypraea spadicea* were common with 4.4/ARM, similar to past years. *Asterina (Patiria) miniata* were much less abundant than last year. This year's mean was 2.0/ARM and most were less than 20mm. *Pisaster giganteus* were rare and only one was found in the seven ARMs (0.14/ARM). *Strongylocentrotus franciscanus* were much more abundant than last year with a mean of 87/ARM, 67% of these were less than 15mm indicating high recruitment this year. *S. purpuratus* were less abundant this year with a mean of 73/ARM. Only 18% of these were less than 15mm, indicating some recruitment, but not as high as *S. franciscanus*. *Centrostephanus coronatus* were relatively abundant in the ARMs with a mean of 4.1/ARM, the highest density recorded at this site. All were less than 25mm, this species of sea urchin grows faster than the *Strongylocentrotus* spp., and animals less than 25mm are probably less than a year old (Shane Anderson pers. comm.).

Location: Southeast Sea Lion, Santa Barbara Island

1998 sampling dates: 6/15, 6/16, 9/29.

1998 status: *Strongylocentrotus purpuratus* barren.

Although sea urchin density has decreased, this site continues to be a barren dominated by *Strongylocentrotus purpuratus*, similar to last year. Macroalgae continued to be virtually absent along the transect. No algae was observed on quadrats. There were several small patches of (about 10) juvenile *Macrocystis pyrifera* plants along the transect. Only one juvenile *Eisenia arborea* was observed. Small *Desmarestia* sp. plants were common. The most common macroalgae along the transect was *Dictyota/Pachydictyon*, and these plants were not very abundant for this site. *Codium setchellii* was relatively abundant on the tops of rocks. Not including coralline algae, algae combined covered 24% of the bottom, similar to last year. However, the composition changed. There was little miscellaneous red algae (0.83%), and a increase in miscellaneous plants that consisted mostly of filamentous diatoms. The latter category covered 21% of the bottom, composing most of the plants/algae on the bottom. Encrusting

coralline algae was abundant covering 53% of the bottom. Articulated coralline algae were rare, and none were observed during RPCs, the lowest coverage recorded for this site. Bare substrate covered 18% of the bottom. The most notable change at this site on our September visit was the increase in the filamentous red alga *Polysiphonia* sp.. This alga was moderately abundant growing on hard substrate over much of the transect. This alga was often growing on *Tethya aurantia* making them difficult to find for size frequency measurements.

The miscellaneous invertebrate category on RPCs covered 16% of the bottom, similar to last year. The most common miscellaneous invertebrates were the small unidentified anemone believed to be *Cactosoma arenaria* or *Sagartia catalinensis*, hydroids and gorgonians. *C. arenaria*/*S. catalinensis* were more abundant along the northern half of the transect. *Balanophyllia elegans* and *Astrangia lajollaensis* covered 0.17% and 8.8% of the bottom respectively. This is an increase for *A. lajollaensis*, but could be a sampling effect due to the patchiness of this species. Tunicates were notably more abundant than last year. This year's coverage was 7.2%, and consisted mostly of *Pycnoclavella stanleyi*. Bryozoans combined covered 0.83%. *Tethya aurantia* were abundant with a density of 0.16/m², their highest density recorded for this site, many of the *T. aurantia* were small. *Lophogorgia chilensis* were relatively abundant with a density of 0.29/m², their highest recorded coverage for this site. Similar to last year, small (<15cm in height) *L. chilensis* were abundant, and made up 21% of the ones measured for size frequencies. As usual for this site, *Muricea californica* were more abundant than *M. fruticosa*. Their densities were 0.028/m² and 0.0056/m² respectively. The temperature logger housing was 95% covered with *Spirobranchus spinosus* and a few barnacles, similar to last year.

Strongylocentrotus purpuratus density continued to decrease for the third consecutive year, but still dominated this site at 20/m². This is a 50% decrease from last year, and we believe mortality was caused by sea urchin wasting disease. *S. franciscanus* were common with a density of 1.3/m², also about a 50% decrease from last year. Juvenile *S. franciscanus* and *S. purpuratus* continued to be uncommon for the third year. *Lytechinus anamesus* were common with a density of 1.8/m² on band transects. In general, sea urchins were out in the open and not confined to crevices. Large *Centrostephanus coronatus* were relatively common, juveniles were abundant in small crevices and under rocks. *C. coronatus* density was 1.1/m², the highest density recorded since we began monitoring them in 1996. Their abundance and small size suggests that this increase is a result of recent recruitment. No Sea urchin wasting syndrome was observed.

Two small black sea urchins, *Arbacia incisa* were found along the transect.

Asterina (Patiria) miniata were common, but less abundant than last year with a density of 0.17/m². *Pisaster giganteus* were common with densities of 0.21/m² and 0.10/m² on quadrats and 5-meter quadrats respectively. *Parastichopus parvimensis* were common with a density of 0.50/m². The brittle star,

Ophiothrix spiculata was observed, but did not appear as abundant as last year. Only one *A. miniata* was observed with sea star wasting disease this summer.

Lithopoma (Astraea) undosum were common, and increased in abundance this year, ending their decrease over the last two years. This year's density was $0.75/\text{m}^2$. *Kelletia kelletii* were rare with a density of $0.0028/\text{m}^2$. *Megathura crenulata* were rare along the transect with a density of $0.0014/\text{m}^2$, similar to last year. No live *Haliotis* spp. were observed. This is the fourth consecutive year that no live *Haliotis* spp. were found along the transect. Several large old *H. corrugata* shells were present along the transect, but not collected. Small *Aplysia californica* were much more abundant than last year with a density of $0.24/\text{m}^2$. The turban snails, *Tegula eiseni* were common. The nudibranch, *Navanax inermis*, was common.

There was a overall low abundance and diversity of fish at this site. As usual, there were more fish present on the southeast end of the transect. *Chromis punctipinnis* and *Oxyjulis californica* were common. Several adult *Hypsypops rubicundus* were observed along the transect, but no juveniles were seen. During the roving diver fish count on June 16th all of the divers observed less than 10 *Semicossyphus pulcher*, this is a relatively low number for this site, but similar to last year. Several male *S. pulcher* were observed, and all were small for males of this species. Juvenile *S. pulcher* were relatively common. *Paralabrax clathratus* were rare along the transect and none of the divers participating on the roving diver fish count on June 16th observed more than one. Several *Girella nigricans* and *Scorpaena guttata* (California scorpionfish) were observed. Surprisingly, *Halichoeres semicinctus* were rare with only one female and one male observed during the roving diver fish count on June 16th. Similar to last year, *Oxylebius pictus* (painted greenlings) were rare, however, several very small juveniles (estimated at less than 4cm) were observed. No *Lythrypnus dalli* were observed along the transect. *Coryphopterus nicholsii* density was $0.29/\text{m}^2$. Similar to last year, *Alloclinus holderi* were abundant with only a slight decrease in density from last year. This year's density was $1.1/\text{m}^2$, and there did not appear to be as many small juveniles as last year. On June 16th, the roving diver fish count was conducted with four divers observing 13 species, and on September 29th with six divers observing 16 species. Most of the fish observed had relatively low abundance.

The temperature logger was working and we successfully downloaded approximately nine months of temperature data. About two weeks of data are missing from the graph in appendix L. this data was missing due to logger malfunction last year.

Location: Arch Point, Santa Barbara Island

1998 sampling dates: 6/16, 6/17, 9/29.

1998 status: *Strongylocentrotus purpuratus* barrens/developing kelp forest.

This site is rapidly changing, and is probably a result of decreasing *Strongylocentrotus purpuratus* density. The northern half (55 meters) of the transect has a higher abundance of *S. purpuratus* and appears typical of a sea urchin barren, except for the tops of some rocks where there were an abundance of encrusting invertebrates and some red and brown algae. The southern half (45 meters) had a lower abundance of *S. purpuratus*, and had the appearance of a developing kelp forest.

No macroalgae was recorded on quadrats this year. *Macrocystis pyrifera* coverage on RPCs was 0.17%. Although low, this was the first time since 1994 that *M. pyrifera* was present along the transect. One subadult *M. pyrifera* was observed on 5-meter quadrats ($0.005/\text{m}^2$). Overall, juvenile and small (about 2 m) subadult *M. pyrifera* were rare immediately along the transect, but common on the offshore side of the transect at least five meters away from the lead line. Juvenile *Eisenia arborea* were also common in this area. Along the southern half of the transect, *Sargassum* sp. was common and many of the plants were large. Miscellaneous green, brown and red algae coverage was 2.3%, 4.7%, and 1.0%, respectively. This was an increase in green and brown algae and a decrease in red algae. The decrease in red algae was a result of less filamentous red algae. The other plant category also decreased and was recorded at 3.8% (from 16% in 1997). The decrease was a result of fewer filamentous brown diatoms. Articulated coralline algae notably increased to a coverage of 14%. This is the highest coverage since 1994, and was mostly on the southern half of the transect. Bare substrate coverage declined to 11%, about half of last years. Rock substrate was recorded at its highest coverage, 97%. The increase is associated with a equivalent decrease in cobble and may have been a result of patchiness of rock/cobble substrate, and/or an actual change in substrate composition at the site.

The most common miscellaneous invertebrates on RPCs were hydroids and *Spirobranchus spinosus*. This category covered 16% of the bottom, the highest recorded coverage at this site. *Phragmatopoma californica* covered 7.7% of the bottom, the highest coverage since 1985. It is interesting to note that the two years *P. californica* was abundant at this site followed El Niño events. Most of the *P. californica* was present on the southern half of the transect. *Corynactis californica* were rare and the first time none were observed during RPCs. Tunicates were more common than the last several years covering 4.2%. The most common tunicate was *Pycnoclavella stanleyi*, similar to southeast sea lion. Sponges were relatively common for this site with a coverage of 0.83%. Coverage of bryozoans continued to be low, covering 0.17% of the bottom. However, the bryozoan, *Thalamoporella californica* was common on the tops of rocks. *Lophogorgia chilensis*, *Muricea fruticosa*, and *M. californica* were all present, but at low densities.

Strongylocentrotus purpuratus density continued to decline for the third consecutive year. This years density was $19/\text{m}^2$ (a decline from $58/\text{m}^2$ in 1997), the lowest since 1993. As mentioned above, *S. purpuratus* were much more abundant along the northern half of the transect. *S. franciscanus* density was $2.9/\text{m}^2$ and has changed little over the last three years. Juvenile *S. purpuratus* and *S. franciscanus*

were rare. The mean size of *S. purpuratus* has gradually increased in size since 1995, and had a mean of 28mm this year. *Lytechinus anamesus* were rare with a density of $0.0083/\text{m}^2$. Similar to Southeast sea lion, juvenile *Centrostephanus coronatus* were relatively abundant while larger adults were common. *C. coronatus* density was $0.79/\text{m}^2$, the highest since monitoring of this species began in 1996. Only one *S. franciscanus* was observed with wasting disease this summer. We believe that *S. purpuratus* densities decreased at this site from the sea urchin wasting syndrome that was prevalent last year.

Asterina (Patiria) miniata were rare and none were observed on quadrats. *Pisaster giganteus* were common and were counted on both quadrats and 5-meter quadrats. Their respective densities were $0.17/\text{m}^2$ and $0.035/\text{m}^2$. *Parastichopus parvimensis* were relatively uncommon with a density of $0.04/\text{m}^2$, the lowest recorded for this site. No sea star wasting disease was observed.

Aplysia californica density was $0.12/\text{m}^2$, similar to last year. *Lithopoma (Astraea) undosum* density was similar to last year at $0.42/\text{m}^2$, this is a relatively low for this site. *Crassedoma (Hinnites) giganteus* were common with a density of $0.015/\text{m}^2$. The turban snails, *Tegula aureotincta*, and *T. eiseni* were moderately abundant. The nudibranch, *Navanax inermis*, and bubble snail, *Haminoea vesicula*, were relatively abundant.

As usual for this site, adult *Hypsypops rubicundus* were abundant, while juveniles were common. *H. rubicundus* nests were common, and one tagged *H. rubicundus* was observed. *Chromis punctipinnis*, *Paralabrax clathratus*, *Medialuna californiensis*, female *Semicossyphus pulcher*, and *Oxyjulis californica* were all common. Only one male *S. pulcher* was observed, and juveniles were relatively common. Female *Halichoeres semicinctus* were common and only one male was observed. Several *Girella nigricans* were observed. Similar to the other two sites at this island, *Alloclinus holderi* remained abundant, but with a decrease in their density from last year. This years density was $2.1/\text{m}^2$, and there were fewer juveniles than last year. *Coryphopterus nicholsii* were rare with none observed in quadrats this year. Roving diver fish counts were conducted on June 16th with five divers observing a total of 19 species, and on September 19th with eight divers observing 23 species.

The temperature logger was missing from this site. It appears that the housing was torn off the stake from some sort of physical force.

Location: Cat Canyon, Santa Barbara Island

1998 sampling dates: 6/17, 9/29, 9/30.

1998 status: *Strongylocentrotus franciscanus* and *S. purpuratus* barrens.

Although sea urchin densities declined, this site remains a sea urchin barren similar to last year. No *Macrocystis pyrifera* plants were present along the transect this year, however several small patches of plants were observed just outside of the transect area. No *M. pyrifera* was observed on quadrats this year, this was the first year since monitoring began at this site in 1986. No macroalgae was observed on quadrats this year. The most abundant algae along the transects was miscellaneous plants. Similar to last year, this category covered 19% of the bottom, and consisted of filamentous diatoms. There was a notable decrease in filamentous red algae from last year. Miscellaneous red algae coverage was 3.0%, and consisted mostly of filamentous algae. The brown algae, *Dictyota/Pachydictyon* was common in small patches on the tops of rocks. Articulated coralline algae were more abundant at the western end of the transect, and continued to decrease for the third consecutive year. This years coverage was 1.0%, its lowest coverage recorded at this site. Encrusting coralline algae increased to 65%, its highest recorded coverage recorded for this site. Bare substrate covered 21% of the bottom.

The areas to the west and north (inshore) of the transect which had “healthy” kelp forests last year, now only have small remnants of these forests. These areas only had a few *M. pyrifera*, *Cystoseira* sp. and *Laminaria farlowii* plants remaining.

Overall, there were few encrusting invertebrates along the bottom. Miscellaneous invertebrate coverage on RPCs was similar to last year at 5.0%, and consisted mostly of the worm, *Spirobranchus spinosus*. *Phragmatopoma californica* coverage continued to be low, with none observed on RPCs. Bryozoans continued to decline and were rare with a coverage of 0.83%, their lowest coverage since 1986. Tunicate coverage remained low for this site at 0.67%, also the lowest coverage since 1986.

The entire transect was sea urchin barrens. *Strongylocentrotus franciscanus* density declined, but were still abundant with $7.5/\text{m}^2$, and dominated the site. *S. purpuratus* declined greatly to $4.3/\text{m}^2$, the lowest density recorded at this site since monitoring began in 1986. Most of the *S. franciscanus* and *S. purpuratus* were out in the open, not confined to crevices. Juvenile *S. purpuratus* and *S. franciscanus* were rare. Sea urchin wasting syndrome was prevalent in both *S. franciscanus* and *S. purpuratus*, but more so in *S. franciscanus*. On June 17th, we estimated that 10-20% of the *Strongylocentrotus* spp. showed signs of wasting syndrome. It was evident from our June 17th visit, that this syndrome was actively causing mortality by the presence of newly dead and completely spineless sea urchins. Whole sea urchin tests were common from both species. There was a notable increase in prevalence of sea urchin wasting disease on our second visit to this site on September 30th. On this visit we estimated that at least 50% of the *S. purpuratus* and about 20% of the *S. franciscanus* showed signs of disease. Whole tests, mostly of *S. purpuratus* were common, indicating recent mortality. In comparisons to these visual estimates, we counted the number of *S. purpuratus* and *S. franciscanus* that showed signs of wasting disease during size frequency measurements on September 29th. On this date, 6/138 (4.3%) of the *S.*

franciscanus, and 66/197 (34%) of the *S. purpuratus* showed signs of wasting disease. Although these are lower percentages than our estimates, one must note that there are distinct patches of sea urchins where the disease is more prevalent.

Juvenile *Centrostephanus coronatus* were relatively common for this site, but not as abundant as the other sites on this Island. *C. coronatus* density was recorded at 0.21/m², and was the first time they were observed on quadrats since we began monitoring them in 1996.

As usual, *Asterina (Patiria) miniata* were rare at this site. None were found during quadrats, and only several were observed along the transect. *Pisaster giganteus* were less common than usual with none observed on quadrats and a density of 0.03/m² on 5-meter quadrats. *Parastichopus parvimensis* were common with a density of 0.42/m². Of 43 *P. giganteus* observed on September 30th, only one appeared to have sea star wasting disease.

Lithopoma (Astraea) undosum continued to remain at a low density. No *Haliotis corrugata* were observed on band transects this year. We only observed one *H. corrugata* within the transect boundaries on both visits to the site this summer. This *H. corrugata* measured 162mm, and was very hungry when fed a blade of *Macrocystis pyrifera*. Two juvenile (less than 20 mm) *H. corrugata* were found under a small rock. One *H. fulgens* and several (2 or 3) other *H. corrugata* were observed just outside the transect boundaries. *Megathura crenulata* were less common than last year with a density of 0.056/m². This year ended their gradual increase in density over the previous three years. *Aplysia californica* were extremely abundant, especially for this site with a density of 0.80/m². This is by far the highest density recorded at this site, and is the highest density recorded for any of the kelp forest monitoring sites since monitoring began in 1982. *Panulirus interruptus* were common with a density of 0.013/m². The turban snails, *Tegula eiseni*, and *T. aureotincta* remained relatively abundant, but there appeared to be fewer than last year.

The fish community has drastically changed since last year. During the roving diver fish count conducted this year on June 17th, only 11 species of fish were observed. In 1997, on June 18th, we observed 21 species. The other roving diver fish count was conducted on September 30th with eight divers observing 14 species. In 1997 on September 23rd a fish count was conducted with seven divers observing 18 species. Overall, the fish that were present were common.

Oxyjulis californica, male and female *Halichoeres semicinctus*, *Embiotoca jacksoni*, and *Medialuna californiensis* were all common. Female and juvenile *Semicossyphus pulcher* were common although only one small male was observed. Juveniles were notably more common than usual. Juvenile *Paralabrax clathratus* were common, but only several adults were observed. *Coryphopterus nicholsii* were rare and none were observed during quadrats. Similar to the other two sites at this island, *Alloclinus*

holderi were relatively abundant with a small decrease in their density from last year. This years density was $1.3/m^2$, and there was notably less juvenile *A. holderi* than last year.

The temperature logger was retrieved and was working. However the logger recorded some erroneous data on May 22, 1998. These erroneous data points ranged from 26-37 F°. The logger was sent back for calibration, and Onset Computer Corp. is looking into the erroneous data recorded. Onset returned the unit noting nothing wrong. We decided to delete all of the temperature data past May 21, 1998, when the unit began recording unreliable temperature data.

Location: South of Cat Canyon, Santa Barbara Island

Note: This is a survey site and not one of the permanent kelp forest monitoring sites.

1998 sampling dates: 9/30

1998 status: Mature kelp forest.

We conducted a survey dive several hundred meters south of the Cat Canyon transect. We anchored at a depth of 20m in an area that was a mature kelp forest with large canopy forming *Macrocystis pyrifera* plants. Most of the plants appeared healthy with less epiphytic bryozoans than the plants at Webster's point Arch (below). Most of the *M. pyrifera* were large widely spaced adults. Juvenile and subadult plants were rare. There were little understory algae and much of the bottom was either bare rock, encrusting coralline algae or encrusting invertebrates. The bottom gradually sloped downward with large boulders and small ridges.

At a depth of 20m, *Ophiothrix spiculata* were common, and were more abundant with depth. Much of the reef ended at about a depth of 90ft, where there was sand. No live *Haliotis spp.* were observed and only several old *H. corrugata* and one old *H. sorenseni* shells were observed. In the areas at about 20m, there were an abundance of adult and juvenile *Centrostephanus coronatus*. These were the most abundant sea urchins at this depth. Further inshore, towards Sutil Island, *Strongylocentrotus franciscanus* were the most dominant sea urchin. Overall, *S. purpuratus* were rare over the entire area. Small *Panulirus interruptus* were common and we observed one very large lobster molt (probably from a 5kg plus lobster). *Parastichopus parvimensis* were common overall, but abundant in some areas.

There were surprisingly few fish, and they were notably small. Overall, there was low abundance and diversity. Small *Paralabrax clathratus* and small female *Semicossyphus pulcher* were the most common fish.

Location: Underwater Arch off Webster Point, Santa Barbara Island

Note: This is a survey site and not one of the permanent kelp forest monitoring sites.

1998 sampling dates: 9/28.

1998 status: Sparse kelp forest with a high abundance of *Eisenia arborea* in the shallow areas.

Latitude: 33 28 53.5 UTM: 11 S 0308377

Longitude: 119 03 44.6 3706575

Although we have dove this arch before, it took us awhile to find this site since we only had Loran C numbers (the "Pacific Ranger" no longer has a Loran). Diane was able to locate the site using her notes. We anchored just south of the wash rock. One needs to use great caution in this area, as there were no waves breaking (this is often so) on the rock, and it is only several feet deep (standing depth).

Overall, this is one of the most beautiful dive sites on Santa Barbara Island. Similar to last year, there was an abundance of adult, subadult, and juvenile *Macrocystis pyrifera*. However, canopy cover was thin with few plants reaching the surface. Many of the plants had tattered fronds with an abundance of epiphytic bryozoans, however some plants were healthy. On the top of the reef at a depth of 10-40 ft, the *Eisenia arborea* forest was very thick and healthy, similar to last year. Juvenile *E. arborea* were also abundant. Adult *Laminaria farlowii* was common in the deeper areas. In the area east of the underwater arch, there were less algae and more *Strongylocentrotus franciscanus*. Small/juvenile *Centrostephanus coronatus* were relatively abundant. *Panulirus interruptus* were abundant in deep crevices.

Very small juvenile *Oxyjulis californica* and *Chromis punctipinnis* were abundant. Small female *Semicossyphus pulcher* were abundant, and several small males as well as several tiny (<2cm) young of year juveniles were observed. *Paralabrax clathratus* and *Medialuna californiensis* were common. A school of California barracuda, *Sphyræna argentea* was observed. One small California moray eel, *Gymnothorax mordax*, was observed.

DISCUSSION

General Biology:

In 1998, *Macrocystis pyrifera* (giant kelp) forests were present at six of the 16 Kelp Forest Monitoring sites, similar to last year. These sites included Wyckoff Ledge at San Miguel Island, Johnson's Lee North, Johnson's Lee South and Rodes Reef at Santa Rosa Island, and Cathedral Cove and Landing Cove at Anacapa Island. Last year, Rodes Reef, Santa Rosa Island was described as a open area with a moderate amount of understory algae and few *M. pyrifera* plants. Similar to last year, nine sites were dominated by echinoderms. Gull Island South, Pelican Bay, and Scorpion Anchorage at Santa Cruz Island, Southeast Sea Lion Rookery and Arch Point at Santa Barbara Island were dominated by *Strongylocentrotus purpuratus*. Hare Rock at San Miguel Island was dominated by *Strongylocentrotus franciscanus*. Cat Canyon at Santa Barbara Island was dominated by both *S. purpuratus* and *S. franciscanus*. Admiral's Reef at Anacapa Island was dominated by both *S. purpuratus* and the brittle star, *Ophiothrix spiculata*. Fry's Harbor at Santa Cruz Island was dominated by *Pachythyone rubra*, and had a moderate density of *S. purpuratus*, and cover of *Astrangia lajollaensis*. Yellowbanks at Santa Cruz Island is a barren with high siltation.

Seven sites had high ($> 15/\text{m}^2$) *Strongylocentrotus purpuratus* densities this year compared to eight sites in 1997. Similar to the last several years, *S. purpuratus* dominated many areas on Santa Cruz, Anacapa, and Santa Barbara Islands. These areas would probably be kelp forests if *S. purpuratus* densities were lower. Although densities remain high at many of these sites, they have mostly decreased since 1996 at Santa Barbara, Anacapa, and Santa Cruz Islands. However, at the sites where their densities have been low in recent years, their densities are increasing. This has been most notable at Johnson's Lee North, Santa Rosa Island, and to a lesser extent at several of the other sites on Santa Rosa and San Miguel Islands. The overall mean density of *S. purpuratus* at all 16 sites combined has decreased for the last three years. The mean density of all the sites in 1995, 1996, 1997, and 1998 were $29/\text{m}^2$, $22/\text{m}^2$, $19/\text{m}^2$, and $14/\text{m}^2$ respectively.

Much of the subtidal habitat at Santa Barbara Island continues to be sea urchin barrens with high densities of *S. purpuratus* and occasionally high densities of *S. franciscanus*. Juvenile *Strongylocentrotus* spp. were virtually absent from all of the sites at Santa Barbara Island. Similar to the past several years, there were few canopy forming *Macrocystis pyrifera* plants at Santa Barbara Island, however there appeared to be slightly more *M. pyrifera* surrounding the Islands than last year. At Anacapa Island, most of the south side and large patches of the north side of the middle and west Anacapa Islands have high densities of *S. purpuratus* and little *M. pyrifera*. Most of the area inside the Anacapa Ecological Refuge on the North side of East Anacapa had healthy *M. pyrifera* forests with low densities of *S. purpuratus*. However, there appeared to be less *M. pyrifera* in the reserve than in 1997. Three of the five sites at Santa Cruz Island

have high densities of *S. purpuratus*, and the two other sites had moderate densities (10-15/m²). Although sea urchin barrens exist on Santa Rosa and San Miguel Islands, they are less prevalent than at the southern/eastern Islands.

Centrostephanus coronatus were notably more abundant at the monitoring sites on Santa Barbara, Anacapa, and Santa Cruz Islands. They were recorded at their highest densities in quadrats and in the ARMs at many of the sites. Many of these were small juveniles and their recruitment was probably a result of warm waters from the 1997/1998 El Niño.

We observed sea urchin wasting syndrome/disease (Richards and Kushner, 1992) at eight sites during 1998, similar to the previous two years. All observations of sea urchin wasting disease were observed on Santa Barbara, Anacapa and Santa Cruz islands. No wasting disease was observed at Santa Rosa or San Miguel Islands this year. Similar to past years, we observed wasting disease mainly affecting *S. purpuratus*, and *S. franciscanus*, but it was also observed in *Lytechinus anamesus*.

Sea star wasting disease (Schroeter and Dixon, 1988) was observed only once this summer (Table 6). It was observed towards the end of summer at Southeast Sea Lion Rookery, Santa Barbara Island, and was only observed afflicting one *A. miniata*. This is significantly less than the 10 sites and four species the disease was observed last year. During the latter half of the sampling season in 1997 we began observing high sea star mortality that appeared to be caused by wasting disease. In 1997 we had finished most of the protocol that monitors sea star density, and as a result did not document any of their declines. The 1998 data showed a decrease in all three species of sea stars monitored at almost all of the sites where they were present in 1997. Towards the end of the summer of 1997, we observed many stars with sea star wasting disease that were near death. We believe the decline in sea star populations was a result of sea star wasting disease.

The brittle star *Ophiothrix spiculata* declined in abundance at both Fry's Harbor at Santa Cruz Island and at Admiral's Reef at Anacapa Island this year. This is the first time a decrease has been observed since this species became prevalent at these sites several years ago. However, we have heard many reports and have observed large areas that continue to be covered with *O. spiculata* on Santa Barbara, Anacapa and Santa Cruz Islands.

Aplysia californica were extremely abundant and recorded at their highest density at six of the monitoring sites on Santa Cruz, Anacapa and Santa Barbara Island. The nudibranch, *Navanax inermis* was also notably abundant at many of the sites.

Island kelp fish, *Alloclinus holderi*, densities remained relatively high, although they increased and decreased at some of the sites. These high densities have persisted over at least the past year. In 1997,

we observed the highest recorded densities for this species at many of the sites. This year appeared to be a good year for *Oxylebius pictus* (painted greenlings) recruitment. Juvenile *O. pictus* were abundant at Hare Rock, Wyckoff Ledge, Rodes Reef and Gull Islands South. Juvenile *Oxyjulis californica* were moderately abundant at many of the sites towards the end of summer. We received few reports of *Stereolepis gigas* (giant black sea bass) observations this year, and we only had one observation in 1998 at Admiral's Reef, Anacapa Island.

Unusual Species:

July 10th we observed the pelagic red crab, *Pleuroncodes planipes* at Pelican Bay, Santa Cruz Island. On August 6th *P. planipes* was observed at Smugglers Cove, Santa Cruz Island. *P. planipes* is often a indicator of warm water masses in the area, and are common at the Channel Islands during El Niño years.

On July 23rd and August 7th, two Guadalupe cardinal fish, *Apogon atricaudus*, were observed at Landing Cove, Anacapa Island. This may be the first time they have been reported at Anacapa Island and may be a range extension for this species.

The sea urchin *Arbacia incisa* was observed in the ARMs at four sites this year. Two *A. incisa* were observed along the transect at Southeast Sea Lion, Santa Barbara Island, and one was found in the ARMs at Gull Island South, Santa Cruz Island and at Landing Cove and Cathedral Cove, Anacapa Island. The farthest North/West site this species was observed was Gull Island South at Santa Cruz Island. This is probably a range extension for this species.

At Cathedral Cove, Anacapa Island, one *Polycera alabe* (a nudibranch) was observed along the transect. This is a more southern species who's range usually doesn't extend north of Isla Cedros, Baja California (Bertsch, 1973). We video taped this specimen for documentation.

During transit to Santa Barbara Island on September 29th we observed a marlin repeatedly jump from the water. Although we could not positively identify the fish, we believe it was a striped marlin, *Tetrapturus audax*.

El Niño:

Early in this year water temperatures were above normal at the Channel Islands, a continuation of the 1997 El Niño. By mid summer, waters had cooled off and were near normal for the remainder of the year. Most of the noticeable changes from the 1997/1998 El Niño were observed in this year's data set. As mentioned above we observed large declines in the sea star populations most likely a result of sea star wasting disease, and high densities of *Alloclinus holderi*.

Protocol Changes:

No protocol changes were conducted this year.

Sampling Difficulties:

All proposed data collection was completed this year except for some missing temperature data as a result of temperature logger failures or missing loggers. The ARMs required a fair amount of maintenance this year as a result of surge damage and corroding cages. Most of the damage occurred at the sites that were on the Southern sides of the Islands, and was presumably from large south swells that affected these area.

Artificial Recruitment Modules (ARMs):

ARMs at ten sites were monitored this year. The four ARMs that were deployed at Arch Point, Santa Barbara Island in 1997 could not be found. We searched a large area around where they were deployed and only part of one brick was found. ARMs were also lost at Johnson's Lee North and Johnson's Lee South, Santa Rosa Island, and at Admirals Reef, Anacapa Island.

The most notable widespread changes in the ARMs this year were the noticeable decrease in abundance of *Pisaster giganteus* and *Asterina (Patiria) miniata*. However, the number of *A. miniata* in the ARMs is much higher than what the "natural" habitat densities suggest. This is similar to what we observed last year. *Centrostephanus coronatus* continued to increase in the ARMs at most sites on Anacapa and Santa Cruz Islands, and were recorded at their highest densities at most of these sites.

We observed *Arbacia incisa*, a more southern species of sea urchin, in the ARMs at three sites. One *A. incisa* was found in the ARMs at each Gull Island, Admiral's Reef and Cathedral Cove sites.

Temperature:

We continued to make progress with the STOWAWAY and HOBOTEMP temperature loggers. We collected continuous 12 months of data (6/1/97 – 5/31/98) at 14 of the 16 sites. The two sites (Pelican Bay and Arch Point) we did not acquire temperature data was due to missing temperature loggers. Both loggers were missing from their still intact thread rods, in other words they were removed by a unknown physical force.

At most of the sites we deployed both a STOWAWAY temperature logger as the primary recording devise and a HOBOTEMP temperature logger as a backup. When both units were working we made a comparison of several temperatures to see if the loggers were recording within their specifications ± 0.2 °C. In all but one instance the temperature loggers were recording within their specifications. At Fry's Harbor there was a discrepancy of 1 °C. The data from the STOWAWAY loggers was used whenever possible, as these have consistently been the most accurate when the loggers have been sent in for calibration.

Resource Use:

On August 26th we attempted to aid the fishing vessel "Silverside" that washed up on the beach at Johnson's Lee, Santa Rosa Island. The vessel washed up while live fish fishing in shallow water (approximately 10-20ft) using "Portuguese" long lines during a large south swell. There were approximately 20-30 long lines that were abandoned and probably continued to fish until they were washed up on shore. We pulled up one of the long lines and released a grass rockfish, *Sebastes rastrelliger*. This species is bringing an excellent price to the fisherman because of their high survival rate, and was probably the target fish for this fisherman. Commercial near-shore live fish fishing has been increasing in recent years.

Data Requests:

In 1998, Kelp Forest Monitoring data was requested by the following: Matthew Edwards and Dr. Jim Estes at University of California at Santa Cruz requested data to include with their work on patterns of disturbance and recovery of kelp forests from California to Baja, Mexico. Arnold Ammann was sent all of the fish transect data for sheephead, and the handbooks. All of the most recent years data was sent to Dr. Allan Stewart-Oaten at the University of California at Santa Barbara, to update his database for ongoing studies. Charles M. Hollahan was sent data for all *Haliotis spp.*, *Lithopoma undosum* and *Megathura crenulata*. Eric Lyman, a undergraduate in the geography Dept. at the University of California at Santa Barbara was sent all for the temperature data for a GIS project. He and several other students were attempting to analyze the fluctuation of kelp abundance with regards to factors including water temperature, topography, shadowing of the Channel Islands in the Santa Barbara Channel, wave energy, current, sea urchin population and ocean floor geology. All sea urchin data was sent to Dr. Peter Kalvass with the Calif. Dept. of Fish and Game, and Heidi Rahn at The Center for Marine Conservation. The entire database was sent to Dr. Sandy Andelman at the National Center for Ecological Analysis and Synthesis.

Information Requests:

For additional copies of this report or other annual reports, please contact:

Denver Service Center
Technical Information Center
P.O. Box 25287
Denver, CO 80225-0287
(303) 969-2130

If you are interested in obtaining the raw data, please write to the address below:

Channel Islands National Park
1901 Spinnaker Drive
Ventura, CA 93001

ACKNOWLEDGEMENTS

This ecological monitoring program was supported by the U.S. National Park Service in cooperation with the California Department of Fish and Game and the U.S. Department of Commerce, National Oceanographic and Atmospheric Administration, Marine Sanctuary Program.

We are deeply indebted to the many divers who have participated in this project in 1998 (Table 5). Many of our volunteer divers are associated with other agencies such as NOAA, and many universities. Without this volunteer base of well trained and qualified divers it would be difficult to conduct this program at its current funding level. Dan Richards and Gary E. Davis continue to provide advice and support for the project as well as aid in data collection. We also greatly appreciate the efforts of Diane Richardson, and Dave Stoltz for supporting us on the boats, keeping us afloat and underwater. Gordon Bailey drew cover illustration.

LITERATURE CITED:

- Bertsch, H. 1973. Distribution and natural history of opisthobranch gastropods from Las Cruces, Baja California del Sur, Mexico. *Beliger*, 16(1):105-111.
- Davies, D. H. 1968. Statistical analysis of the relation between kelp harvesting and sportfishing in the California kelp beds. In North, W. J. and Hubbs, C. L. (editors) *Utilization of Kelp-bed Resources in Southern California*. pp. 151-212. Calif. Dept. of Fish and Game Fish Bull. 139.
- Davis, G. E., D. J. Kushner, J. M. Mondragon, J. E. Mondragon, D. Lerma, and D. Richards. 1997. *Kelp Forest Monitoring Handbook, Volume 1: Sampling Protocol*. Channel Islands National Park. Ventura, California.
- Davis, G. E. 1985. Kelp forest monitoring program: preliminary report on biological sampling design. Univ. of Cal. Davis Coop. National Park Resources Studies Unit. Tech. Rept. No. 19. 46p.
- Davis, G. E. 1986. Kelp forest dynamics in Channel Islands National Park, California, 1982-85. Channel Islands National Park and National Marine Sanctuary Natural Science Study Reports. CHIS-86-001. 11p.
- Davis, G. E. and W. L. Halvorson. 1988. Inventory and monitoring of natural resources in Channel Islands National Park California. Channel Islands National Park Natural Science Reports. Ventura, California.
- Davis, G. E., D. V. Richards and D. J. Kushner. 1996. Kelp Forest Monitoring Design Review. Technical Report CHIS-96-01.
- Engle, J. M. (Personal Communication) Tatman Foundation. Santa Barbara, CA.
- Kushner, D., R. Walder, L. Gorodezky, D. Lerma, D. V. Richards. 1995a. Kelp forest ecological monitoring, Channel Islands National Park (1993 annual report). Technical Report CHIS-95-02.
- Kushner, D. J., D. Lerma, D. V. Richards. 1995b. Kelp Forest Monitoring, 1994 Annual Report. Technical Report-CHIS-95-03.
- Kushner, D. J., D. Lerma, J. Mondragon, and J. Morgan. 1997a. Kelp Forest Monitoring, 1995 Annual Report. Technical Report-CHIS-97-01.
- Kushner, D. J., J. Morgan, J. Mondragon, and D. Lerma. 1997b. Kelp Forest Monitoring, 1996 Annual Report. Technical Report-CHIS-97-04.
- Kushner, D. J., J. Morgan, J. Mondragon, and D. Lerma. 1998. Kelp Forest Monitoring, 1997 Annual Report. Technical Report-CHIS-98-05.
- National Oceanographic and Atmospheric Administration, Coastal Ocean Program. 1997. El Niño Watch, Advisory no. 97-1 through 97-12.
- Richards, D. V., C. Gramlich, G. E. Davis, and M. McNulty. 1997. Kelp forest ecological monitoring Channel Islands National Park 1982 - 1989.
- Richards, D.V., W. Avery and D. Kushner. 1993a. Kelp Forest Monitoring -- Channel Islands National Park (1990 annual report). Technical Report NPS/WRUC/NRTR-93/05.

- Richards, D.V., D. Kushner and W. Avery. 1993b. Kelp Forest Monitoring -- Channel Islands National Park (1991 annual report). Technical Report NPS/WRUC/NRTR-93/06.
- Richards, D.V. and D. Kushner. 1994. Kelp Forest Monitoring, 1992 annual report. Channel Islands National Park, Ventura, California. Technical Report-CHIS-94-01.
- Schroeter, S. C. and J. D. Dixon. 1988. The roll of disease in Southern California kelp forests. Abstracts from the Southern California Academy of Sciences annual meeting. #18.
- Woodhouse, C. D. (Principle Investigator). 1981. Literature review of the resources of Santa Cruz and Santa Rosa Islands and the marine waters of Channel Islands National Park, California. Santa Barbara Museum of Natural History Contract Rep. Nat. Park Serv. CX 8000-0-0028. 2 Vol.

Table 1. Regularly monitored species by taxonomic grouping, common name, scientific name and associated monitoring technique.

TAXA/COMMON NAME	SCIENTIFIC NAME	TECHNIQUE
ALGAE		
Miscellaneous Green Algae		R
Miscellaneous Red Algae		R
Articulated Coralline Algae		R
Encrusting Coralline Algae		R
Agar weed	<i>Gelidium spp.</i>	R
Sea tongue	<i>Gigartina spp.</i>	R
Miscellaneous Brown Algae		R
Acid weed	<i>Desmarestia spp.</i>	R
Oar weed	<i>Laminaria farlowii</i>	R,Q
Bladder chain kelp	<i>Cystoseira spp.</i>	R
Giant kelp	<i>Macrocystis pyrifera</i>	R,Q,M
California Sea Palm	<i>Pterygophora californica</i>	R,Q
Southern Sea Palm	<i>Eisenia arborea</i>	R,Q
Miscellaneous plants		R
INVERTEBRATES		
Miscellaneous Sponges		R
Orange puffball sponge	<i>Tethya aurantia</i>	B,S
Southern Staghorn Bryozoan	<i>Diaperoecia californica</i>	R
Miscellaneous Bryozoans		R
California hydrocoral	<i>Stylaster (Allopora) californica</i>	B,S
White-spotted rose anemone	<i>Tealia lufotensis</i>	B
Red gorgonian	<i>Lophogorgia chilensis</i>	B,S
Brown gorgonian	<i>Muricea fruticosa</i>	B,S
California golden gorgonian	<i>Muricea californica</i>	B,S
Strawberry anemone	<i>Corynactis californica</i>	R
Orange cup coral	<i>Balanophyllia elegans</i>	R
Cup coral	<i>Astrangia lajollaensis</i>	R
Hydroids		R
Ornate tube worm	<i>Diopatra ornata</i>	R
Colonial sand-tube worm	<i>Phragmatopoma californica</i>	R
Scaled-tube snail	<i>Serpulorbis squamigerus</i>	R
Chestnut cowrie	<i>Cypraea spadicea</i>	Q
Wavy turban snail	<i>Lithopoma (Astraea) undosum</i>	Q,S
Red turban snail	<i>Lithopoma (Astraea) gibberosum</i>	Q,S
Bat star	<i>Asterina (Patiria) miniata</i>	Q,S
Giant-spined sea star	<i>Pisaster giganteus</i>	Q,S,M
Sunflower star	<i>Pycnopodia helianthoides</i>	B,S
White sea urchin	<i>Lytechinus anamesus</i>	B,S
Red sea urchin	<i>Strongylocentrotus franciscanus</i>	Q,S
Purple sea urchin	<i>Strongylocentrotus purpuratus</i>	Q,S
Warty sea cucumber	<i>Parastichopus parvimensis</i>	Q
Aggregated red sea cucumber	<i>Pachythyone rubra</i>	R
Red abalone	<i>Haliotis rufescens</i>	B,S
Pink abalone	<i>Haliotis corrugata</i>	B,S
Green abalone	<i>Haliotis fulgens</i>	B,S

Table 1. Continued.

TAXA/COMMON NAME	SCIENTIFIC NAME	TECHNIQUE
Kellet's whelk	<i>Kelletia kelletii</i>	B,S
Giant keyhole limpet	<i>Megathura crenulata</i>	B,S
California brown sea hare	<i>Aplysia californica</i>	B
Rock scallop	<i>Crassedoma (Hinnites) giganteum</i>	B,S
California spiny lobster	<i>Panulirus interruptus</i>	B
Tunicates		R
Stalked tunicate	<i>Styela montereyensis</i>	Q
Miscellaneous Invertebrates		R
FISH		
Bluebanded goby	<i>Lythrypnus dalli</i>	Q
Blackeye goby	<i>Coryphopterus nicholsii</i>	Q
Island kelpfish	<i>Alloclinus holderi</i>	Q
Blacksmith	<i>Chromis punctipinnis</i>	V
Señorita	<i>Oxyjulis californica</i>	V
Blue rockfish	<i>Sebastes mystinus</i>	V
Olive rockfish	<i>Sebastes serranoides</i>	V
Kelp rockfish	<i>Sebastes atrovirens</i>	V
Kelp bass	<i>Paralabrax clathratus</i>	V
California Sheephead	<i>Semicossyphus pulcher</i>	V
Black surfperch	<i>Embiotoca jacksoni</i>	V
Striped surfperch	<i>Embiotoca lateralis</i>	V
Pile perch	<i>Damalichthys vacca</i>	V
Garibaldi	<i>Hypsypops rubicundus</i>	V
Opaleye	<i>Girella nigricans</i>	V
Rock Wrasse	<i>Halichoeres semicinctus</i>	V
SUBSTRATE		
Bare substrate		R
Substrates: Rock		R
Cobble		R
Sand		R

B= Band Transect

Q= Quadrat

R= Random Point Contact

M= 5m²-Quadrat

S= Size frequency Measurement

V= Visual Transect

CHANGES IN SCIENTIFIC NOMENCLATURE:

<i>Patiria miniata</i>	=	<i>Asterina miniata</i>
<i>Astraea undosum</i>	=	<i>Lithopoma undosum</i>
<i>Astraea gibberosa</i>	=	<i>Lithopoma gibberosum</i>
<i>Hinnites giganteum</i>	=	<i>Crassedoma giganteum</i>
<i>Allopora californica</i>	=	<i>Stylaster californica</i>

Table 2. Station Information.

ISLAND	LOCATION	ABBREVIATION	DEPTH METERS	YEAR ESTABLISHED
San Miguel	Wyckoff Ledge	SMWL	13-15	1981
San Miguel	Hare Rock	SMHR	6-9	1981
Santa Rosa	Johnson's Lee North	SRJLNO	9-11	1981
Santa Rosa	Johnson's Lee South	SRJLSO	14-16	1981
Santa Rosa	Rodes Reef	SRRR	13-15	1983
Santa Cruz	Gull Island South	SCGI	14-16	1981
Santa Cruz	Fry's Harbor	SCFH	12-13	1981
Santa Cruz	Pelican Bay	SCPB	6-8	1981
Santa Cruz	Scorpion Anchorage	SCSA	5-6	1981
Santa Cruz	Yellowbanks	SCYB	14-15	1986
Anacapa	Admiral's Reef	ANAR	13-15	1981
Anacapa	Cathedral Cove	ANCC	6-11	1981
Anacapa	Landing Cove	ANLC	5-12	1981
Santa Barbara	Southeast Sea Lion Rookery	SBSESL	12-14	1981
Santa Barbara	Arch Point	SBAR	7-8	1981
Santa Barbara	Cat Canyon	SBCAT	7-9	1986

Table 3. Summary of sampling techniques used to monitor population dynamics of selected kelp forest taxa.

TECHNIQUE	SAMPLE NUMBER OF SIZE REPLECATES
Quadrat count	1 m X 1 m 24X / site
Band Transect count	3 m X 10 m 24X / site
5m ² -Quadrat	1 m X 5m 40X/ site
Random Point Contact	40 points 15X / site (0.5 x 3 m)
Visual Fish transects	2 m(w) X 3 m(h) X 50 m(l) 8X / sites 5 minutes
Video transects	5 minutes / 100 m; 2X / site, and also a 360° pan at 0, 50 and 100m along transect.
Size frequency measurements	30 to 200 / species: 1X / site (see size frequency measurement dimensions below)
Species Checklist	30 - 90 minutes, 1X / site
Artificial Recruitment Modules	7 - 15 modules / site

Size Frequency measurement dimensions:

Genus	Sample Size	Measurement
<i>Macrocystis</i>	100	Stipe count (1 m above bottom), max. holdfast diameter, mm
<i>Tethya</i>	30	Max. diameter, mm
<i>Stylaster (Stylaster</i>	50	Max. height and width, mm
<i>(Allopora))</i>	30	Max. height and width, mm
<i>Lophogorgia</i>	30	Max. height and width, mm
<i>Muricea</i>	30	Max. shell length, mm
<i>Megathura</i>	30	Max. shell length, mm
<i>Haliotis</i>	30	Max. shell diameter, mm
<i>Lithopoma (Astraea)</i>	30	Max. shell length, mm
<i>Kelletia</i>	30	Max. shell length, mm
<i>Crassedoma (Hinnites)</i>	200	Max. test diameter, mm
<i>Strongylocentrotus</i>	200	Max. test diameter, mm
<i>Lytechinus</i>	30	Length of the longest ray, mm
<i>Pycnopodia</i>	30	Length of the longest ray, mm
<i>Asterina (Patiria)</i>	30	Length of the longest ray, mm
<i>Pisaster</i>		

Table 4. 1998 Kelp forest monitoring site status.

ISLAND/SITE	STATUS
<u>San Miguel Island:</u>	
Wyckoff Ledge	Mature kelp forest with dense understory of red and brown algae.
Hare Rock	<i>Strongylocentrotus franciscanus</i> Barrens.
<u>Santa Rosa Island:</u>	
Johnson's Lee North	Developing kelp forest.
Johnson's Lee South	Mature kelp forest.
Rodes Reef	Developing kelp forest with a moderate amount of understory red algae.
<u>Santa Cruz Island:</u>	
Gull Island South	<i>Strongylocentrotus purpuratus</i> barrens.
Fry's Harbor	Open area with high densities of aggregating red sea cucumbers, <i>Pachythyone rubra</i> , and moderate densities of <i>Astrangia lajollaensis</i> and <i>Strongylocentrotus purpuratus</i> .
Pelican Bay	<i>Strongylocentrotus purpuratus</i> barren.
Scorpion Anchorage	<i>Strongylocentrotus purpuratus</i> barrens.
Yellowbanks	Barren area with high siltation.
<u>Anacapa Island:</u>	
Admiral's Reef	<i>Strongylocentrotus purpuratus</i> and <i>Ophiothrix spiculata</i> (brittle star) barrens.
Cathedral Cove	Developing kelp forest / Open area.
Landing Cove	Open kelp forest.
<u>Santa Barbara Island:</u>	
Southeast Sea Lion Rookery	<i>Strongylocentrotus purpuratus</i> barrens.
Arch Point	<i>Strongylocentrotus purpuratus</i> barrens / Developing kelp forest.
Cat Canyon	<i>Strongylocentrotus franciscanus</i> and <i>S. purpuratus</i> barrens.

Table 5. 1998 Kelp Forest Monitoring Program participant and cruise list.

PARTICIPANTS	AFFILIATION	CRUISES PARTICIPATED
Alesandrini, Stian	CHIS	1,2,3,4,5,6,7
Brooks, John	NPS	2
Bullard, Aimee	CHIS-VIP	4,5,6,7
Canestro, Don	UCSC	7
Collier, Chantal	CCD/UCLA	1,4
Conti, John	CHIS-VIP	6
Davis, Gary	CHIS	1
Donahue, Megan	UCD	4,5
Faist, Chris	UCSB	6
Fastenau, Henry	UCD	3
Faulkner, Bill	CHIS	6
Haaker, Peter	CDF&G	6
Hebshi, Aaron	UCSC	2
Hessell, Eric	CHIS-VIP	1,2,3,4
Kennedy, Kathy	MLML	5
Koehnke, Jill	CSF	3
Kushner, David	CHIS	1,2,3,4,5,6,7
Kutz, Dida	MLML	4
Lafferty, Kevin	UCSB/BRD	7
Lerma, Derek	CHIS	1,2,3,4,5,
Lima, Jim	MMS	5
Lohuis, Derek	CHIS	2
Provo, John	CHIS	4
Reilly, Paul	CDF&G	2
Richards, Dan	CHIS	2,7
Richardson, Diane	CHIS	1,2,3,5,6,7
Setian, Jolyn	UCD	3
Shaffer, Jonathan	CHIS	1,2,3,4,5,6,7
Taniguchi, Ian	CDF&G	3
Trone, John	UCSC	7
Wagshall, Adam	HSU	1
Walder, Ron	CHIS	6
Zentgaf, Michelle	UCSC	5

CRUISE NUMBER	CRUISE DATES	SITES VISITED
Cruise #1	June 15-19, 1998	SBSESL, SBCAT, SBAP, ANAR, ANCC
Cruise #2	July 6-10, 1998	SMWL, SMHR, SRJLNO, SRJLSO, SRRR, SCPB
Cruise #3	July 20-24, 1998	SCGI, SCFH, ANCC, ANLC
Cruise #4	August 3-7, 1998	SRJLSO, SRRR, SCFH, SCPB, SCSA, SCYB, ANLC, ANAR
Cruise #5	August 24-28, 1998	SRJLNO, SRJLSO, SCGI, SCYB, ANLC
Cruise #6	September 14-18, 1998	SMWL, SMHR, SRJLNO, SRJLSO, SCSA, SCYB
Cruise #7	Sep. 28 - Oct. 2, 1998	SRJLNO, SBSESL, SBAP, SBCAT

Table 6. 1998 Echinoderm wasting disease/syndrome observations.

ISLAND/SITE	Sea Star Wasting Syndrome		Sea Urchin Wasting Syndrome	
	SPECIES OBSERVED	DATE(s)	SPECIES OBSERVED	DATE(s)
<u>San Miguel Island</u>				
Wyckoff Ledge	none		none	
Hare Rock	none		none	
<u>Santa Rosa Island</u>				
Johnson's Lee North	none		none	
Johnson's Lee South	none		none	
Rodes Reef	none		none	
<u>Santa Cruz Island</u>				
Gull Island South	none		3	7/21
Fry's Harbor	none		2	7/22
Pelican Bay	none		2	7/10, 8/5
Scorpion Anchorage	none		none	
Yellowbanks	none		2	9/18
" "			3	8/24
<u>Anacapa Island</u>				
Admiral's Reef	none		3,6	6/18, 8/6
Cathedral Cove	none		6	7/23
Landing Cove	none		none	
<u>Santa Barbara Island</u>				
SE Sea Lion Rookery	1	9/29	none	
Arch Point	none		6	9/29
Cat Canyon	none		2,6	6/19, 9/29

SPECIES LEGEND:

- 1 = *Asterina (Asterina (Patiria)) miniata*
- 2 = *Strongylocentrotus purpuratus*
- 3 = *Lytechinus anamesus*
- 4 = *Pisaster giganteus*
- 5 = *Astrometis sertulifera*
- 6 = *Strongylocentrotus franciscanus*
- 7 = *Parastichopus parvimensis*
- 8 = *Dermasterias imbricata*
- 9 = *Mediaster aequalis*

none = not observed at this site during our visits in 1997

date = date(s) disease/syndrome was observed