Monterey Bay National Marine Sanctuary

A Comparative Intertidal Study and User Survey, Point Pinos, California

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Submitted to:

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Preface

In April 2000, the City of Pacific Grove contracted with the Monterey Bay Sanctuary Foundation (MBSF) to serve as the neutral fiscal sponsor for a project to study the impacts of human activities on the rocky intertidal shore and tidepools at Point Pinos. The City created a Point Pinos Tidepool Task Force Subcommittee on Research to develop and oversee the research project and interface with the MBSF. The Subcommittee members were appointed from numerous interested parties with differing views on potential impacts resulting from visitor use. The Subcommittee was responsible for: developing a Request for Proposals (RFP), distributing the RFP to solicit research proposals, and selecting a contractor based on proposed methods and qualifications. The Subcommittee was also responsible for approving the final and more detailed study plan submitted by the selected contractor, reviewing quarterly progress reports, and approving the final report on the project.

The RFP, designed to address four primary questions concerning patterns of visitor use, activities, impacts, and past changes at Point Pinos, was circulated to the coastal and marine science communities for solicitation of proposals. Throughout the entire process of proposal review and contractor selection, including project implementation, the Subcommittee required that rigorous science be incorporated into the project plans. Proposals were received from four outstanding investigators and institutions. In addition to the Subcommittee review of the proposals, five external review scientists with backgrounds in marine science provided their views on the proposals and the likelihood of the project's objectives being achieved. Ultimately, the contract was awarded to Tenera Environmental of San Francisco and San Luis Obispo, CA. The feedback from the external reviewers and the Subcommittee was then incorporated into the final and more detailed study plan submitted by Tenera Environmental. All project decisions were made by consensus among the Subcommittee members, and the assessment of impacts was reached according to the analysis of findings discussed with the contractor. The members of the Subcommittee and the Tenera research team should be commended for their objectivity, collaborative approach, and substantial commitment of time throughout the process.

This final report may be viewed as the completion of the specific research project, yet also may serve as the baseline for future projects. We are grateful to The David and Lucile Packard Foundation for their generous funding support of the project, and also to the Monterey Bay National Marine Sanctuary and the City of Pacific Grove for their financial contributions.

Dennis J. Long
Executive Director
Monterey Bay Sanctuary Foundation

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Summary

The Summary section highlights the findings in the report. It should not be used as a substitute for the information and detailed findings provided in the accompanying sections.

The purpose of this study was to investigate the effects of visitor use on the Point Pinos rocky shoreline located on the Monterey Peninsula in central California. Point Pinos receives high levels of visitor use because of its scenic values and easy accessibility from roads, adjoining parking lots, and trails. One of the main attractions of Point Pinos is the rich, diverse marine life along the rocky shore. Tidepools are common in the area, and small sandy beaches also occur along the upper shore. Point Pinos is within the Monterey Bay National Marine Sanctuary and the Pacific Grove Marine Gardens Fish Refuge.

There is substantial evidence in the scientific literature demonstrating that high levels of visitor use can negatively impact intertidal communities through rock turning, inadvertent trampling, and the collection and displacement of organisms. Although Point Pinos has legal statutes protecting it from some of these activities, the present and projected levels of visitor use have raised concerns on the effectiveness of the regulations in protecting the health and viability of marine life at this frequently visited section of coastline.

In this study we assess visitor use levels and activities at Point Pinos, and compare the condition of the shoreline biological community in areas of high and low use. Although numerous scientific studies have previously been completed at Point Pinos, there were no existing data that could be used as a baseline to make a definitive assessment on the current effects of visitor use. Therefore, during summer 2002 we completed sampling to develop a database to evaluate visitor impacts. We sampled species abundances over broad regions of shoreline habitat in areas of high and low visitor use using transects situated in the upper and low intertidal. We also sampled specific habitats, such as tidepools, as they represent focal points of interest and are exposed to visitor effects.

We sampled over 150 species of invertebrates, algae, and intertidal fishes, and analyzed the data for differences in abundance between the visitor use areas of Point Pinos and reference areas. We did not find any conclusive evidence of effects from collecting. We found that lower coverage of some types of algae in the upper intertidal zone and around the margins of tidepools may have been caused by chronic trampling from visitors. All of the affected trampled areas were in the upper intertidal zone (> +2 ft MLLW tide level) where our visitor surveys showed that people spend most of their time. Even though trampling may have contributed to the reduced algal cover on the upper surfaces of rocks at Point Pinos, these same species were found on the sides of rocks and in crevices that were not as exposed to trampling. Despite the lower abundances of some algal types, foot traffic had not resulted in barren pathways through the intertidal. This is mainly due to

the high topographic relief of the shoreline and the lack of flat rock platforms that would otherwise tend to concentrate visitor use.

We also investigated whether local populations of owl limpets and black abalone have been affected by illegal harvesting for human consumption. Since large individuals in the population of these species are more susceptible to impacts from collecting, we measured shell sizes to determine whether there were fewer large animals at Point Pinos, relative to other areas with less visitor use. Although black abalone populations in particular have been affected historically by human harvesting and sea otter predation, there were no significant differences in size distributions between high and low use areas, including the nearby Hopkins Marine Life Refuge. The Hopkins Marine Life Refuge is treated in the present study as a low use area because it is fenced off from general public use, although it is an area of high scientific research activity. The research facility also has an on-site caretaker for security that further limits the possibility of poaching.

Aside from apparent trampling effects, disturbances that have likely occurred at some level from visitor use did not appear to exceed the range of disturbances that can occur naturally, as we found few differences between areas of high and low visitor use that presumably experience similar levels of natural disturbance. Natural physical disturbances (e.g., boulder rolling from storm waves, sand scour) affect species composition and abundance, but also contribute to the diversity of marine life by maintaining a mix of many species with varied age structures in their populations. Furthermore, many of the activities associated with visitor use, such as rock turning and trampling, are similar to the types of natural physical disturbances that the biological community is subjected to. Point Pinos is also located along a shoreline with naturally high algal productivity and growth from coastal upwelling that increases the habitat structure and food resources for associated invertebrates. The rocky shore is also contiguous with adjoining rocky areas supporting similar species assemblages, thus having nearby spore and larval supplies for recruitment. As a result, recovery potential can be high, reducing the effects of transitory disturbances, such as visitor use. We found that the Point Pinos shoreline is as diverse as adjoining shorelines that had very little visitor use, probably related to the high natural variability in the area, which also resulted in the difficulty to detect large differences from visitor impacts.

However, our studies of visitor use impacts had several limitations. First, the studies were observational in nature and did not include experimental manipulations that could be used to establish relationships between the biological patterns and visitor use. Secondly, because biological communities are naturally variable, data from two areas (e.g., ‘control’ and ‘impact’ areas) will almost always have some statistically significant differences, and these differences may not necessarily be related to visitor use. The basis for concluding that the differences detected in a one-time observational study, are actually the effects of visitor use, is dependent on the magnitude of differences between control and impact areas and the consistency of the results from a variety of species that are susceptible to visitor impacts. In the present study, purple sea urchins were significantly less abundant in tidepools at the Point Pinos shore, but the absence of effects on other species that are also prone to collecting or damage from collecting reduces the likelihood that this single difference was due to visitor impacts. Finally, the short-term nature of the study could not account for seasonal or inter-annual variation in species abundances. Long-term monitoring at an increased number of sites in both visitor use and reference areas would help determine if there are any differences in the patterns of changes in species composition and abundance among areas.

An additional reason why we did not detect a greater number of visitor impacts may have been related to several resource conservation measures that had come into place several years prior to our studies, which allowed impacted species to recover. The Pacific Grove Police Department had increased their involvement in resource enforcement at Point Pinos. Educational signage explaining tidepool etiquette in three languages was placed at three locations along the Point Pinos shore. Bay Net, a Monterey Bay National Marine Sanctuary volunteer docent program, expanded their education outreach and conservation awareness instruction to Point Pinos and vicinity. Also, the Coalition to Preserve and Restore Point Pinos Tidepools, a public advocacy group, began education outreach at Point Pinos. Lastly, the California Department of Fish and Game issued a moratorium on scientific collecting in the area.

While the several year period of increased conservation measures that were implemented prior to our studies may have been sufficient for many species to recover, not all could have necessarily recovered completely in this period of time. Longer periods are generally required for species that do not readily recruit from limited reproduction and propagule dispersal, which includes slow growing, long lived species, such as owl limpets, abalone, and sea stars. Accordingly, the lack of substantial findings of adverse visitor impacts may also indicate that the impacts were not large to begin with.

We estimate that approximately 50,000 people visit the Point Pinos intertidal zone annually, representing a small percentage of the total visitors to Point Pinos. Many other rocky intertidal zones in California that are near urban areas experience greater levels of visitation, and resource managers in these areas are confronted with similar issues of balancing resource conservation with continued access and uses. Accordingly, we feel that planning for additional resource conservation measures at Point Pinos, including monitoring, may be warranted in light of the findings of this study, because visitor use will likely increase in the future.

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1.0 Introduction

1.1 Purpose

The purpose of this study was to assess visitor effects on the rocky intertidal zone biota at Point Pinos in Pacific Grove, California, located within the Monterey Bay National Marine Sanctuary (**Figure 1-1**). 'Visitor effect' is any change in the natural abundance of a species, assemblage of species, or habitat condition caused by collecting, trampling, improper handling or displacement of organisms, and rock turning. Effects of fishing from the shore were not studied, although we include fishing activities observed in the study. While Point Pinos is a distinctive headland jutting out towards the sea, our study also included areas adjacent to the point, from approximately Acropolis Street to an area referred to as the 'Great Tidepool' (**Figure 1-1**). We refer to this particular stretch of coast (ca. 0.8 mi, 1.3 km) as the Point Pinos shoreline.

1.2 Rationale for the Study

Rocky intertidal shorelines support diverse assemblages of marine plants and animals, but visitor use can negatively impact these marine communities (Chan 1970, Zedler 1978, Beauchamp and Gowing 1982, Povey and Keough 1991, Newton et al. 1993, Addessi 1994, Brosnan et al.1994, Murray 1998, Murray et al. 1999, Engle and Davis 2000). The nature and intensity of the impacts, however, depends on the type of biological community present, physical nature of the habitats (e.g., boulder/cobble fields, rocky outcroppings, etc.), and levels of visitor use.

One of the most common causes of impact is from trampling as visitors walk over rocks and explore tidepools. Marine plants may be crushed, broken, and dislodged. Animals on the tops of smooth rocks are highly prone to being crushed, while those nestled in crevices or growing on the sides and underneath rocks are protected from being trampled. Other impacts result from the collection of organisms for human consumption, bait, aquaria, research, and curiosity (Hockey and Bosman 1986, Ortega 1987, Underwood and Kennelly 1990, Addessi 1994).

Organisms that are associated with the impacted populations can also be indirectly affected (Ghazaanshaki et al. 1983, Moreno et al. 1984, Duran and Castilla 1989, Povey and Keough 1991, Brown and Taylor 1999, Schiel and Taylor 1999). For example, trampling that reduces algal cover may in turn reduce the abundance of invertebrates that utilize the cover for protective habitat (Brown and Taylor 1999). Conversely, algal cover may increase when invertebrate grazers are collected (Moreno et al. 1984), and prey

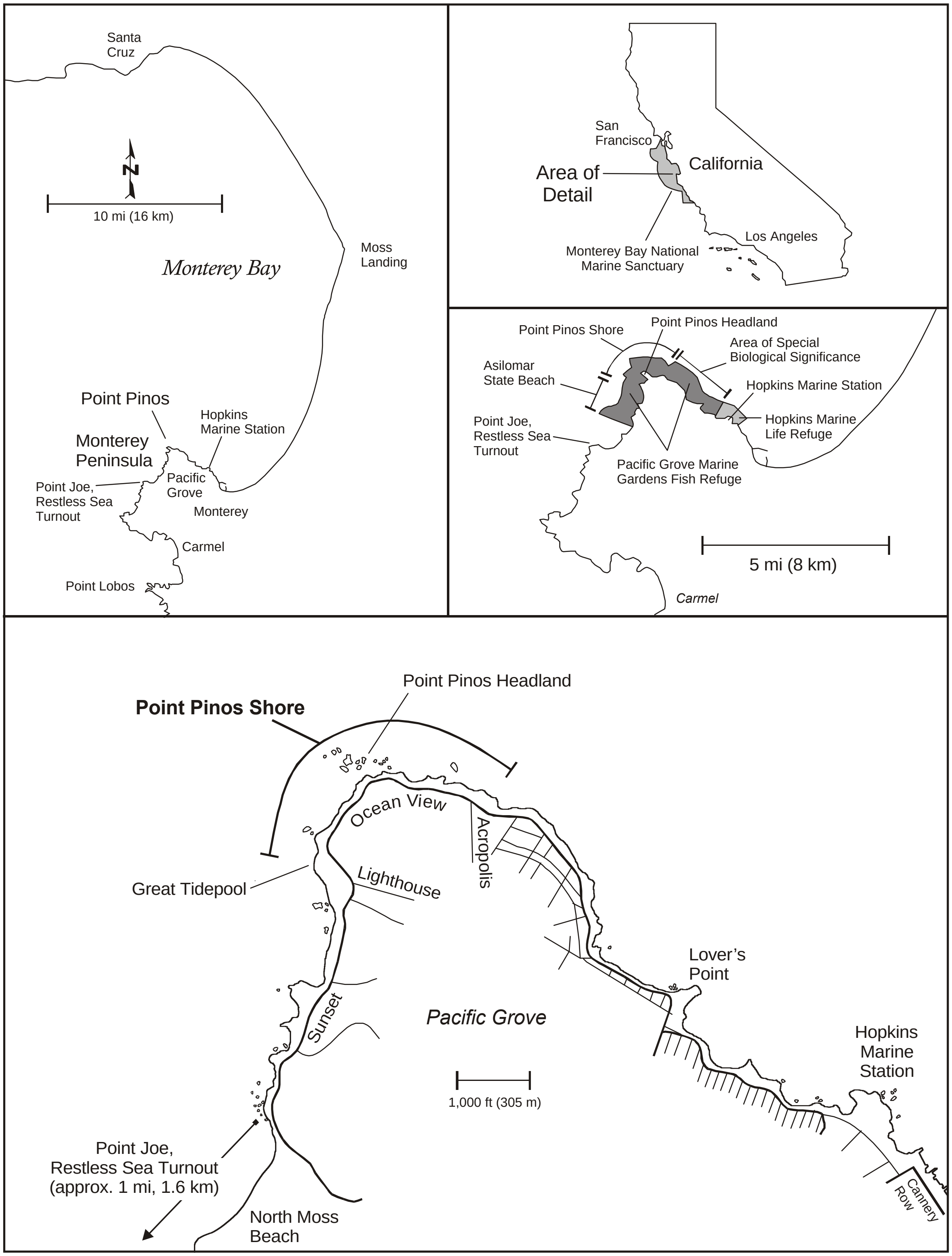

Figure 1-1. Location of Point Pinos on the Monterey Peninsula and regulatory designations.

items (e.g., turban snails) may benefit when predator species (e.g., sea stars) are collected and removed from the community.

Disturbances that are not chronic, but intermittent, may allow the affected area to recover (Sousa 1979). For example, impacts may be ameliorated by high reproductive capacities for a species to recover through settlement of spores and larvae and subsequent growth of new individuals (Hockey and Bosman 1986, Catterall and Poiner 1987, Lasiak 1991, Povey and Keough 1991, Keough and Quinn 1998). Studies have shown that the species involved in the recovery process and rates of recovery, however, can vary depending on the assemblages affected (Kinnetics 1989). Highly motile species, such as turban snails that are dislodged from rocks, may be able to recover almost immediately after rock turning, as they can move back into their former habitats (Chapman and Underwood 1996). On the other hand, slower moving species, such as sea stars may not be able to occupy their former habitat as quickly after being dislodged or displaced from handling. Also, mussel beds may take up to 10 years or more to recover, based on results from experimental clearings (Kinnetics 1989, Richards 1994). If disturbances from visitor use are chronic, the affected portions of the community may persist in an alternate state of reduced biodiversity (Povey and Keough 1991, Brosnan and Crumrine 1994). Depending on the intensity of impacts, the cumulative effects from visitor use may also be indistinguishable or within the range of changes resulting from natural disturbances, such as from strong wave action or severe weather (Bally and Griffiths 1989, Newton et al. 1993).

The intertidal zone of Point Pinos (**Figure 1-2**) and vicinity lies within the Monterey Bay National Marine Sanctuary, and is among the most biologically diverse habitats on the Monterey Peninsula. It is a popular area for recreation, and offers a variety of opportunities for education and scientific research. Indeed, a large part of its recognition as a diverse area stems from the amount of research completed in the area. For example, some of the foremost and comprehensive literature on California's intertidal flora and fauna are based on species identifications and specimens inhabiting Point Pinos and vicinity (Smith 1969, Smith and Carlton 1975, Abbott and Hollenberg 1976, Sparling 1977, Morris et al. 1980).

Point Pinos is also one of the most publicly accessible shoreline locations on the Monterey Peninsula. Consequently, there is concern that the diversity and abundance of the intertidal marine biota at Point Pinos has become degraded, or is at imminent risk of becoming significantly degraded as a direct result of increasing levels of human use. Population growth in the Monterey county area is

Figure 1-2. Rocky intertidal zone of the Point Pinos shore.

expected to further increase (**Figure 1-3**), and coastal tourism will likely continue to rise because the area is a popular vacation destination. Academic researchers also desire to have access to an array of study areas, including Point Pinos. In addition, school field trips to Point Pinos and other rocky shore areas have become more frequent with the inclusion of marine education in curricula at all levels.

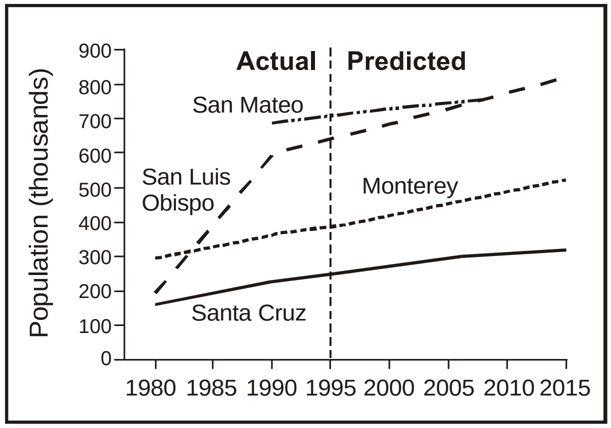

Figure 1-3. Actual and predicted population growth for Monterey and neighboring counties. (source: http://www.mbnms.nos.noaa.gov/sitchar/soci1.html.)

Aside from the incidental effects from trampling, tidepooling activities typically involve some form of collecting or handling of organisms. People may be unaware that their actions can cause long-term harm to the shoreline or that their activities are often unlawful. On the other hand, specimens may be collected legally under a scientific collecting permit issued by the California State Department of Fish and Game. Organisms typically collected under a scientific collecting permit are for voucher specimens, laboratory research, and aquaria. Poaching is a separate concern, in which species, such as abalone, are illegally harvested for consumption or sale. The uncertainty of the effects from all forms of human use has caused local interest groups to call for further enforcement of existing regulations and increased marine resource protection and conservation policies at Point Pinos.

Despite the potential for human impacts along the Point Pinos shoreline, there is no consensus among the various interest groups on the magnitude or ecological significance of the impacts. The existing viewpoints are largely subjective and anecdotal, but are supported by the knowledge that visitor use has been implicated in intertidal community impacts from visitor impacts in other areas. The lack of quantitative data on the nature, magnitude, and extent of visitor use at Point Pinos has justified the need for site specific impact studies in this area. Accordingly, this quantitative comparative visitor use study at Point Pinos was designed in cooperation with the City of Pacific Grove Point Pinos Tidepool Task Force Subcommittee on Research, comprised of representatives from the local public and scientific community, and the Monterey Bay Sanctuary Foundation. The study was funded by The David and Lucile Packard Foundation, the City of Pacific Grove, and the Monterey Bay National Marine Sanctuary.

1.3 Goals and Objectives

There were two primary goals of the study with the following objectives:

Goal 1: Describe patterns of visitor use:

- Obtain numbers on the distribution of people, what areas are used most, and during what times and seasons.
- Compile the types of activities observed, collecting records, citations, and warnings.
- Compare visitor numbers with other shoreline areas.

Goal 2: Determine if the diversity and abundance of the marine biota at Point Pinos has been measurably altered by visitor use:

- Describe what species and habitats have been potentially affected or are at greatest risk to poaching, casual visitor use, and collecting.
- Describe what changes can be attributed to natural causes.

An ideal sampling design for this type of study would have been to sample 'impact' and 'control' areas before and after (during) the impact (Stewart-Oaten et al. 1986). However, due to the lack of existing baseline data, our study approach necessitated the development of a new database to specifically compare species composition and abundance between areas of less visitor use near Point Pinos with areas of higher visitor use along the Point Pinos shore. Virtually all areas of the Point Pinos shore, adjoining portions of the coast, and the Monterey Peninsula in general, are accessible to some degree, and are therefore susceptible to some level of visitor impact. Therefore, we completed visitor census surveys to establish the biological studies in representative areas of high visitor use at Point Pinos and in areas of relatively lower visitor use in adjoining areas.

Large natural spatial variation in species composition and abundance, that is typically present along rocky shorelines, often makes it difficult to conclude visitor use as being the primary cause for the differences or a major factor contributing to differences. Accordingly, a difference in a single species found between areas may not provide substantive evidence to conclude that the difference was caused by visitor use. Consequently in the present study, differences between areas were attributed to visitor use only when they involved multiple species susceptible to visitor impacts.

Identifying visitor use as a factor contributing to differences in biological communities between areas could have also been addressed more definitively using an experimental approach. For example, visitor impacts could be strongly implicated in areas of visitor use if the areas were closed to access and subsequent abundances changed and converged with those of 'controls'. Another type of study would have been to manipulatively increase visitor use to impart greater impacts and follow changes relative to controls. However, these types of studies would have required commitment of substantial resources to a long-term study, including the authority to restrict or manipulate visitor access.

1.4 Environmental Setting

Point Pinos, located in the Monterey Bay National Marine Sanctuary (MBNMS), is a major rocky promontory of the Monterey Peninsula that forms the southern shoreline of Monterey Bay (**Figure 1-1**). The Point Pinos shoreline consists of granite outcroppings intermixed with boulder and cobble fields. Small sand beaches occur along the upper shore of many sections of the rocky intertidal zone. The general area is considered to be a biologically diverse and productive coastal zone in California. The heterogeneous rocky substratum combined with influences from nutrient rich, cold upwelled water results in a rich diversity of marine flora and fauna.

The general area is also regarded as a popular tourist destination for its scenic beauty, moderate climate, shopping, restaurants, and other visitor attractions. Historic Cannery Row, the City of Carmel, Monterey Bay Aquarium, and famous golf courses are nearby. The local shores also provide convenient opportunities for education and research. Several academic research institutions are located nearby. These include Hopkins Marine Station of Stanford University, the Naval Post Graduate School, Monterey Peninsula Community College, California State University, Monterey Bay, Moss Landing Marine Laboratories, Monterey Bay Aquarium Research Institute, and University of California, Santa Cruz.

The Point Pinos shoreline is exceptionally accessible, and therefore very susceptible to visitor impacts. While other popular intertidal areas may have only one main access path leading to the intertidal, the Point Pinos shoreline is accessible from numerous locations. The intertidal is only a few steps away from five unpaved parking lots adjacent to the shore (**Figure 1-4**). Each parking lot has about a 10-20 car capacity. Three of the parking lots have signs explaining tidepool etiquette in three languages (English, Spanish, Taiwanese) (**Figure 1-5**).

Figure 1-4. Parking lot adjoining the Point Pinos shore. Four other parking lots as this adjoin the Point Pinos shore.

Roads, densely populated neighborhoods, and the Pacific Grove Municipal Golf Course occur immediately inshore of the intertidal zone. The adjoining rocky shoreline southeast of Point Pinos extends to Lover's Point, another rocky headland and popular tourist area. Immediately down the coast from Point Pinos (southwest direction) is Asilomar State Beach. The shoreline of the State Beach is also primarily rocky, but at its southern end it merges with Moss Beach, a sandy surf swept area. The intertidal rocky shores to the immediate southeast and southwest of the Point Pinos shore have less visitor use, except for Lover's Point.

Figure 1-5. Tidepool etiquette sign at Point Pinos.

The City of Pacific Grove municipal sewage treatment plant once discharged approximately three million gallons per day of 1° treated effluent into Monterey Bay from an outfall located on the eastern side of the Point Pinos headland. Plant operations were abandoned in the mid-1970s when the sewage was redirected to another facility and outfall east of Monterey. The area of the Point Pinos headland has recovered from any biological impacts of the sewage discharge (Pearse et al. 1998).

1.5 Regulatory Setting

Numerous regulations at Point Pinos were enacted to help preserve the natural diversity of marine life. The regulations are complex, due to overlapping jurisdictions in the area among the California Department of Fish and Game (CDF&G), City of Pacific Grove, and California State Parks at Asilomar State Beach. Regulations concerning permissible visitor activities along the shoreline areas should be confirmed from those agencies. McArdle (1997), MBNMS (1999), and Brown (2001) provide overviews on the regulatory framework for the area (**Appendix B**).

The Pacific Grove Marine Refuge (**Figure 1-1**) that includes Point Pinos was established in 1952 by the City of Pacific Grove in recognition of its biodiversity and as a basis for resource conservation actions imparted by the City. The Refuge extends from the mean high tide line out to a depth of 18 m (60 ft) offshore, a distance of approximately 305 m (1,000 ft) from the shore. Subsequently in 1963, the CDF&G established the Pacific Grove Marine Gardens Fish Refuge that encompasses the same area to provide a basis for marine resource management and protection imparted by the State.

Point Pinos is centered within the City and State Refuges. Southwest from Point Pinos, both Refuges extend and overlap Asilomar State Beach. Southeast from Point Pinos, both Refuges overlap a State Water Resources Control Board Area of Special Biological

Significance (ASBS). The southeast boundaries of both Refuges and the ASBS terminate at the Hopkins Marine Life Refuge.

Because the Pacific Grove Marine Refuge and the Pacific Grove Marine Gardens Fish Refuge encompass the same intertidal zones and water body, there is overlap in City and CDF&G regulatory authority over the area. The City of Pacific Grove has regulatory authority over the Pacific Grove Marine Refuge, while the CDF&G has regulatory authority over the Pacific Grove Marine Gardens Fish Refuge. Asilomar State Beach and the ASBS overlap both Refuges, but do not have conditions that are more restrictive than those imparted by the City of Pacific Grove and CDF&G for their respective areas.

The CDF&G has designated that the Pacific Grove Marine Gardens Fish Refuge is a unique protected area that does not have the same status or regulations as other marine refuges, marine life refuges, state beaches, state preserves, or state underwater parks that are regulated uniformly within the California Fish and Game Code. The Pacific Grove Marine Gardens Fish Refuge has allowances and restrictions that are distinct from other protected areas. Accordingly, some CDF&G regulations that are designated for other protected areas are not applicable to the Pacific Grove Marine Gardens Fish Refuge.

City Ordinance 00-12 was adopted by the City of Pacific Grove in 2000, and places conditions that are more restrictive than those imparted by the CDF&G in the City's Pacific Grove Marine Refuge. For example, CDF&G regulations allow for the collection of up to 10 pounds (wet weight) of marine plants in aggregate per person per day without any license in the Pacific Grove Marine Gardens Fish Refuge, with the exception that no eelgrass (*Zostera*), surfgrass (*Phyllospadix*), or palm kelps (*Postelsia*) may be taken (Title 14, CCR: 30.00(a) and 30.10). However, City Ordinance 00-12 prohibits the collecting of all marine plants, based on the City's jurisdiction over the Pacific Grove Marine Refuge. Furthermore, up to one handful of non-living plant and animal material consisting of detached plants, pebbles, flotsam, and jetsam may be collected in the City's refuge.

Scientific collecting regulations are another example of more restrictive conditions established by the City. Scientific collecting permits are regulated and issued by the CDF&G. The permit may be individually modified for a specific site or permit holder. The CDF&G may authorize and limit the kind and number of specimens that may be taken, type of equipment and methods used, the time and seasons for collecting, and the areas where collecting may occur. Scientific collecting in the area was allowed prior to 1999. However, City ordinance 00-12 requires that scientific collecting in the Pacific Grove Marine Refuge also be approved by the City Manager. In 1999, the CDF&G issued a moratorium on granting scientific collecting permits for the Pacific Grove Marine Gardens Fish Refuge (Carrie Wilson, CDF&G, pers. com.). Since then and only under special circumstances has the CDF&G issued scientific collecting permits for the Pacific Grove Marine Gardens Fish Refuge, but approval must have also been granted by the City Manager. In May 2003, however, the CDF&G revised its policy regarding scientific collecting in the Pacific Grove Marine Gardens Fish Refuge (**Attachment 7, Appendix B**). The Point Pinos headland is presently 'split' in half with scientific collecting resumed southeast (upcoast) of the headland. In addition, scientific collecting permits for this area of the refuge will now be issued following screening that includes more specific questions on the purpose of collecting, the organisms to be collected, and reasons why the collecting must be done at Point Pinos (Paul Riley, CDF&G, pers.com.). The collecting of rocks or modifying geological features throughout the area is regulated by the MBNMS, but Pacific Grove Municipal Code Chapter 14.04.020 and 14.04.030 prohibits altering sand, gravel, and rocks in the Pacific Grove Marine Refuge.

Although 'Fish Refuge' implies that fishes are protected, fishing is allowed. Any person 16 years or older must possess a valid California sportfishing license in order to take or possess fishes. Some invertebrates may also be collected with a fishing license. Up to 35 sand dollars, 35 sea urchins, and 35 worms may be collected per person per day in the Pacific Grove Marine Gardens Fish Refuge and Pacific Grove Marine Refuge with a valid sportfishing license.

1.6 Report Organization

The study consisted of visitor use surveys combined with biological sampling to assess the magnitude and spatial extent of shoreline impacts that could be attributed to visitor use. The individual subtasks are reported separately in their appropriate sections:

- **Section 2.0 - Visitor Use Descriptions:** This section contains the results and findings from our census surveys, visitor questionnaires, bus visit assessment, and includes a compilation of collecting citations and warnings. Visitor numbers are also compared to other areas, and we include a description on how visitor numbers vary with seasonal tide conditions.
- **Section 3.0 - Biological Descriptions:** This section contains the sampling results and findings from our habitat-based surveys, species-specific surveys, and general surveys for species composition and abundance. This section also includes interviews with scientists familiar with the Point Pinos area for supplemental information not available in the literature.

  In reporting results we refer to species as 'taxa' or 'species'. Taxa is a more general term that often refers to several species grouped together because they are closely related. In the present report, we treat the terms 'taxa' and 'species' as having synonymous meaning since 'taxa', although consisting of a species complex, represents a biological entity as does 'species' in our analyses.
- **Section 4.0 – Integrated Discussion of Visitor Use and Biological Impacts:** This section incorporates the findings from all of the studies to evaluate potential impacts related to visitor use.

This study could not have been completed without assistance from a variety of people. They are acknowledged with personal references in the report, and their affiliations are listed in **Appendix A**.

2.0 Visitor Use Descriptions

SECTION SUMMARY

* ~85 % of the people observed in the study were in the parking lots and on the cliff banks.
* ~15 % of the people observed were down on the seashore, representing approximately 50,000 people that step into the Point Pinos intertidal zone annually. Research indicates that visitor use is over twice this amount at other popular rocky intertidal areas in California.
* ~18 % of the people in the intertidal zone were observed handling organisms, turning rocks, and displacing animals.
* The three tidepool etiquette signs are limited in communicating tidepool protection to tourists.
* 100+ individual buses associated with educational group field trips visit and use the Point Pinos intertidal zone annually. A wide variety of tidepool activities are associated with the bus visits. Significantly greater numbers of private charter buses of tourists pass through the area and may stop at Point Pinos, but do not necessarily use the intertidal zone.
* In general, there is a fairly effective network of surveillance and enforcement along the Point Pinos shoreline that helps to reduce potential impacts from visitor activities. Volunteer education outreach docents and concerned citizen groups help in this effort.
* Most use of the intertidal zone occurs in spring, winter, and late fall, coinciding with lowest tides that occur during the mid-day.

Several tasks were completed to develop an account of visitor use at Point Pinos. The study approach and findings are described below for:

- Visitor distribution in relation to shoreline resources
- Visitor activities
- Demographics and other personal visitor information
- Bus visits
- Surveillance, collecting violations, and advisories
- Use associated with time of year
- Comparisons of visitor numbers with other areas

2.1 Visitor Distribution

Purpose

Census surveys were completed to describe patterns of visitor distribution along the Point Pinos shore and adjoining areas.

Background

Before establishing our visitor use and reference biological stations we needed to determine which areas were most heavily used by visitors and which areas had little use that could be used as control (reference) locations. A previous study by Clowes and Coleman (2000) provided counts of people at Point Pinos in spring 2000, but they did not include adjoining areas. In the present study, we further substantiated the patterns of visitor distribution at Point Pinos, but also extended the census surveys to areas immediately southeast and southwest of Point Pinos.

Methods

The stretch of coast encompassing Point Pinos was divided into 27 segments from Third St., near Hopkins Marine Station, to Moss Beach at the southern end of Asilomar State Beach (**Figure 2-1**). The segments were separated and identified by geographical features (e.g., rocky outcroppings, pinnacles, etc.), and ranged in length between 47 m and 484 m (51–529 yds) (average of 208 m, 227 yds). The length of each segment was determined by having no fundamental change in the nature of access along the length of its shore. For

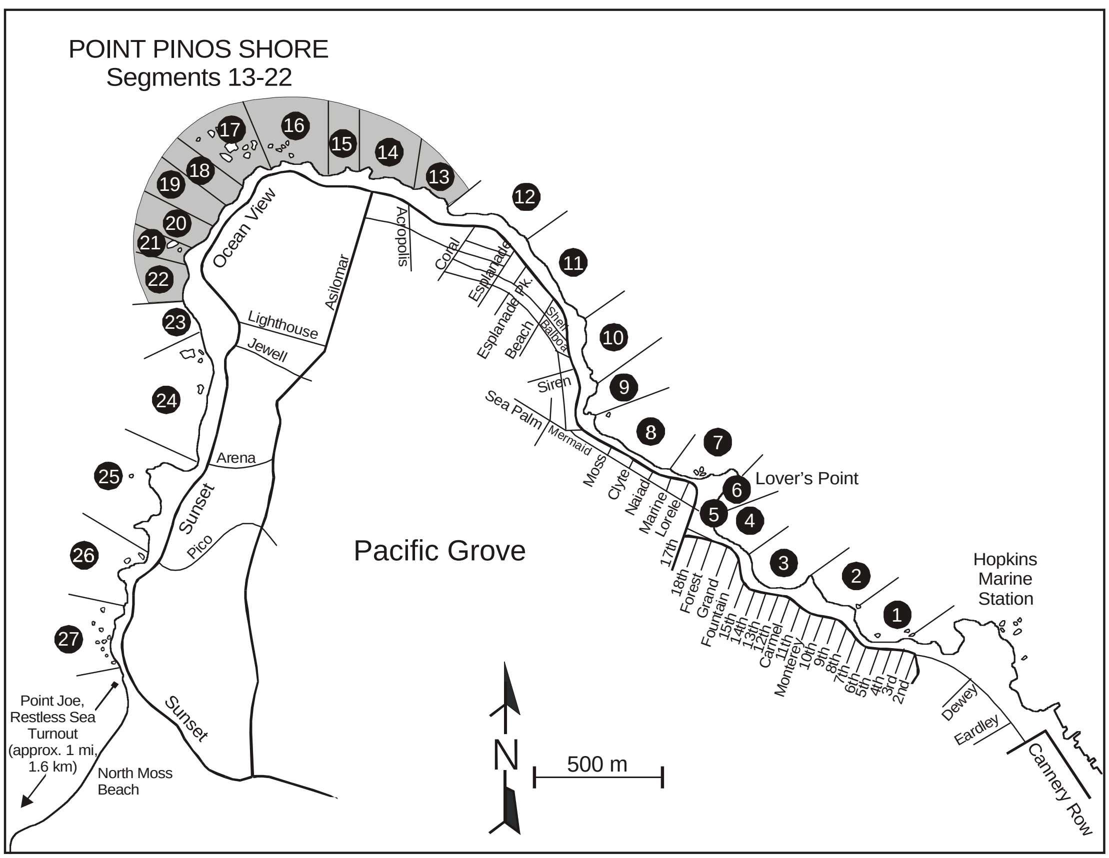

Figure 2-1. Visitor count segments.

example, a segment with difficult access to the intertidal zone (steep drop off from the embankment to the ocean) would be separated from an adjoining segment with easier shore access provided by foot paths. Segments 13 to 22 comprised the Point Pinos shore, the same stretch of shore surveyed by Clowes and Coleman (2000).

Counts of people were made in each segment during 1-2 hour intervals in 47 surveys spread over 16 months (October 2, 2001 to January 16, 2003). In each survey, the numbers in each segment were distinguished according to where the people were located along an elevation gradient up and down the slope of the shore as follows:

- Parking lots and turnouts near the shore (sitting and sightseeing from cars)
- Top of embankment, standing in parking lots, and on walking trails (jogging, walking, standing, bicycling)
- On sandy pocket beaches
- Intertidal splash zone and higher (characterized by rocks that are most often dry and barren)
- Upper-rocky intertidal zone (characterized by rockweeds and barnacles, +3 to +5 ft MLLW)
- Mid-rocky intertidal zone (characterized by foliose algae, 0 to +3 ft MLLW)
- Low-rocky intertidal zone (characterized by surfgrass, 0 ft MLLW)

The surveys were made on foot, beginning at Hopkins Marine Station, passing around the Point Pinos shore, and ending at North Moss Beach or vice versa. Therefore, each survey provided a 'snapshot' of visitor counts and distribution in each segment. This was to avoid counting people more than once as they moved about. Weather and sea state data were also recorded for each survey.

Volunteers of Bay Net, a non-profit marine science education outreach program, completed all of the visitor surveys. Accordingly, the actual survey days were completed based on the availability of volunteers. Under ideal circumstances, visitor use surveys should be completed to account for all types of days, times of the day, tidal levels, weather, etc. (Underwood and Kennelly 1990). Although not conforming to this ideal sampling strategy, the surveys were completed at various times of day, tidal levels, and generally good weather conditions (**Appendix C**). The results were to provide relative counts of people among areas to establish our biological sampling stations in areas of 'high' visitor use relative to areas of 'lower' visitor use. Consequently, all surveys did not need to be completed only during the lowest occurring tides.

Visitor numbers differed among the census segments related to location, ease of access, and segment length. Therefore, to compare visitor densities between segments, the visitor counts for each segment were standardized to a common shoreline distance of 100 m

(109 yd). Visitor densities could have also been standardized based on the spatial area of the intertidal zone, as the width of the intertidal zone varied among segments. At Point Pinos, however, most people did not utilize the full width of the intertidal zone, but tended to focus on the area nearer the high tide level at the embankment of the shore. Accordingly, we compare levels of visitor use for the segments corrected for shoreline distance rather than the spatial area of the intertidal zone. The latitude and longitude of the end points of each segment were recorded using a geographic position system (GPS) with an accuracy of less than 3 m. The segment distances were then determined using a geographic information system (ESRI Arc-Info).

The data that were most pertinent to our study were counts of people in the rocky intertidal zone to establish our biological sampling stations. Consequently, counts of people on the sandy beaches, on rocks above the intertidal zone, on the walking trails, and in the parking lots were not used, except in describing overall visitor attendance and use of the Point Pinos area.

The Restless Sea Turnout site and Hopkins Marine Station (**Figure 2-1**) were ultimately included as reference sites in our biological sampling (see *Section 3.0 – Biological Descriptions*). However, no counts were made at those locations since public use at those intertidal zones was considered to be low or absent. The Restless Sea Turnout area is located near Point Joe along 17-Mile Drive on private Del Monte Property. The area is used mainly as a scenic stop and vantage point for tourists. A wood fence rail along the shorecliff deters people from accessing the intertidal zone. The Hopkins Marine Station intertidal zone is also not used greatly by the general public, but is an area of relatively high research activity. The Station is enclosed by a fence with an entrance gate, and has a caretaker to provide additional site security.

Results

Nineteen surveys were completed prior to biological sampling to identify areas of ‘high’ visitor use and areas of ‘lower’ visitor use. The results of the surveys were continued during and after the biological sampling period to further validate the distribution of people. This provided a total of 47 census surveys completed over the course of the visitor count study (October 2, 2001 to January 16, 2003). A total of 8,762 people was observed in the surveys of people above and within the intertidal zone. Three of the surveys only included the Point Pinos shoreline (Segments 13 to 22) in which 319 people were counted. Data from the three surveys of only the Point Pinos segments were not included where shoreline comparisons required a single data set for all 27 segments to determine areas of high and low use in the rocky intertidal for establishing our biological stations. All surveys were conducted during days of relatively good weather and non-stormy seas when people would tend to use the intertidal zone.

Distribution of People Along the Shore

People in the rocky intertidal zone were found to be most abundant along the Point Pinos shore, but were abundant at Lover's Point as well (**Figure 2-2**). The data represent the percent frequency of counts in each segment of the study region, standardized according to the number of people counted in the rocky intertidal zone per 100 m length of shoreline. People counted on sand beaches and higher on the shore (e.g., in parking lots) are not included in **Figure 2-2**. Fishers are also not included, since they fish from a variety of heights on the shore that include rocks above the intertidal zone.

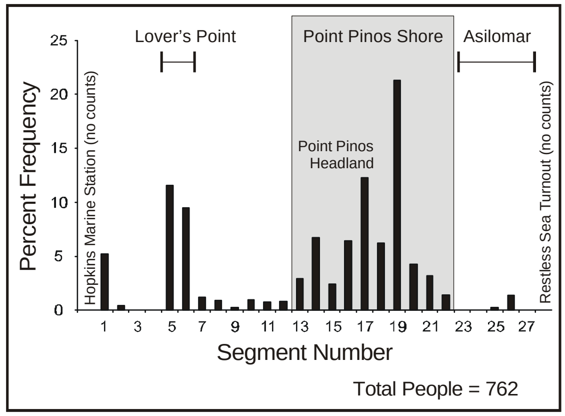

Figure 2-2. Distribution of people along the coast in the rocky intertidal zone (excludes beaches).

The Point Pinos segments differed in densities of people. The Point Pinos headland (Segment 17) had relatively high levels of visitor use, but highest counts overall were tallied in Segment 19 located about 250 m (273 yd) southwest of the Point Pinos headland.

Distribution of People Up and Down the Slope of the Shore

The general distribution of people up and down the slope of the shore indicates that most people who visit the Point Pinos shore (Segments 13 to 22) tend to remain well above the intertidal and do not venture down near the water (**Figure 2-3**). We found that 85 % of the people observed (2,528 individuals) occurred in the parking lots, on the cliff trails, and on rocks well above the intertidal zone. The remaining 15 % of the people observed (449 individuals) were on the intertidal sand beaches and rocky intertidal zone, with numbers that decreased down the slope of the shore to the water from the upper sand beaches down through the rocky intertidal.

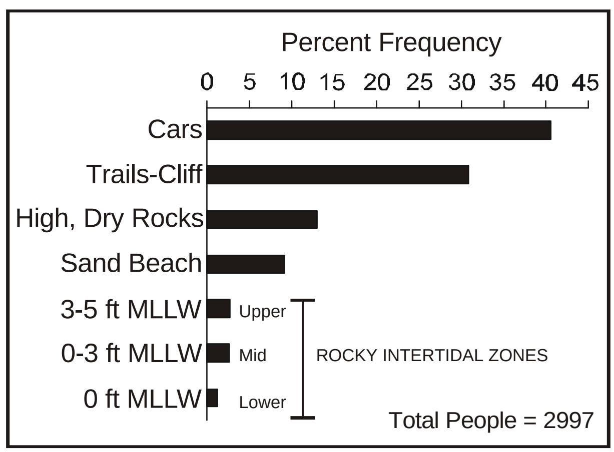

Figure 2-3. Distribution of people down the slope of the Point Pinos shore (Segments 13-22). Data do not including fishers.

It must be acknowledged that everyone visiting beaches and the rocky intertidal in the study sites must start out from parking lots and cliff trails. However, if large numbers also venture down to the beaches and intertidal zones, then the numbers of people in the parking lots should be relatively equivalent to the numbers down on the seashore. Numbers would be highly variable if all arrived at one time, left their cars, then returned. However, people arrive and depart from Point Pinos constantly. In nearly all cases we observed a larger number of people in the parking lots and on the trails, compared to the seashore.

Discussion

The purpose of the surveys was to obtain data on visitation along the coast in order to establish our biological sampling stations in areas of ‘high’ visitor use and in areas of ‘lower’ visitor use. We acknowledge that Point Pinos and much of the Monterey Peninsula shore can be accessed by people. Consequently, it is highly unlikely that any area is completely protected from visitor impacts, including our reference stations. The surveys were implemented primarily to obtain information on the relative distribution of people along the shore in the intertidal zone, and not designed to sample numbers that may be present only during the lowest occurring tides. It was assumed that surveys, even during moderate tides and regardless of day, would provide the same information on distribution of visitors along the shore as periods with lower tides, although actual densities of people may differ.

Distribution of People Along the Shore

The results of the surveys supported our expectation that the Point Pinos shore is the area of highest visitor use in the study region, although visitor use was found to be concentrated at Lover’s Point as well (**Figure 2-2**). Also, there was no gradient of visitor densities along the Point Pinos shoreline (e.g., from segment 13 to 22) because the entire stretch of shore has multiple entry points for accessing the intertidal zone. The reason for the higher numbers in Segment 19 remains unknown, but it may be because the parking lot there has a relatively wide view of the intertidal zone, the shoreline and parking lot are good vantage points to see the Point Pinos headland, and abundant tidepools occur nearby. In addition, we found that the distribution of people among the various Point Pinos segments was similar to that found in an earlier study of the same area done by Clowes and Coleman (2000).

Lover’s Point is also a popular area. The concentrations of people observed at Lover’s Point were associated with the area’s adjoining public amenities consisting of restaurants, hotels, a grass park, beach, and concessions. We did not complete biological studies at Lover’s Point, although this would have been of interest for comparisons to our Point Pinos data (see *Section 3.0 – Biological Descriptions*). With limited resources we chose to complete as much sampling at Point Pinos as possible, rather than begin new studies at Lover's Point.

Distribution of People Up and Down the Slope of the Shore

We found most people along the Point Pinos shore (Segments 13 to 22) were in locations well above the intertidal zone (85 % of the counts), regardless of tidal conditions. This pattern is generally similar to that found by Clowes and Coleman (2000) who completed all of their observations during low tides, and found approximately 55 % of the people in the parking lots, 27 % on the intertidal beaches, and 15 % in the rocky intertidal.

Our observations and those of Clowes and Coleman (2000) also indicate that most people who venture into the intertidal zone tend to spend most of their time in the upper versus lower elevations. There are several likely reasons:

- The upper intertidal has more dry bare rock, and therefore safer footing than the lower intertidal, which is covered with slippery algae.
- The upper intertidal is exposed for a greater amount time than the lower intertidal.
- People do not tend to wander close to the water, due to the risk of getting splashed by waves.
- People are not always appropriately dressed to explore the wet areas of the low intertidal (e.g., wearing rubber boots).
- The increasing possibility of slipping probably separates the people who venture further down the slope of the shore by age-class. For example, elderly people would likely not go out as far or stay out as long as young people, contributing to lower potential numbers of people in the offshore intertidal areas.

The general similarity of results between our study and Clowes and Coleman (2000) indicates that visitor use occurs as a gradient with fewer people down the slope of the shore to the waterline. If the shore consisted of an elevated smooth, flat rock platform, people might be expected to utilize a greater width of the intertidal zone. However, Point Pinos lacks these types of platforms, and is characterized by high relief rocks that make it difficult to move through the intertidal zone.

Annual Visitation

We estimate from extrapolating the census data of people in the intertidal zone that 30,000-50,000 people visit the rocky intertidal zone each year in the Point Pinos segments (for calculation methods see *Section 2.7 - Comparison of Visitor Numbers with Other Areas*). However, most of our surveys did not fully account for weekends and holidays when visitor use would be expected to be higher. Consequently the 30,000 value may be an under-estimate of annual visitor use. In contrast, Clowes and Coleman (2000) completed their census surveys specifically during low tides during the relatively high visitor use spring season, and included weekdays and weekends. Numbers from their study provide the higher annual estimate of 50,000 people. This may represent a closer approximation to actual annual visitor use, because it represents a greater number of low tides when more people would tend to visit the intertidal zone.

The 50,000 annual visitation estimate is equivalent to a daily average of less than 150 people visiting the intertidal zone. Although we have no estimate of the daily range, highest numbers probably occur most often during weekends and holidays and particularly when bus trips coincide with days of high general public use. Although we never observed hundreds of people at one time in the intertidal, the potential does exist. On the other hand, many hundreds, perhaps thousands, of people may visit the Point Pinos area each day when considering the counts in the parking lots and on walking trails.

2.2 Visitor Activities in the Intertidal Zone

Purpose

Observations and records of visitor activities were made during the census surveys to quantify what people generally did while visiting the intertidal zone.

Background

People will engage in various activities in the rocky intertidal zone, ranging from passively standing and walking from rock to rock, to turning rocks and collecting animals. We recorded observations to acquire baseline data on the frequencies of these types of behaviors.

Methods

The numbers of people observed in the rocky intertidal zone and on the beaches were classified into three types of activities:

- ‘Active’ (handling organisms, rock turning)
- ‘Passive’ (standing, kneeling, walking, observing without turning rocks)
- Fishing

Results

We observed 70 fishers and a total of 762 other people in the upper, mid, and lower rocky intertidal zones. People on the beaches were excluded, due to their activities at the time of the observation (walking, sitting, standing) having no potential impact to rocky intertidal habitats. Eighteen percent of the people that were not fishing were engaged in some other form of rocky intertidal ‘active’ tidepool activity (e.g., handling or touching organisms, lifting rocks) versus passively standing, kneeling, or walking.

Most of the fishers observed in the study region were in the Point Pinos segments with most of the fishing occurring from a rocky area about 200 m southeast of the Point Pinos headland (Segment 16). We interviewed only three fishers (**Appendix C**). Two were from the Monterey area, and the other was from Santa Maria located approximately 177 miles (285 km) south of Point Pinos. All indicated that they acquire their bait from stores, and did not pull mussels or other invertebrates from the rocks to use as bait. Two stated that they fish in the Point Pinos area approximately 50 times per year with each fishing trip lasting several hours. All were fishing for whatever was available (i.e., none were targeting a particular species).

Additional visitor activities were noted in Bay Net advisory logs (**Appendix D**). The results are further described below (see *Section 2.5 - Surveillance, Collecting Violations, and Advisories*). Bay Net logged 34 advisories during the study, which we defined as contacts between docents and visitors as a result of some action suggesting the possibility of illegal collecting, etc. Most of the advisories were with people who had buckets, cups, bags, or pry bars. The majority of individuals stated that they did not know the Point Pinos area was a marine protected area where collecting is not allowed. A few did know, but stated that they had planned to return the animals. The most common explanation for the collecting was ‘no particular reason other than for showing to friends and relatives’, not for consumption, aquaria, bait, or education. The organisms were replaced after having been informed that collecting was illegal. Nearly all people questioned were visiting from out of the area, as close as San Jose, California and as far away as Asia.

Discussion

The census surveys provided only a ‘snapshot’ of visitor activities. About 18 % of the people observed in the rocky intertidal zone were engaged in some form of active behavior. This consisted mainly of collecting, versus just standing, kneeling, or walking. However, we presume that a majority of people who traverse the intertidal zone will eventually handle an animal, pick up a shell, lift a rock, and perhaps collect, etc. All of these types of activities are not always seen in ‘snapshot’ surveys because the duration of the action is short. Consequently, the probability of witnessing all potential activities is small. Our observations of people engaged in ‘active’ tidepool activities (18%), however, is remarkably similar to that found by Addessi (1994) in San Diego where she noted that approximately 20 % of the visitors at any given time were observed collecting or displacing animals. Almost all instances involved rock turning.

Our 34 Bay Net advisories are small in comparison to southern California records. Murray et al. (1999) noted that lifeguards in Orange County have issued an annual average of over 25,000 advisories over the past several years. The larger advisory numbers for southern California are likely the result of the lifeguards being on duty for longer periods each day over consecutive days, and larger numbers of visitors. In contrast, our Bay Net observations and contacts were made over a shorter duration; 1-2 hour periods approximately four times per month over the 16 month survey period.

The potential impacts to the intertidal community depend on the severity of the actions and the frequency with which they occur. Although the action of someone picking up an animal and then replacing it is a form of collecting, it is less severe than someone carrying the animal to a different location or collecting it to take home. Nearly all of the Bay Net advisories were to people who had already collected organisms, and they were from out of the area. This may indicate that the local public has a greater understanding of the environmental regulations and political and social sensitivities of the area with regards to public use.

We know from first hand experience that illegal collecting occurs at Point Pinos. One foggy morning at approximately 4:00 A.M. we were conducting our sampling. A man and woman (both adults) with flashlights appeared near our sampling area. The man asked: “So what are you guys here hunting for tonight?” The man was holding a large knife, and said he was here to get some crabs and perhaps abalone for dinner. We informed him that this was a marine protected area where collecting is not allowed. He said: “Yes I know”. The man and woman then went on their way. They were obviously there to illegally collect in the protective cover of darkness.

2.3 Demographics and Other Personal Visitor Information

Purpose

Visitors were interviewed using a survey questionnaire to determine the demography and other characteristics of the people who visit Point Pinos.

Background

The visiting population consists of residents and tourists. Interviews were conducted to determine social aspects of the visitors to Point Pinos.

Methods

Bay Net volunteers took opportunities during the surveys to complete individual questionnaires with various people to characterize the visiting population based on the following categories:

- Demographics (residence)
- Purpose of visits
- Time, frequency, and duration of visits
- Extent of tidepool exploration
- Understanding of resource protection at Point Pinos

Fishers were also asked about their catches, time spent fishing, type and source of bait, and whether they were local residents or tourists. The results of the fisher interviews are also discussed with the descriptions of visitor activities (*Section 2.2*).

Results

Bay Net interviewed 18 individuals in the field (**Appendix C**).

Demographics

By chance, none of the interviewees were from the Monterey Peninsula area. The closest residence was Salinas, California while the farthest was Taiwan. Most of the other interviewees were from other places in central California and inland to Fresno.

Purpose and Rationale of Visits

Nearly all of the interviewees indicated that they visit Point Pinos for multiple reasons that include the area's scenic beauty, diversity of marine life, ease of access, proximity to other attractions, and clean environment. Most indicated that their visits tend to be more for passive relaxation, tidepooling, and enjoyment of the area's beauty rather than for activities that require more planning, such as kayaking and fishing.

Time, Frequency, and Duration of Visits

Many of those interviewed indicated that they visit Point Pinos several days per year. Because all interviewees were from out of the area, most indicated that they come mainly during weekends and holidays. They typically plan their visits for the afternoon versus morning and evening with each visit lasting about two hours.

Extent of Tidepool Exploration

Most interviewees said that when they venture into the intertidal zone they go out as far as where it starts to become 'slippery'. We interpret this as the mid-intertidal zone where there is a sufficient diversity of plants and animals to maintain interest and curiosity without the greater risk of getting wet or falling.

Understanding of Resource Protection at Point Pinos

The frequency of return visits was expected to be positively correlated with an understanding of resource protection at Point Pinos. Fourteen of the 18 interviewees had been to Point Pinos previously, while four were experiencing their first visit. Almost all of the 14 returnees (86 %) knew that Point Pinos was a protected area, but only one-third (36 %) were aware of the signs explaining tidepool etiquette, which had been in place for over a year. The four interviewees that were visiting Point Pinos for the first time were unaware that Point Pinos was a protected area and had not seen any signage.

Discussion

Our results characterizing the demography and activities of the general public are limited, as only 18 people were interviewed. The results, however, indicate that Point Pinos is visited by a variety of people from various places within California and around the world. The responses clearly indicate that people enjoy Point Pinos, and will return on other occasions. Any management considerations will need to accommodate the reasons that people come to visit and return to the area. The results also indicate that the tidepool etiquette signage has been of limited use in communicating to visitors the restrictions placed on handling, collecting, and displacing tidepool organisms. Although the signs had been in place for over a year, many people did not know the signs existed or had not read them even though they had been to Point Pinos before.

2.4 Bus Visits

Purpose

Groups that arrive by bus at Point Pinos create pulses of high visitor use near the parking areas. The sporadic high numbers of people often raise immediate concern for the health and protection of the marine biota. Here we have gathered information on the frequency of bus visits to Point Pinos, organizations that accommodate the group visits, and types of associated tidepool behaviors observed.

Background

Schools, clubs, youth groups, and private organizations commonly visit Point Pinos via bus and van pools. The area is easy for bus visits with the large parking lots near the intertidal zone. Because the area is open to the public, can be easily accessed by public roads, and there are no occupied entrance gates to monitor the traffic, there have been no previously compiled tallies on the number of bus trips that visit Point Pinos.

Methods

Although our Bay Net volunteers noted the occurrence of four bus visits over the course of their visitor surveys, we made additional contacts with people knowledgeable of group visits to provide more information for estimating the frequency of bus trips to Point Pinos.

Results

Annual estimates of the numbers of buses that arrive and use the intertidal zone of the Point Pinos shore are portrayed by organization in **Figure 2-4**. The following provides a description of the various organizations and basis for the estimates.

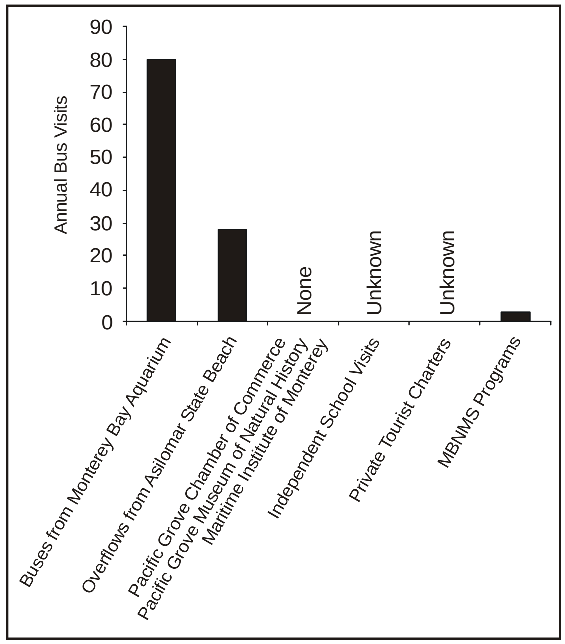

Figure 2-4. Estimates of annual bus visits that use the Point Pinos shore.

Monterey Bay Aquarium

The Monterey Bay Aquarium receives hundreds of group visits annually, with each group arriving in one to several buses. (The following information was obtained from Rita Bell, Monterey Bay Aquarium, Education Program Manager). During the school year, approximately 60,000 school children visit the Aquarium via bus trips. During the summer, an additional 20,000 children visit the Aquarium associated with group trips. Assuming that 50 people constitute an average bus load, approximately 1,600 individual buses arrive at the Aquarium per year. Many of the groups tend to be from the local Monterey Bay area with fewer coming from farther away (e.g., San Jose, Salinas, etc.). The highest numbers of groups visit the Aquarium during spring.

It is estimated that less than five percent of the bus trips that visit the Aquarium extend their trip to the Point Pinos tidepools and shoreline, although specific records of this are not kept (Rita Bell, pers. com.). This is equivalent to approximately 80 individual buses per year that visit Point Pinos from the Monterey Bay Aquarium (**Figure 2-4**). The educational program of the Aquarium includes a field trip planning guide that is sent to school classes beforehand. This includes education materials and field trip tidepool etiquette guidelines for the visitors and for the bus drivers (e.g., turn off engines when parked, etc.). Most bus trips need to return home within normal school hours, and therefore there is not a sufficient amount of time for all bus trips to visit the Aquarium plus complete a field trip to the intertidal zone. The Aquarium also occasionally provides docent led field trips to Point Pinos that are associated with education programs for teachers.

Asilomar State Beach and Conference Grounds

We estimate that approximately 28 individual buses totaling over 1,000 students go to Point Pinos each year, as overflows from the Asilomar State Beach and Conference Ground marine science interpretive program (**Figure 2-4**). The Asilomar State Beach and Conference Grounds is part of the California State Park system. The 107 acre coastal property is located approximately 0.3 mi (0.5 km) southwest of the Point Pinos headland (**Figure 1-1**). The Asilomar facilities provide accommodations, meeting rooms, and food services for state agencies, business groups, weddings, reunions, etc. The facilities also have planned environmental interpretive programs for groups seeking to visit the Asilomar State Beach tidepools, but not necessarily staying at the conference facilities.

The following information was obtained from Dennis Hanson (Asilomar Superintendent) and Roxann Jacobus (Park Ranger). The Asilomar State Beach tidepool interpretive programs are structured for school groups ranging from kindergarten through 12th grade. Each school group is divided into sub-groups of 5-6 people to limit the number of tidepool visitors at any given time on the Asilomar State Beach rocky intertidal zone. Each sub-group is led by an education outreach interpreter and chaperone. The sub-groups are rotated between sandy beach-based activities and tidepool-based activities approximately every 15 minutes until all groups have been able to explore the tidepools . Each sub-group taken into the rocky intertidal is led to a different, but nearby area, to reduce overuse of the same areas.

There have been 6-12 trips per year on average in recent years at Asilomar State Beach led by the Asilomar program. The Asilomar program receives another six trips per year from smaller schools, youth groups, etc. that come in van/car pools to visit the Asilomar State Beach tidepools. Approximately 30 percent of the visiting bus groups stay overnight at the Asilomar Conference Grounds or nearby and combine a tidepool visit with a Monterey Bay Aquarium visit.

Many schools, however, decide that they do not have a sufficient amount of time for the rotational procedure used by the Asilomar program at Asilomar State Beach. As an alternative, these schools will often shift their activities to Point Pinos where there are no limits on the numbers of students in the intertidal zone at one time. Asilomar Park Rangers and interpreters may follow the bus trips to Point Pinos to provide interpretive information. This amounts to approximately 14 trips each year that decide to go to Point Pinos rather than Asilomar State Beach. Each of these trips typically consists of two buses totaling 60-90 students. This is equivalent to approximately 1,000 students each year that go to Point Pinos independently as overflows from the Asilomar interpretive program (**Figure 2-4**), assuming there are 75 people per trip (range midpoint) for two buses and there are 14-two bus trips per year.

Independent School Bus Visits

An unknown number of schools and organizations visit the Point Pinos intertidal zone in bus and van pools that are independent of the Monterey Bay Aquarium and Asilomar State Beach programs. Although independent school trips can be considered as commonly occurring at Point Pinos, we had no means to estimate their frequency of occurrence.

Private Tourist Charters

Private bus charters for tourists groups are commonly seen driving around Point Pinos or stopped in the parking lots. The total number of buses remains unknown. They originate from many places, and are guided to the area by many different travel agencies and other sources.

Many of the private charter bus trips are related to visits to the nearby Del Monte Forest Property/Pebble Beach area via 17-Mile Dive. Approximately 3,000-4,000 individual charter buses tour the 17-Mile Drive area each year, based on tallies over a nine year period (data provided by Roxaynne Spruance, Environmental Compliance Manager, Pebble Beach Co.). Daily levels are highest during summer. Some of these buses may extend their coastal sightseeing trip by leaving the 17-Mile Dive gate near Asilomar State Beach and continuing on Sunset Drive to pass around Point Pinos. The total number of private charter buses that stop or pass by Point Pinos is not known, but up to 20 individual charter buses per day driving through the area can be very common during the summer and holidays (Moe Ammar, President Pacific Grove Chamber of Commerce, pers. com.). Many are foreign groups (Roxann Jacobus, pers. com.), and if they stop, most of the tourists do not collect any organisms from the tidepools. A possible reason is that they are not adequately dressed to explore tidepools. It is felt that most tourists are mainly interested in the scenic beauty of Point Pinos and typically do not wander down into the intertidal. Some collecting does occur, however, which involves mainly sea stars and some shell gathering for souvenirs (Roxann Jacobus, per. com.).

Other Tour Group Organizations

Several other visitor associations were contacted regarding bus visits to Point Pinos. We found that they generally do not direct or lead bus trips to Point Pinos. The Pacific Grove Chamber of Commerce does not provide field trips to intertidal zones, but they do provide information about the area’s local tourist attractions that includes tidepooling (Penny Worley, Membership Director, pers. com.). Most people who inquire about vacation attractions are individuals and families, not tourist agencies. The Maritime Institute of Monterey (branch of the History and Art Association) also caters to tourists, but only for tours of its own facilities. They do not direct bus trips to Point Pinos or other intertidal areas (Alys Bliesner, Education Coordinator, pers. com.). The Pacific Grove Museum of Natural History also schedules bus visits for tours of its own facilities. They also do not direct bus trips to the tidepools as an additional activity (Ron Kettlewell, Museum Education Specialists; Dr. Steven Bailey, Museum Director, pers. com.). In fact, staff at the museum discourage tidepool visits when asked by the bus groups. The MBNMS does not have a broad-based education outreach bus trip program for leading groups to the tidepools. However, they do work each year with 1-3 specially arranged groups in leading visits to the tidepools (Liz Love, education specialists, MBNMS, pers. com.).

Bay Net Observations

Bay Net noted the occurrence of four bus visits during their surveys. One was Dr. John Pearse's biology class for the MBNMS Long-Term Monitoring Program and Experiential Training for Students (LiMPETS). The other three bus visits were school groups from out of the area. Two of these bus groups had collecting materials. All three groups knew that the area was protected and the leaders/docents had discussed tidepool etiquette responsibilities with the students. The ratio of docents to students in these three independent bus groups was as low as two docents for over 80 students.

Discussion

The school group trips associated with the Monterey Bay Aquarium and the Asilomar State Beach and Conference Ground education programs likely account for a large percentage, perhaps the majority, of bus groups who visit and explore the Point Pinos intertidal zone. We estimate that the combined total from both programs is slightly above 100 individual buses per year. This is equivalent to approximately 5,000 people, assuming each bus carries about 50 people. Unknown additional numbers of group visits to Point Pinos are associated with private tourist charters, schools, and organizations who visit Point Pinos independently.

The pulses of people on the shore from the bus trips raise attention and concern for potential impacts to intertidal biota. Many of the passengers, teachers, and leaders of bus visits likely have some understanding of proper tidepool etiquette, but nevertheless, various types of behaviors can be seen. The following are examples of some of the tidepool and seashore uses observed with group visits.

During the study we witnessed a bus visit at Point Pinos that had just come from the Monterey Bay Aquarium. It was a high school group of approximately 60 students from Santa Barbara, California. It appeared that the purpose of the visit was to provide some leisure time prior to the drive back to Santa Barbara. The weather was nice and the tide was still relatively low (ca. +0.6 ft MLLW). We observed very few students going into the intertidal zone, probably because they were not appropriately dressed to venture near the water. They had no collecting materials or buckets. Nearly all of the students remained on the bank top or on the high barren rock promontories well above the intertidal zone. The students may have been instructed to not go near the water.

On another occasion we came across another group visit at Point Pinos that was led by the Monterey Bay Aquarium docents. Most of the 50 people in the group were adults. Nearly all were in the intertidal zone, but none was collecting or mishandling organisms. The people were gathered in several groups of 6-10 people. Each group appeared associated with an instructor. It seemed that the group was there for educational purposes, and were well aware of the potential impacts caused by collecting, rock turning, and displacing organisms.

The Coalition to Preserve and Restore Point Pinos Tidepools (Tidepool Coalition) observed a school bus trip of approximately 50 children at Point Pinos (**Appendix D**). The teachers of the bus group provided paper plates to the children for collecting animals. The teachers remained on the beach while the students collected bat stars and moved animals from the lower intertidal zone to the upper intertidal zone. One student had six bat stars on her plate. A Tidepool Coalition monitor approached the group and teachers and distributed handouts explaining tidepool etiquette. Captain Carl Miller (City of Pacific Grove Police Dept.) was notified of the incident.

We also witnessed an elementary class that arrived in a van pool. They were from a local school. The teacher was well aware of tidepool etiquette and the political and social sensitivities of the area. The children were well disciplined in the field. They had notebooks and papers but no collecting equipment.

Ms. Roxann Jacobus (Park Ranger, Asilomar State Beach) has commonly seen bus groups of children spreading through the intertidal zone without immediate supervision nearby. Some have come to Point Pinos from the Monterey Bay Aquarium. In some cases, the bus stops were done to provide free time for the children to expend energy and for the chaperones to take a break. Children have been observed collecting and bringing animals back to show the teachers and chaperones. In these instances, Ms. Jacobus has sent out statements to the schools, teachers, and principals requesting that these types of inappropriate behaviors be discontinued because of the potential to significantly harm the intertidal resources. The notifications have been effective in reducing these kinds of unsupervised visits.

2.5 Surveillance, Collecting Violations, and Advisories

Purpose

This section presents a description of surveillance and enforcement at Point Pinos and a review of available collecting citations and advisories.

Background

Enforcement and advisory records provide documentation on the known levels of illegal collecting, species collected, and types of inappropriate tidepool behaviors.

Methods

CDF&G enforcement records were compiled from information made available from Captain Tim Olivas (CDF&G). We were not able to access records ourselves, due to reasons of confidentiality. Captain Carl Miller (City of Pacific Grove) provided police department records, which included citations and warnings issued by Asilomar State Beach rangers.

Bay Net and the Tidepool Coalition (Coalition to Preserve and Restore Point Pinos Tidepools) furnished additional observations. Bay Net and the Tidepool Coalition provide on-site marine science interpretation and conservation education to the general public. Whenever possible, the monitors made contact with people at Point Pinos who were observed mishandling organisms (e.g., collecting, displacing animals, leaving rocks overturned). In these instances, the individual(s) were advised of the improper activity, while at the same time provided proper tidepool etiquette information. When collecting was observed, monitors saw that the organisms were properly returned to the field. Logs were kept of each incident.

Results

Descriptions of Surveillance

Point Pinos and the immediate adjoining shorelines are routinely surveyed by three resource protection agencies (CDF&G, Pacific Grove Police Department, and California State Parks at Asilomar State Beach). In 2000, the City of Pacific Grove Police Department created an environmental resource protection officer position with the specific role to ensure that the Point Pinos shoreline has adequate patrolling, surveillance, and response for illegal collecting and other inappropriate tidepool behaviors. Since 2000, patrols of the area have occurred almost hourly, day and night. Asilomar State Beach rangers also conduct routine patrols of the Asilomar region. Asilomar rangers will take the additional initiative to contact groups larger than 5-6 people gathered on the Asilomar State Beach rocky shoreline, regardless of their activity. Patrols by CDF&G wardens and officers have occurred about once per week over the past several years, depending on weather, tide conditions, and staff availability. However, patrols will probably occur less frequently with budget and staff reductions in the enforcement division (Donald Kelly, CDF&G, Lieutenant Marine Region, pers. com.).

Two other organizations also conduct surveillance at Point Pinos. Docents of Bay Net occasionally witness inappropriate tidepool activities by visitors. As of October 2001, Bay Net has kept formal documentation of the incidents. The Tidepool Coalition, a Pacific Grove special interest citizens group, has also conducted observations of visitor use and activities at Point Pinos. The Coalition has also kept written records of their observations.

Review of Enforcement Records

A summary of the available collecting information provided by the CDF&G, Pacific Grove Police Department, Asilomar State Beach, Bay Net, and the Tidepool Coalition appears in **Table 2- 1**. The individual logs appear in **Appendix D**. Most occurrences logged by the resource protection agencies have consisted of citations for illegal collecting, with the exception that the Pacific Grove Police Department has also issued warnings. All of the citations and warnings concerned the illegal take of larger size invertebrates (e.g., turban snails, sea stars, crabs). Confiscated animals were either returned to the ocean or transported to the Monterey Bay Aquarium. Incidents dealt with by Bay Net and the Tidepool Coalition tended to include other forms of tidepool behavior, such as rock turning, collecting shells, displacing animals, and some collecting.

Discussion

In general, it appears there is a well organized and fairly effective network of surveillance and enforcement along the Point Pinos shoreline that helps to reduce potential impacts from visitor activities. Enforcement and advisory records provide documentation on unlawful and inappropriate actions in the intertidal zone, but records, as shown in **Table 2-1**, probably only represent a portion of inappropriate actions that actually occur. Enforcement staff, and informed citizens such as Bay Net and the Tidepool Coalition, are not present at Point Pinos at all times. Furthermore, some form of inappropriate tidepool behavior can eventually be seen during any prolonged observation of the area. However, not all observed perpetrators are confronted, and therefore, many violations go uncited.

In southern California, rocky shoreline areas that are popular visitor destinations have larger records of citations and advisories than Point Pinos. The advisories issued by lifeguards at many places in Orange County have averaged 25,532 annually over two years (Murray et al. 1999). This number is high, due to the on-site presence of the lifeguard enforcement personnel for most hours of the day and higher numbers of visitors to the rocky intertidal areas. However, the lifeguards are generally not present in the field during the fall and winter months when visitor use can still be high. Consequently, many more incidences likely go undocumented. The high number of incidents and advisories is not unexpected because, in these areas, an average of nearly one individual every 10 minutes has been observed engaged in some form of inappropriate tidepool activity (Murray et al. 1999)

CDF&G scientific collecting reports are also another source of information on organisms removed from their habitats. Holders of scientific collecting permits are required to

Table 2-1. Number of fishing collecting citations and advisories in the Pacific Grove Marine Life Gardens Fish Refuge (1991-2002). See **Appendix D** for records.

Organization	Year	Fishing License Violation	Illegal Take of Invertebrates	Advisories
Asilomar State Beach (Calif. State Parks))	1991	19	26 (types not specified)	-
	1992	8	10 (types not specified)	-
	1993	7	14 (types not specified)	-
	1994	17	20 (types not specified)	-
	1995	17	19 (types not specified)	-
	1996	10	8 (types not specified)	-
	1997	10	8 (types not specified)	-
	1998	6	5 (types not specified)	-
	1999	-	0	-
	2000	-	0	-
	2001	-	5 (mainly mussels)	-
California State Department of Fish and Game[1]	2000	-	7 (mainly starfish, crabs, abalone, limpets, turban snails)	-
Pacific Grove Police Department	1997	-	3 (mainly mussels, limpets and turban snails)	-
	1998	-	3 (mainly turban snails and mussels)	-
	1999	-	14 (mainly turban snails and mussels)	5 (unknown animals returned to ocean)
	2000	-	3 (mainly turban snails and rock crabs)	-
	2001	-	-	33
	2002	-	1 (five starfish returned to ocean)	39 additional warnings/inquiries occurred in 1999-2002, but the types were not specified by year-
Bay Net[2]	2001	-	-	4 (rockturning, collecting algae, shells, rocks, starfish, crabs, tuban snails; all returned to ocean)
	2002	-	-	25 (rockturning, collecting algae, shells, rocks, starfish, crabs, tuban snails; all returned to ocean)
Tidepool Coalition[3]	2002	-	-	13 (rockturning, collecting starfish, mussels, turban snails)

[1] Data for only the year 2000 were available
[2] Bay Net began formal documentation of advisories in October 2001 as part of the present study
[3] Tidepool Coalition (Coalition to Preserve and Restore Pt. Pinos Tidepools): Observations from Feb-Jul 2002

submit a report of the organisms collected every two years upon expiration of their permit. However, the collecting reports are not archived in a way that allows the data to be retrieved by location. Consequently, it is impractical at present to construct a complete database on past amounts of scientific collecting at Point Pinos.

2.6 Use Associated with Tidal Conditions and Time of Year

Purpose

The purpose of this analysis was to determine the relationship among visitor use, tidal conditions, and time of year.

Background

The extent of visitor use in the intertidal zone is dependent upon the stage of the tide. Tidal exchanges in California are semi-diurnal, consisting of two unequal high tides and two unequal low tides that occur within each lunar cycle (24 hrs, 50 min), the time for the moon to pass over the same point on earth. The four tidal levels are referred to as the high-high, low-high, high-low, and low-low, and they shift approximately 50 minutes later each successive day, due to the time span of the lunar cycle. The lowest tides in winter and spring occur during the afternoon. In summer, the lowest tides shift to occurring during early morning darkness or just after sunrise. Fall has the poorest daytime distribution of lowest tides, except in November, when they occur during the afternoon. The same seasonal shift in times of lowest tides is repeated each year. The seasonal shift can influence visitor frequency in the intertidal zone because a greater amount of the intertidal zone is uncovered during daylight hours in winter and spring. Consequently, intertidal organisms are at greatest risk to impacts from visitor use during these seasons. In contrast, tidal levels are higher during mid-day hours in summer and early fall. Therefore, intertidal organisms are less susceptible to visitor impacts during these months.

Methods

We completed an analysis using tide level measurements to demonstrate the daily shifts in the occurrence of maximum low tides over the course of a year. We compared our data on numbers of people on the intertidal beaches and rocky shore (see *Section 2.1 – Visitor Distribution*) with maximum low tide occurrences in 2002 as an example year to describe levels of visitor use in the intertidal zone with changing tidal regimes.

Results

The best periods for visiting tidepools are when low tides occur during daylight. These periods occur mainly in spring, winter, and in a single month in fall (November) (**Figure 2-5**). Good low tides in spring occur in the afternoon, but then shift to more occurring during early morning hours (after sunrise) as summer approaches. In summer, the lowest low tides occur shortly after sunrise or during early morning darkness. Fall low tides are typically poor, and they tend to occur in the afternoon or at night.

November, however, is a transition month that has a number of good low tides in the afternoon.

We found that most people explored the intertidal zone during winter months (**Figure 2-6**). The high numbers in fall were mostly concentrated in November. The lowest numbers occurred during summer. Although summer has very good low tides, they tend to occur before or shortly after sunrise.

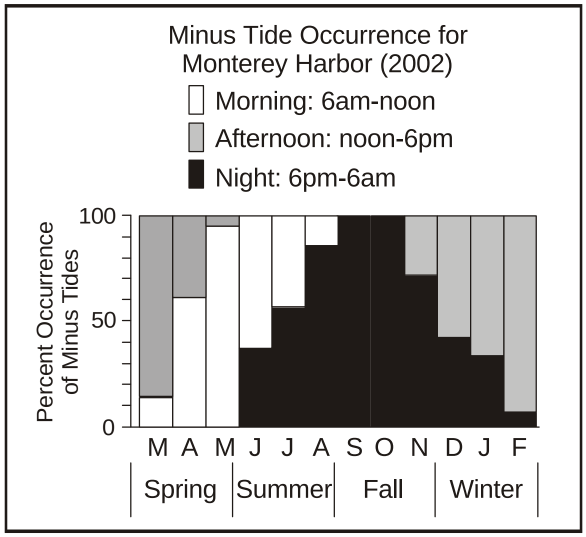

Figure 2-5. Low-low tide occurrences by time of day and month in 2002 for Monterey Harbor.

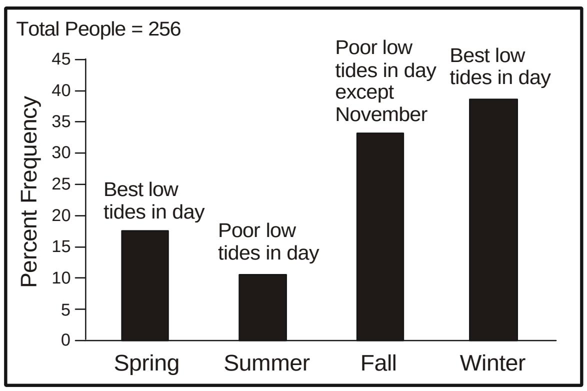

Figure 2-6. Relative visitor use of the Point Pinos intertidal zone with season.

Discussion

The result of this analysis indicates that spring and winter months and late fall are generally when the greatest visitor use occurs in the intertidal zone because the lowest low tides occur during daylight. In contrast, tidal levels are usually higher during the day in summer. The lack of good low tides during the afternoon on summer days also afford the intertidal species some natural protection from visitor impacts at a time when regional tourism is generally high. This is ecologically beneficial because central California species are often at their peak levels of abundance in summer and fall from spring recruitment and growth and they are also reproductive (Sparling 1977, Horn et al. 1983, Tenera 1997).

The results from this analysis provide only an initial assessment of how levels of visitation in the intertidal zone might shift over the course of a year. While tidal regimes may not change significantly from one year to the next, the frequency of visitation may. Therefore, this one-year analysis may not accurately project visitation in other years.

2.7 Comparison of Visitor Numbers with Other Areas

Purpose

The purpose of this study was to develop a perspective on visitor numbers at Point Pinos in relationship to other popular intertidal areas that are easily accessible.

Background

People frequent other rocky intertidal areas in California in addition to Point Pinos. Many of these areas also experience heavy use because, like Point Pinos, they have parking lots that are close to the shore, walking trails leading to the intertidal zone, and are close to urban areas. Several of these shoreline areas were included in this comparison to determine how visitor numbers compare among areas with similar access and coastal resources.

Methods

We compiled estimates of visitor attendance for other areas from a number of sources:

- Fitzgerald Marine Reserve (San Mateo County): source/ Bob Breen, Sr. Staff Ranger
- Natural Bridges State Beach (Santa Cruz County): source/ Martha Nitzberg, Education Outreach Specialist
- Point Lobos State Reserve (Monterey County): source/ Pat Clark-Gray, Monterey State Parks; Chuck Bancroft, Ranger
- Little Corona (Orange County): source/ Cheri Schonfeld, Marine Life Refuge Supervisor
- Crystal Cove (Orange County): source/ Winter Bonnin, State Park Interpreter
- Dana Point Marine Life Refuge (Orange County): source/ John Lewengrub, Marine Life Refuge Project Manager
- Cabrillo National Monument (San Diego County): source/ Engle and Davis (2000)

Total annual attendance estimates were used for comparison purposes to provide a generalized representation of overall visitor use. Other types of attendance figures may be used to compare areas (such as maximum daily attendance levels), but these were judged to be unreliable for comparison purposes. For example, some areas may experience equivalent maximum daily levels of attendance during holidays or during lowest tides of the year, but total annual attendance may be substantially different and therefore more relevant for comparison purposes.

We extrapolated the visitor counts from Clowes and Coleman (2000) and counts obtained in the present study to provide two estimates of annual visitor attendance for the Point Pinos shore (excludes people in parking lots and on cliff trails). Annual visitation estimates from the two data sets were derived by: 1) extrapolating the daily mean survey count of people in the rocky zone, on the beaches, and fishers; 2) assuming there is a four-fold turnover of this population each day; and 3) assuming all 365 days of the year are available for use. We included those on the beaches and fishers as they were included in estimates for other areas.

We based our four-fold daily turnover factor from our field questionnaire results indicating that people stay in the intertidal zone and beaches approximately 1.5 hours on average (**Appendix C**). Although in our field questionnaires most people stated that they tended to spend at least two hours visiting Point Pinos, they likely did not spend all of that time in the intertidal zone. Therefore, we arbitrarily reduced the time spent in the intertidal by one-half hour. The four-fold turnover assumption is based on the approximate six hour time span between high and low tides when the intertidal is uncovered and accessible. This is equivalent to a complete exchange of people on the shore every 1.5 hours four times daily.

Annual visitation levels for other areas were obtained through interviews with associated management staff, and by extrapolating data from published results in the same manner as above. We found that some areas had programs, which had visitor counts that had been compiled or had completed a sufficient number of field observations to derive estimates of total annual visitor attendance.

Results

Point Pinos Annual Visitation

Visitor use in the Point Pinos intertidal area is estimated to be in the range of 30,000 to 50,000 people annually. Clowes and Coleman (2000) counted a total of 7,809 people in 233 surveys in the intertidal zone that they referred to as ‘shore’ and ‘rocky intertidal’. The average per survey multiplied by the daily turnover factor and summed over all days of the year yields an estimate of 48,932 people per year. Data from the present study indicates that approximately 30,000 people step onto the beaches and rocky intertidal of the Point Pinos shore each year. In 47 surveys, we observed 874 people in the Point Pinos rocky intertidal zone, on the beaches, and fishers. The average per survey multiplied to account for daily turnover and all days of the year yields an estimate of 27,150 people per year.

Annual Visitation at Other Areas

Annual attendance estimates among areas are compared in **Table 2-2**. The numbers are for general comparisons only, since different methods were used to estimate total annual visitor attendance and some information was lacking.

Based on the results in **Table 2-2**, the Fitzgerald Marine Reserve in San Mateo County appears to have the highest concentration of people in the intertidal zone each year when considering the length of shoreline most visited (**Figure 2-7**). The Fitzgerald Marine Reserve has between 110,000 to 135,000 visitors per year that visit the rocky intertidal and sandy beach (Breen 1998). While the Reserve is approximately 4.8 km long (3 mi), the numbers tend to be most concentrated in the first 500 m (547 yd) of shoreline from the main access path. This results in the Reserve having the most heavily used intertidal zone of those compared in **Figure 2-7**. All other areas are not as heavily used as the Fitzgerald Marine Reserve, when accounting for visitor numbers based on the amount of shoreline distance most used.

We estimate that the Cabrillo National Monument has approximately 102,200 people per year that visit the intertidal zone. We derived this estimate from census counts of people made in 288 surveys from 1990 through 1995 by Engle and Davis (2000). This annual estimate is likely biased on the high side because most counts were made during minus tides when daily visitor use was probably highest, and the numbers were extrapolated for the entire year, which has a variety of tides. Annual visitor estimates were not available for some areas in Orange County because they did not have census programs (**Table 2-2**). The most definitive information was on school bus visits organized through the local education outreach programs. However, many other groups arrive independently, and there is unreliable data on visitor use by the general public. Despite the lack of reliable data, it has been roughly estimated that approximately one million people visit the seven Orange County reserves collectively over the course of a year (John Lewengrub, Project Manager, Dana Point Marine Life Refuge, pers. com.). Therefore, well over 100,000 people on average may visit each of the seven Orange County reserves per year. For the Orange County reserves, we used the value of 100,000 people per shoreline distance most used to compare visitor numbers with other areas in **Figure 2-7**. Point Lobos has the lowest numbers of people visiting the intertidal zone. Most people stay on the nature trails (Chuck Bancroft, Park Ranger, pers. com.).

Discussion

Our estimate of total annual visitor attendance of the Point Pinos intertidal zone ranges between 30,000 to 50,000 people per year, based on extrapolations of our data and those of Clowes and Coleman (2000), respectively. These values may be considerably different from actual attendance levels because many assumptions were used to derive the estimates and the original data had certain limitations. The Clowes and Coleman (2000)

Table 2-2. Visitor use among popular rocky intertidal areas in central and southern California.

Unit (County)	Estimates of Attendance	Length of Rocky Shore Most Visited	Data Source	Methods	Comments
Point Pinos (Monterey Co.)	30,000 – 50,000 per year	1.3 km (0.80 mi)	Annual attendance extrapolated from data collected in the present study and from data in Clowes and Coleman (2000)	Data from extrapolations.	Use high, but not as high as other areas. Attendance probably closer to 50,000 people/yr
Fitzgerald Marine Reserve (San Mateo Co.)	2001: 24,000 (500 classes) 2002: 22,000 (400 classes) 100,000+ total visitors/year*	500 m (0.31 mi)	Bob Breen (Park Ranger, San Mateo Co. Parks and Recreation, pers. com.)	Counts of buses, cars, and walk-ins.	General public use exceeds school use. Limit Goal: 300-500/day
Natural Bridges State Beach (Santa Cruz Co.)	Approx. 200,000/yr visit the beach and park but unknown numbers visit the rocky intertidal Approx. 4,000 students/yr visit the intertidal zone through docent-led education programs	0.4 km (0.25 mi)	Martha Nitzberg (Education Outreach Specialts, pers. com.)	Tallies of cars and entry passes.	No estimates of total visitor use for intertidal zone, although considered high.
Point Lobos State Reserve (Monterey Co.)	Daily Intertidal Use Max: 20-25 people/any time Total: 50-75 people/day 30,000-50,000 total visitors/year, but few go into the intertidal	Weston Beach: 100 m (0.06 mi)	Pat Clark-Gray (District Interpretive Specialist, Calif. State Parks, Monterey District, pers. com.) Chuck Bancroft (Park Ranger, Point Lobos, pers. com.)	Numbers from gate records of groups, cars, walk-ins.	Intertidal use mainly at Weston Beach. Most use is nature trails.
Little Corona Marine Life Refuge -Robert E. Badham Marine Life Refuge- (Orange Co.)	2000-01: 7,800 in classes plus 7,800 not in classes 2001-02: 6,000 in classes plus 6,000 not in classes 2002-03: 4,000 in classes plus 1,000 not in classes Summer wkends: 500-1000/day Summer wkdays: 500-800/day Historical max: 1,200-1,500 in classes/day No estimates of total visitors/year	0.8 km (0.50 mi)	Cheri Schonfeld (Marine Life Refuge Supervisor, City of Newport Beach, pers. com.)	Numbers from school visits that go through reservations and the marine science program.	Attempting to lower visitor use each year. General public use well exceeds school use. Limit: Goal: 200-300/day
Irvine Coast Marine Life Refuge -Crystal Cove- (Orange Co.)	1996: 7,690 in classes 2003: 9,000 in classes (anticipated) Multiple access points No estimates of total visitors/year	4.0 km (2.5 mi)	Winter Bonnin (State Park Interpreter, Crystal Cove State Park, pers. com.)	Numbers are from school visits that go through reservations and the marine science program.	Scheduled bus visits are nearly booked for the year by mid-Feb.
Dana Point Marine Life Refuge (Orange Co.)	1,000-2,000 students/yr via the Ocean Institute interpretive program. More students via other programs. Up to 4,000 total visitors/day during good days with 600 people in smaller groups One main access 100,000 total visitors/year, based on extrapolations from visitor counts collected 5 years ago	1.2 km (0.75 mi)	John Lewengrub (Project Manager, Dana Point Marine Life Refuge, pers. com.)	Total annual visitor counts based on extrapolated data from visitor census surveys from planned programs.	Visitor count surveys are not as numerous as five years ago. Beginning a tidepool biological monitoring program.
Cabrillo National Monument (San Diego Co.)	1990-95: Max. 384 people/day 100,000 total visitors/year	1 km (0.62 mi)	Engle and Davis (2000)	Annual attendance extrapolated from data in Engle and Davis (2000).	Most use concentrated in Area 1 (300 m). Most counts made during minus tides.

study was not done over an entire year, but rather every day within 1-2 hours of low tide and over seven consecutive weeks in spring. Our surveys extended over a longer duration (16 months), but the data are partially incomplete because most counts were made during weekdays and were not tide dependent (see *Section 2.1 - Visitor Distribution*). Accordingly, the 50,000 estimate is probably a closer approximation to the actual number of people who visit the Point Pinos intertidal zone each year, compared to the 30,000 estimate based on our data. The Clowes and Coleman (2000) study included visitor counts during a greater number of days with good minus tides when more people would be expected to visit the intertidal zone.

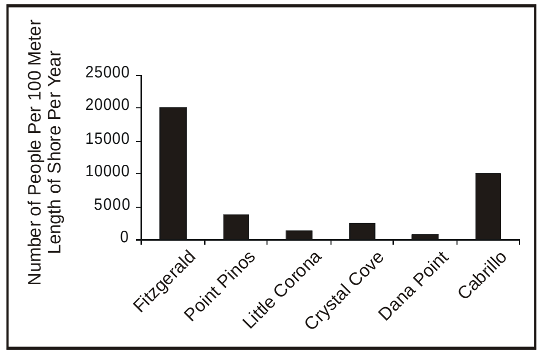

Figure 2-7. Annual visitor attendance estimates for several popular intertidal areas in California standardized for 100 m length of shore of distances most visited.

Weather condition is another factor that was not taken into account for extrapolating estimates. We could assume that on average there are about 20-30 days per year of rain and strong winds when visitation at Point Pinos is very low. This would lower our annual estimates slightly for Point Pinos. However, fog that commonly occurs at Point Pinos during spring and summer does not necessarily deter people from using the seashore (Milos Radakovich, pers. com.).

Based on our estimates, visitor attendance at Point Pinos can be considered high relative to other areas, but visitor use at the Fitzgerald Marine Reserve near San Francisco and in areas of southern California appears to be high as well (**Figure 2-7**). The visitor estimates compared among areas in **Table 2-2** are all based on the numbers of visitors in the intertidal zone. If our estimates included people in parked cars, on cliffs, and on walking trails, our annual attendance estimate would be in the hundreds of thousands annually. However, this number should not be used to represent our best estimates of people actually visiting the intertidal zone.

While total annual visitor attendance at Point Pinos may not be as high as some other areas, peak daily attendance levels may be comparable, but the frequency of these peak levels may be less. Point Pinos may experience up to several hundred people in the intertidal zone throughout the day, which could be equivalent to maximum levels for many other areas. This could occur, for example, when school bus visits arrive and are added to the general public visiting the shore. However, this peak level of attendance would not occur every day throughout the year.

The higher attendance in southern California is likely associated with consistently nicer weather, proximity to urban areas, and scarcity of rocky habitats in southern California, which would tend to concentrate visitors seeking tidepools to specific areas. On the other hand, high attendance at the Fitzgerald Marine Reserve in San Mateo County is likely associated with its proximity to the densely populated San Francisco Bay/Silicon Valley area. Furthermore, the rocky intertidal zone at the Fitzgerald Marine Reserve consists of a flat rock bench platform. The low topographical relief provides for a more convenient and safer tidepooling experience compared to the steep rocks at Point Pinos (Bob Breen, Fitzgerald Marine Reserve, Ranger, pers. com.). This combined with a main parking lot and restroom facilities likely account for the popularity of the Fitzgerald Marine Reserve. Natural Bridges State Beach in Santa Cruz County is another area that receives high visitor use, although there are no reliable estimates on the numbers of people that visit the rocky intertidal zone annually (Martha Nitzberg, Education Outreach Specialist, pers. com.). High attendance there is likely associated with convenient parking, ease of access, and the adjoining State Park.

3.0 Biological Descriptions

SECTION SUMMARY

* Over 150 species of invertebrates, algae, and intertidal fishes were sampled and analyzed for differences in abundance between areas of high visitor use along the Point Pinos shore and areas of lower visitor use (reference areas) located to the southeast and southwest of Point Pinos.
* Comparisons were made between areas for the biota inhabiting discrete tidepools, areas surrounding the tidepools, and broader areas of the upper and lower intertidal zones.
* Statistically significant differences were detected in total algal cover between the high and low use areas, with the high use area having about 25 percent less total algal cover. The difference was due mainly to reduced coverage of rockweeds and turf algae in the visitor use area, relative to the reference area. The areas affected were in the upper intertidal near public access points, so one explanation for the reduced algal cover is increased foot traffic (trampling) from visitors that erode the algae and limit recruitment.
* No statistically significant differences were detected in the invertebrates and fishes, with the exception of purple sea urchins. The abundance of purple sea urchins was significantly lower in the Point Pinos tidepools, relative to the reference area tidepools. While sea urchins may be of interest and curiosity to visitors, they are difficult to collect, since they have spines and are often tightly nestled in crevices and small depressions in the rocks. The difficulty in collecting these animals, combined with the lack of statistically significantly lower abundances of other invertebrates susceptible to visitor impacts, reduces the likelihood that visitor impacts were the primary cause for the lower abundance of purple sea urchins.
* An independent study completed by a Moss Landing Marine Laboratories student at Point Pinos indicated that anemones and possibly barnacles are other species susceptible to trampling effects in the upper intertidal.
* Abalone and owl limpets are often collected for consumption. Because we had no baseline data on abundances, we examined collecting effects by also determining whether visitor use areas had lower numbers of large animals, relative to areas with less visitor use. There were no significant differences in the mean sizes of black abalone and owl limpets between high and low visitor use areas. The similarity in shell sizes for the two areas indicates that there was no difference in harvesting levels for these species between areas.
* Interviews with scientists familiar with the Point Pinos shore provided supplemental qualitative information on changes at Point Pinos over time. However, it was difficult to use this information to determine whether the changes were from visitor use or from natural causes because observations were not available for other areas with less visitor use.
* Sites originally sampled in 1977 using qualitative observations were also sampled in the present study, but did not provide definitive results on possible changes at Point Pinos over time because it was difficult to duplicate the qualitative search methods used in the initial survey.

As the major element of the present study, we compared the abundance and diversity of intertidal marine life at Point Pinos to reference sites that received substantially less visitor use. All shorelines of Point Pinos and most of the greater Monterey Peninsula area are susceptible to some level of visitor impacts because almost all areas are accessible to some degree. Accordingly, we relied on our visitor census observations to identify sampling areas with high visitor use and areas of low visitor use for comparison purposes.

Conclusions from the present study would have been more robust had there been data that was collected before and during periods of heavy visitor use in both ‘impact’ and ‘control’ areas (BACI design) (Stewart-Oaten et al. 1986). However, there were no previous biological studies with sufficient baseline information that could be used for this type of study (**Appendix E**). Consequently, our study required new surveys that were designed to detect differences between areas that could then be evaluated to determine if they were consistent with effects of visitor use.

The biological sampling was completed during a survey in summer 2002. With limited resources we chose to concentrate the sampling effort during a single survey period, with the largest number of replicate sites practical, rather than conduct several less detailed surveys over a longer time period. The following tasks were included in the biological studies:

- Algal, invertebrate, and fish abundances in tidepools
- Algal and invertebrate abundances surrounding tidepools
- Algal and invertebrate abundances in band transects
- Invertebrate composition underneath and on the surfaces of turnable substrates
- Owl limpet and black abalone shell measurements
- Re-survey of sites sampled in 1977 by California State Water Resources Control Board (1979)
- Trampling effects supplemental study done by a Moss Landing Marine Laboratories student

The study design in all tasks, with the exception of the survey of the 1977 sites, consisted of sampling replicated stations in areas of ‘high’ visitor use along the Point Pinos shore and reference stations in areas of ‘low’ visitor use to the southeast and southwest of Point Pinos (**Figures 3-1 and 3-2**). Prior to sampling, we completed 28 visitor census surveys to develop criteria for locating the biological sampling stations (see *Section 2.1 – Visitor Distribution*). Our visitor use stations along the Point Pinos shore included a range of potentially affected locations in high use areas. Our reference stations with lower visitor use were located as close as possible to Point Pinos in order to minimize differences in biological composition resulting from geographical and oceanographic variation.

Of the stations sampled, visitor use was highest at Parking Lot 5 at Point Pinos (PP Lot 5-North) and lowest at Hopkins and Restless Sea (**Figure 3-2**.). We assumed that the Restless Sea and Hopkins Marine Life Refuge area only experience minor levels of visitor use, compared to the Point Pinos shore, although we did not complete visitor census surveys in these two reference areas to confirm this. The Restless Sea area is located on private property along 17-Mile Drive, and while many tourists view the coastline from this parking area, few venture into the intertidal zone due to a steep cliff

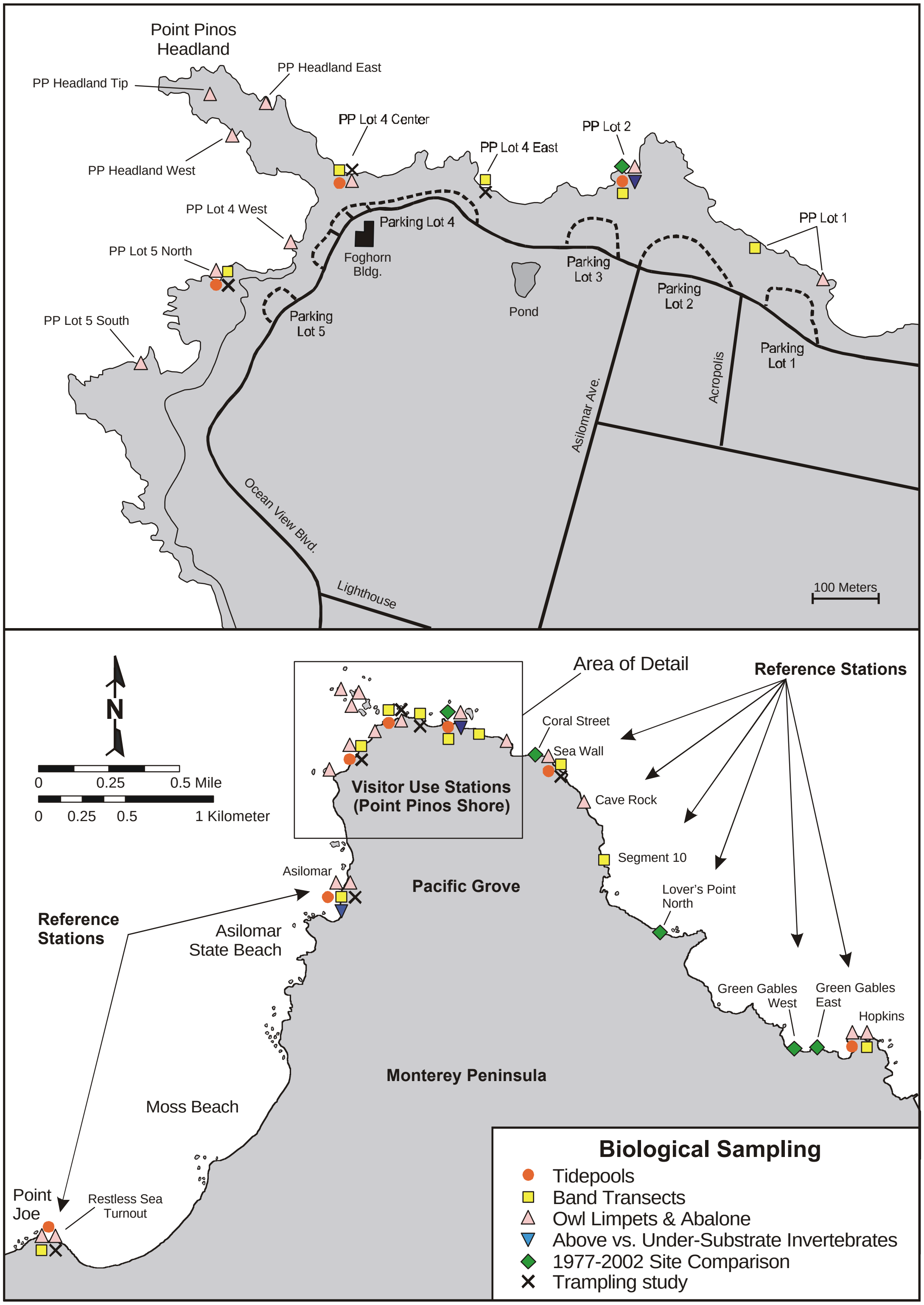

Figure 3-1. Locations of biological sampling stations.

backing the shore, a fence, and rough water. However, some scientific collecting has occurred in the general area in the past (Roxanne Spruance, Pebble Beach Company, pers. com.). The Hopkins Marine Life Refuge is also fenced off from the general public but is frequently used by researchers at the lab (Ms. Freya Sommer, Hopkins Marine Life Refuge Manager, pers. com.). Based on Ms. Sommer's recommendations, we selected sampling sites within the refuge where there had been the least amount of field research activity.

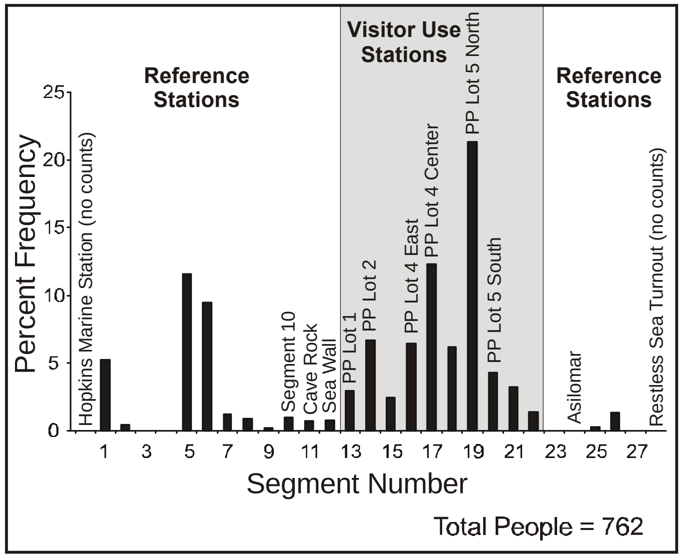

Figure 3-2. Levels of visitor use in the rocky intertidal zone associated with the biological sampling stations. The Hopkins and the Restless Sea Turnout stations have been arbitrarily assigned as having no visitor use.

In addition to the biological sampling, we used other lines of evidence to assess visitor use effects at Point Pinos. We interviewed marine biologists and longtime residents who had recollections of conditions at Point Pinos as early as the 1950s.

We refer to species in the report mainly by their scientific names rather than common names, particularly in the tables and figures. **Appendix F** lists scientific names, common names, and classifications for reader reference. **Appendices G** through **K** contains the quantitative database. Results of statistical analyses are referred to throughout the report. Tables depicting the analysis results appear in **Appendix J**.

3.1 Tidepool Study

Purpose

We quantified organisms in tidepools around Point Pinos and vicinity with varying levels of visitor use and in reference areas with less visitor use to determine if there were any differences between the two areas that might be attributed to visitor activities.

Background

Tidepools are pools of standing water in the intertidal zone that remain as the tide recedes. They can harbor a high diversity of invertebrates and fishes because unlike the rest of the mid- and upper-intertidal they are not subjected to desiccation during low tides. The Point Pinos shoreline and vicinity are characterized by a diverse array of tidepools (**Figure 3-3**). Because they are focal points of visitor interest, organisms in the tidepools may be susceptible to mortality from handling and collecting, and the areas around the tidepools can be subjected to trampling impacts.

Figure 3-3. Tidepool at Point Pinos. Quadrat is 0.25 m^2 (50 cm x 50 cm)

Methods

Sampling

Five tidepools at each of three visitor use area sites along the Point Pinos shore and five tidepools at each of four reference sites were sampled for species composition and abundance. One additional reference site over the visitor use sites was sampled to ensure that natural variation, as a baseline, was accounted for as best as possible in the study. The sites are shown in **Figure 3-1**. All macroinvertebrates and fishes observed in each tidepool were counted without removing them from their habitat and the percent cover of each algal species was estimated. Some colonial or encrusting invertebrate species that could not be counted as individuals were quantified as percent cover. The specific tidepools sampled were selected based on the following criteria:

- Likely to be encountered by visitors from access points when traversing the intertidal zone towards the water
- Located in the upper intertidal rockweed/barnacle zone (approx. +4 ft MLLW)
- Surface areas of approximately 1-2 m^2 and depths not exceeding 0.25 m (small enough to sample)
- Surrounded by flat rocks for easier visitor access and viewing

All organisms in this and the following studies were identified in the field. No specimens were collected. In cases of an uncertain species identification, notes and drawings were made of the organism and taken back to the laboratory to resolve the species identification.

Analysis

<u>Community Analysis</u>

The abundance (density or percent cover) of the individual invertebrate and fish species in the tidepools were statistically analyzed. Although collected, data on algal cover in the tidepools were not analyzed because we considered the algae to be least affected by tidepool visitor activities that are usually focused on collecting animals.

The multivariate analysis technique of non-metric multidimensional scaling (MDS) available in PRIMER Ver. 5.2.0 (Clarke and Gorley 2001) was used to detect differences in species composition and abundance among the various tidepools. The first step in the MDS analysis was to obtain a dissimilarity (distance) matrix of the tidepools based on the differences in species abundances between all possible pairs of tidepools. In our analyses we used the Bray-Curtis measure of dissimilarity. MDS then iteratively configured the tidepools to maximize the rank correlation between the distances in the MDS configuration and the original Bray-Curtis distance matrix.

In MDS analysis, ‘stress’ is used as a measure of the goodness-of-fit between the Bray-Curtis measures of dissimilarity and the MDS spatial configuration of those scores (Clarke and Warwick 2001). High values of stress (>0.20) indicate that the analysis has not adequately summarized the distances among the tidepools (points) in the MDS configuration. Values closer to zero indicate a good fit between the MDS configuration and the original Bray-Curtis distance matrix. The value of stress is most affected by the incorrect placement of points that are very distant from each other (Clarke and Warwick 2001).

The MDS algorithm can be sensitive to outliers (unusual data), which results in disproportional distances between the outlier(s) and the other points. Consequently, the MDS optimization does not accurately reflect the associations among the other points. Although MDS with severe outliers may have low stress values, the fine structure among the other points may not be revealed. In fact, there may be poor fit among the other points. Therefore, it is recommended that MDS be repeated on the points that might form groupings within the analysis and, where appropriate, to repeat the analysis of separate groups of points revealed in the analysis (Clarke and Warwick 2001). It follows that single outliers would have even a larger effect on the analysis and should be removed and the data reanalyzed.

Other components of the PRIMER package were used to determine the contributions of each species to the differences between reference and visitor use areas (SIMPER), and to determine if the differences were statistically significant (ANOSIM). Individual species that were identified in the multivariate analysis as important contributors to differences between areas were then tested to determine if these differences were statistically significant using the standard univariate statistical technique of ANOVA.

All statistical tests used a probability level of 90% to determine significance. The 90% level was chosen over the more commonly used 95% to increase the statistical power of the tests, thereby decreasing the probability of making a Type II error (Winer et al. 1991). This lower probability level increases the likelihood of finding significant changes where none may have occurred (Type I error), but in assessing impacts on a unique area such as Point Pinos it is also important to balance this error against the potentially more serious error of not recognizing a significant impact when one has occurred (Type II error) (Mapstone 1995). The power of a test is a measure of the probability of correctly concluding that a change occurred (Winer et al. 1991).

Species composition and abundance typically varies among tidepools, due to factors such as size, depth, exposure to waves, flushing characteristics, and other micro-habitat differences (e.g., substrate rugosity, ledges, moveable cobbles that can scour walls and the bottom). We attempted to sample tidepools that were equivalent in these physical characteristics with the main feature being surface area and depth with smooth walls and bottoms. However, the sizes differed slightly so we standardized species abundances to a common surface area unit of 0.25 m^2. We sampled 20 tidepools in the reference area and 15 tidepools in the visitor use area to account for the physical variation between areas. The 0.25 m^2 data were square root transformed prior to MDS analysis to help account for the influence of the less abundant species in the analysis.

Select Species Analysis

The ten species with the largest contributions in the SIMPER analysis were analyzed for individual differences using analysis of variance (ANOVA). The ANOVA model used a nested design with sites and tidepools as random factors nested within the fixed factor of reference and visitor use areas. The ANOVA assumption of homogeneity of variances among sites was tested using the Brown-Forsythe test available in the GLM procedure in SAS Ver. 8.0 (SAS Institute 1999). When the assumption of homogeneous variances was rejected the data were transformed using either a log(data value +1) or square root(data value +1) transformation and retested. The data that best met the assumptions were analyzed using the Mixed procedure in SAS, and an option for using a Satterthwaite approximation for the denominator degrees of freedom was used for data with heterogeneous variances. The power of the analysis was calculated to determine the probability of detecting an actual difference between reference and visitor use areas if one existed.

Results

Community Analysis

In a qualitative overview, invertebrates were generally greater in abundance in the reference area tidepools compared to the visitor area tidepools (**Figure 3-4**). Hermit crabs (*Pagurus* spp.), purple sea urchins (*Strongylocentrotus purpuratus*), and anemones (*Anthopleura elegantissima/sola*) were among the most commons species and were more abundant in the reference area tidepools. In contrast, the visitor area tidepools had greater

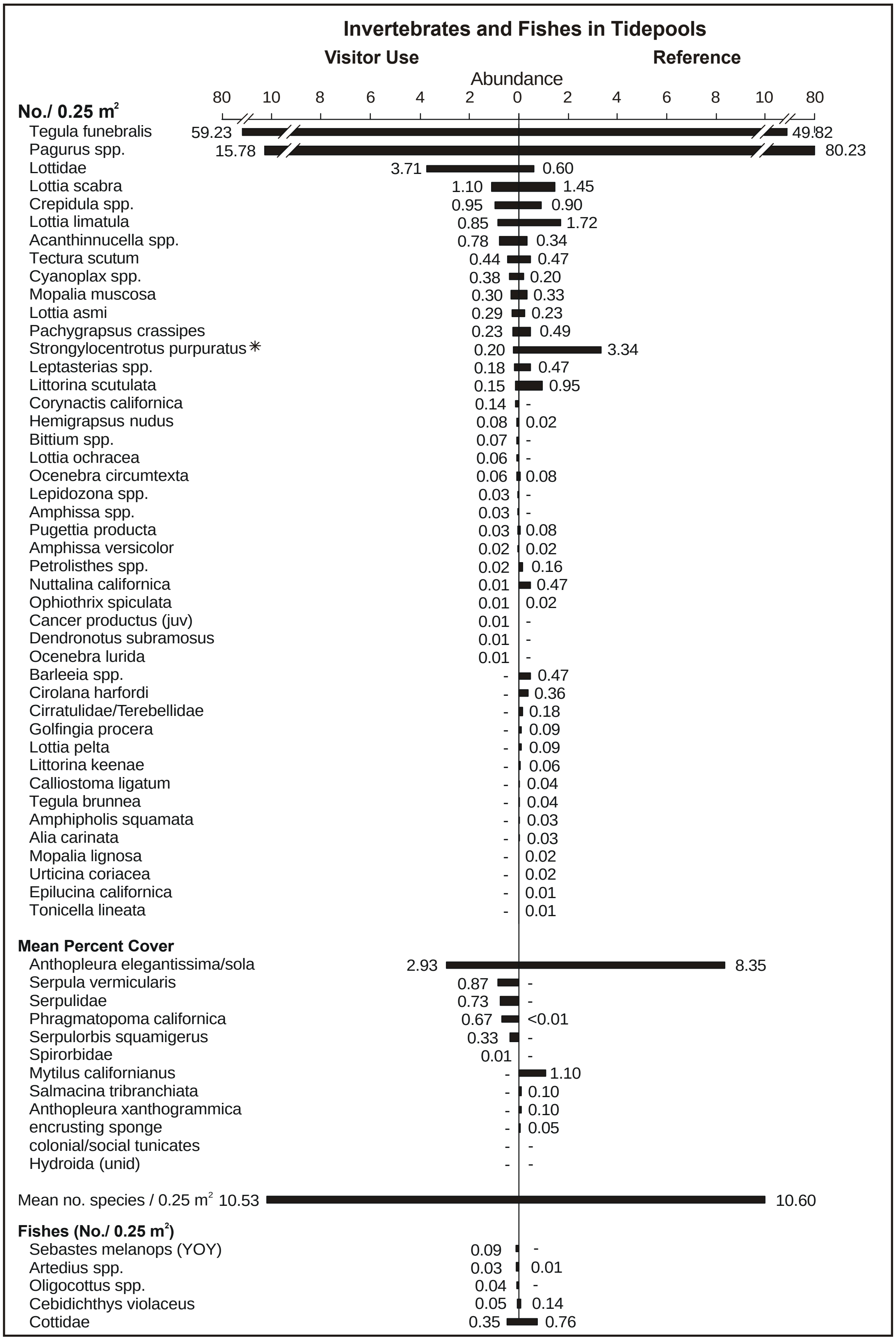

Figure 3-4. Invertebrate and fish abundances in tidepools in the visitor use and reference areas. Asterisk denotes a statistically significantly difference in abundance between areas was detected using ANOVA.

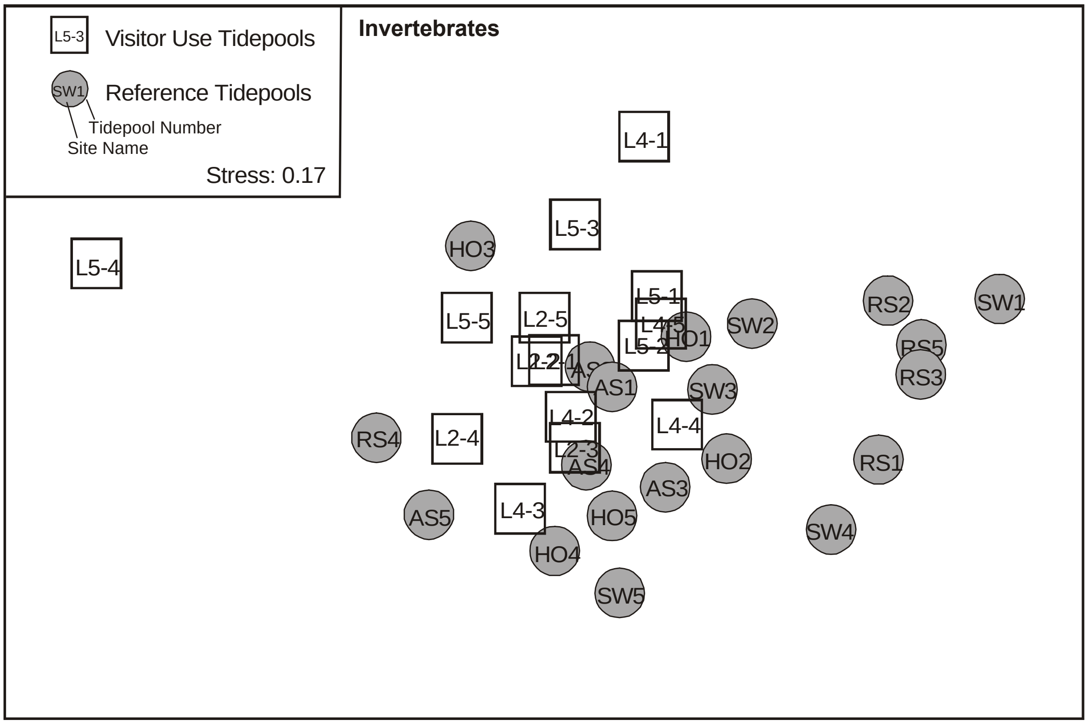

Figure 3-5. First MDS of Bray-Curtis distances of invertebrate abundances in tidepools.

numbers of limpets (Lottiidae). The mean number of species (ca. 10.5 per tidepool) was nearly identical between the visitor use and reference areas.

Initial MDS analyses showed that Tidepool 4 at PP Lot-5 North (L5-4) was a severe outlier that caused the analysis to ignore the distances among the other tidepools and thereby not reveal other differences (**Figure 3-5**). It was therefore omitted from further analyses. The tidepool was almost completely covered with diatoms (Phylum: Chrysophyta) and was low in invertebrate abundance. (Note that the site names of the scores in the figure and all following MDS figures are abbreviated, and the abbreviations and corresponding full site names are presented in **Table 3-1**.)

The separation of scores in the second MDS analysis based on 56 species shows that variation in species composition and abundance was generally greater among the reference tidepools than the visitor use area tidepools (**Figure 3-6**). The moderate level of stress (0.18) for the analysis of the tidepool organisms,

Table 3-1. Station name abbreviations in MDS figures.

MDS Figures	Figure 3-1 (Map)
Visitor Use	
L1	PP Lot 1
L2	PP Lot 2
L4-C	PP Lot 4-Center
L4-E	PP Lot 4-East
L5-N	PP Lot 5-North
Reference	
AS	Asilomar
SW	Sea Wall
RS	Restless Sea
HO	Hopkins
SG	Segment 10

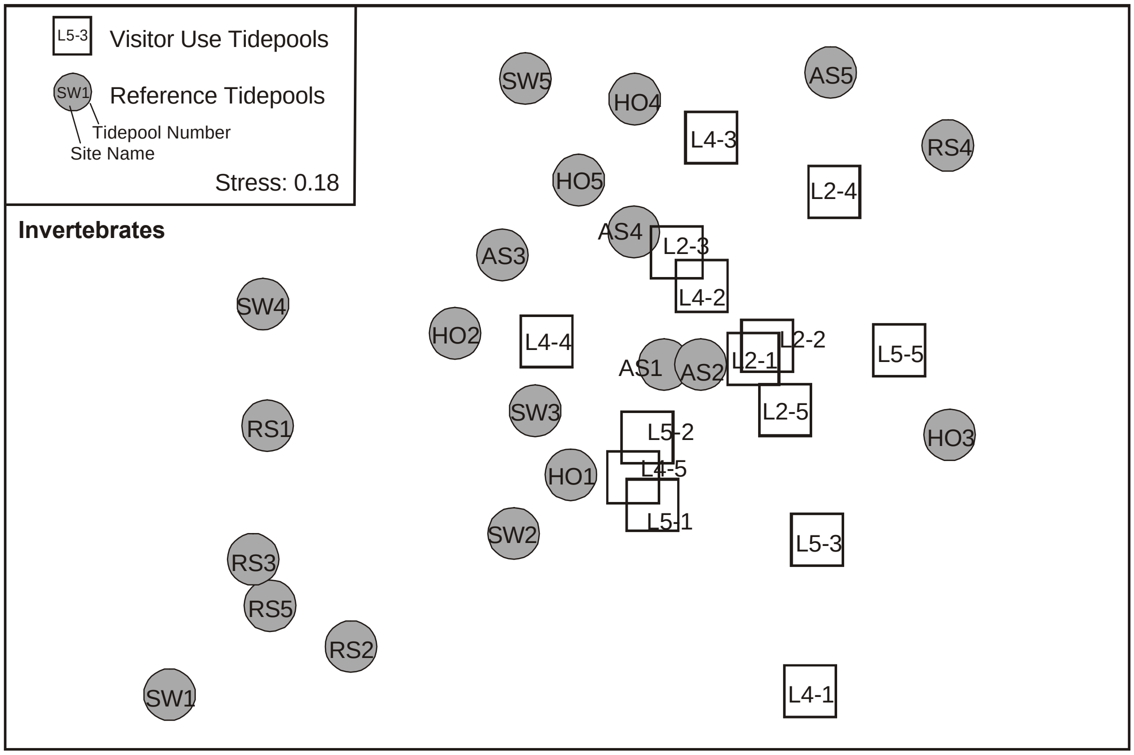

Figure 3-6. Second MDS of Bray-Curtis distances of invertebrate abundances in tidepools.

however, indicates the difficulty of representing the large amount of variation among the sites in the two MDS dimensions. SIMPER analysis showed that average similarity among reference tidepools was 50 percent. The average similarity among the visitor area tidepools was greater at 61 percent. Despite the overall large variation, a statistically significant difference (p=0.03) between the reference and visitor use area tidepool areas was detected using ANOSIM.

SIMPER analysis showed that 16 of the 56 invertebrate species accounted for 80 percent of the dissimilarity between the reference and visitor use area tidepools (**Table 1**, **Appendix J**). The four most abundant species accounted for more than 48 percent of the total dissimilarity and included hermit crabs (*Pagurus* spp.), black turban snails (*Tegula funebralis*), anemones (*Anthopleura elegantissima/sola*), and purple sea urchins (*Strongylocentrotus purpuratus*). Several species of limpets were also represented in the top group of species.

Data from the tidepools at each site were then averaged, and the site averages were analyzed with MDS to determine if differences among the visitor and reference areas could also be detected when within-site variation was pooled. In this analysis, the visitor site scores became more clearly separated from the reference site scores, and the low stress (0.03) indicates a better fit between site distances and the MDS configuration of scores (**Figure 3-7**). Even with the low number of sites, ANOSIM detected a statistically significant difference (p=0.09) between tidepool communities in the reference versus visitor use sites. SIMPER analysis showed that many of the same species from the previous analysis were still responsible for the difference between areas in this analysis, but the contribution of black turban snails was reduced (**Table 2**, **Appendix J**).

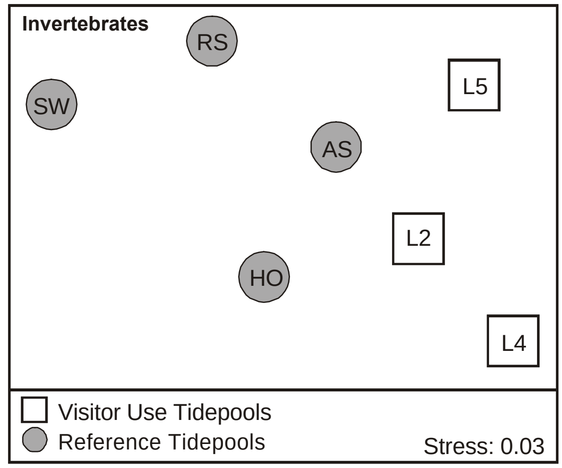

Figure 3-7. MDS of Bray-Curtis distances of average invertebrate abundances in tidepools.

Select Species Analysis

Purple sea urchins were significantly lower in the visitor use tidepools (p=0.02, **Table 3**, **Appendix J**). No differences were detected for the other invertebrates or for species richness (number of species/taxa). Although slipper shells (*Crepidula* spp.) and black limpets (*Lottia asmi*) were among the species accounting for differences between the visitor use and reference tidepools in the ANOSIM analysis (**Tables 1 and 2**, **Appendix J**), they were not further analyzed because these snails occur primarily on turban snails. In addition, no differences were detected for the fishes analyzed in the tidepool study (**Table 3**, **Appendix J**). The low power of the analysis reflected the difficulty of detecting differences between the visitor and reference sites for individual species with high variation in their abundances among sites.

Discussion

The MDS analyses of individual tidepools at each site and the average of the tidepools at each site showed differences in invertebrate abundances between the reference and visitor areas. The differences in the two analyses were statistically significant. Hermit crabs and purple sea urchins were among the largest contributors to the community differences between visitor and reference area tidepools. The overall average abundances of both species were substantially less in the visitor use area tidepools, but only the lower abundance of purple sea urchins was statistically significant. Visitors may occasionally collect urchins and hermit crabs, but the actual cause for their lower abundances compared to the reference tidepools remains unknown.

The low power of the ANOVA to detect differences for the other species, including species richness, is consistent with the MDS results that showed large within and among site variation. All species that we analyzed can be patchy in distribution among tidepools, making it difficult to detect potential differences among them, although we did detect a significantly lower abundance of purple sea urchins in the visitor use area tidepools. The high natural variability in the abundances of tidepool species probably accounts for the low power for the ANOVA analysis and the moderate level of stress in the MDS analysis.

Tidepool 4 at PP Lot-5 North was an outlier due to high percent cover of diatoms (**Table 7, Appendix G**) and was low in invertebrate abundance (**Table 14, Appendix G**). This tidepool was not included in the community analyses to increase the ability to detect differences among the remaining tidepools. High diatom cover is an indication of disturbance (e.g., scour, wave action), which creates open substrate for colonization of this ephemeral species group by the removal of organisms that would otherwise occupy or dominate the space (Foster et al. 2003, 1988). While it is unlikely that visitors would increase the amount of bare rock space by scraping and trampling rocks inside tidepools, the collecting of diatom grazers from the tidepool could have allowed diatom cover to increase. Grazing turban snails were scarce in the tidepool. However, limpet grazers were relatively common. Consequently, the specific reason for the high diatom cover in this particular tidepool remains unknown. Other tidepools at the same site were not covered with diatoms, indicating high spatial variation in the occurrence of this diatom species group.

3.2 Tidepool Perimeter Study

Purpose

Tidepools bounded by relatively flat rocks just above the pool waterline are attractive to visitors for observing tidepool biota because the flat rocks provide safer footing than irregularly sloping surfaces. We hypothesized that the biota on rocks forming the perimeter of such tidepools could be differentially impacted by incidental trampling or collecting. We sampled the flat rocks immediately surrounding tidepools to determine whether the biological communities around the perimeters of the tidepools in visitor use areas were different from reference areas.

Methods

Sampling

Invertebrates and algae were quantified in three 0.25 m^2 quadrats positioned on the flattest rocks forming the perimeter of each tidepool. There were five tidepools at each of the four reference sites and five tidepools at each of the three visitor use sites. The site locations are shown in **Figure 3-1**. The abundances of invertebrates and algae were quantified by either counts or percent cover similar to the procedures used to quantify tidepool organisms (see *Section 3.1 – Tidepool Study*).

Analysis

The data were analyzed using the same methods as described for the tidepool study (*Section 3.1*), with the exception that the raw data were summarized differently for the MDS and other community analyses. The three quadrats associated with each tidepool were first averaged. This provided a 'quadrat average abundance' for each species around each tidepool. The data were also analyzed by averaging the average quadrat abundances for all of the tidepools at each site. This second analysis provided four 'site averages' for the reference areas and three 'site averages' for the visitor use areas for each species sampled. The ANOVA model used a nested design with quadrats, tidepools, and sites as random factors nested within the fixed factor of reference and visitor use areas. In the ANOVA analyses, only the data from Tidepool 4 at PP Lot-5 North (L5-4) were not used.

Results

Overview

A qualitative overview of the complete data set shows that the most prominent difference between the algal communities on the flat rocks immediately surrounding the reference and visitor use area tidepools was the greater abundance of *Endocladia muricata* (nail brush seaweed) in the reference area and the occurrence of diatoms (Chrysophyta) in the visitor use area (**Figure 3-8**). Total upright algal cover was also greater in the reference area with *Endocladia* largely being responsible for the greater cover, relative to the visitor use area.

Invertebrate abundances and species richness were greater in the quadrats around the reference area tidepools when compared to the visitor area quadrats (**Figure 3-9**). The differences at the reference area tidepools included greater numbers of periwinkle snails (*Littorina scutulata* and *L. planaxis*) and sessile invertebrates. In contrast, black turban snails (*Tegula funebralis*) and the limpet *Lottia digitalis* were more abundant in the quadrats around the visitor area tidepools, relative to the reference sites.

Algal Community Analysis

The MDS analysis involved several steps because several outlier quadrat areas around tidepools were identified in the data. The initial MDS analysis with all the data using the average abundances of algal species from the perimeter quadrats around the tidepools showed that a single tidepool (L5-4) at a visitor use site was an outlier due to high cover of diatoms (**Figure 3-10**). While this analysis underscores the high spatial variation in the visitor use areas, this tidepool perimeter obscured the MDS configuration among the other tidepool perimeter areas. The very low stress value for this first analysis resulted from the very small distances among the other stations relative to the large distance to

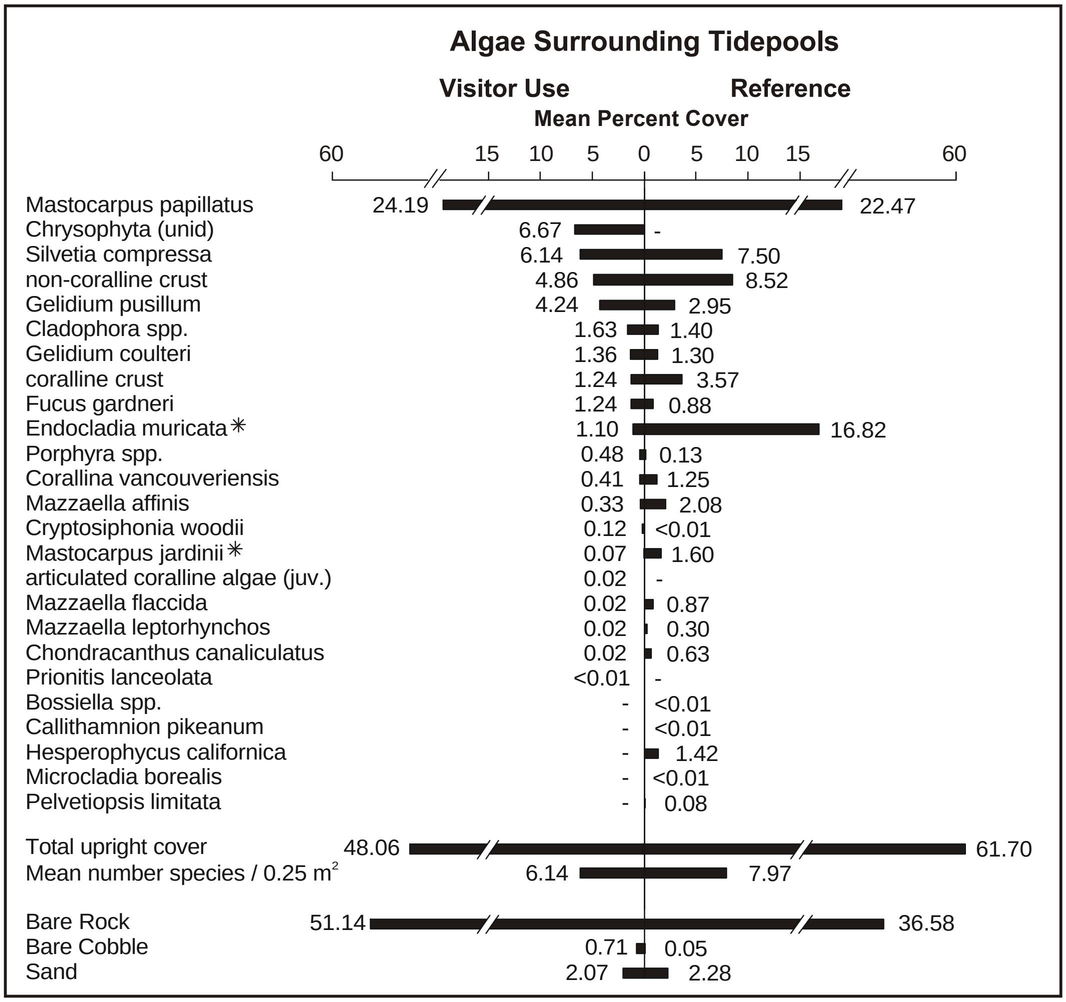

Figure 3-8. Algal and substrate cover on rocks surrounding tidepools in the visitor use and reference areas. Asterisk denotes a statistically significantly difference in abundance between areas was detected using ANOVA.

L5-4. The MDS was able to perfectly position this single tidepool area relative to the other tidepool areas, resulting in the very low value of stress. Therefore, the data for L5-4 were removed and the MDS analysis was repeated.

The second MDS analysis indicated that two other tidepool perimeter areas were also outliers (RS-4 and L5-5) (**Figure 3-11**). These two areas, one in the reference area and the other in the visitor use area, were both largely barren rock with low invertebrate abundances relative to all other tidepool perimeter areas. Consequently, these two areas were omitted to focus on the pattern of differences among the remaining areas.

The MDS analysis of the remaining tidepool perimeter areas based on the average abundances of algal species from the quadrats around the tidepools still showed large

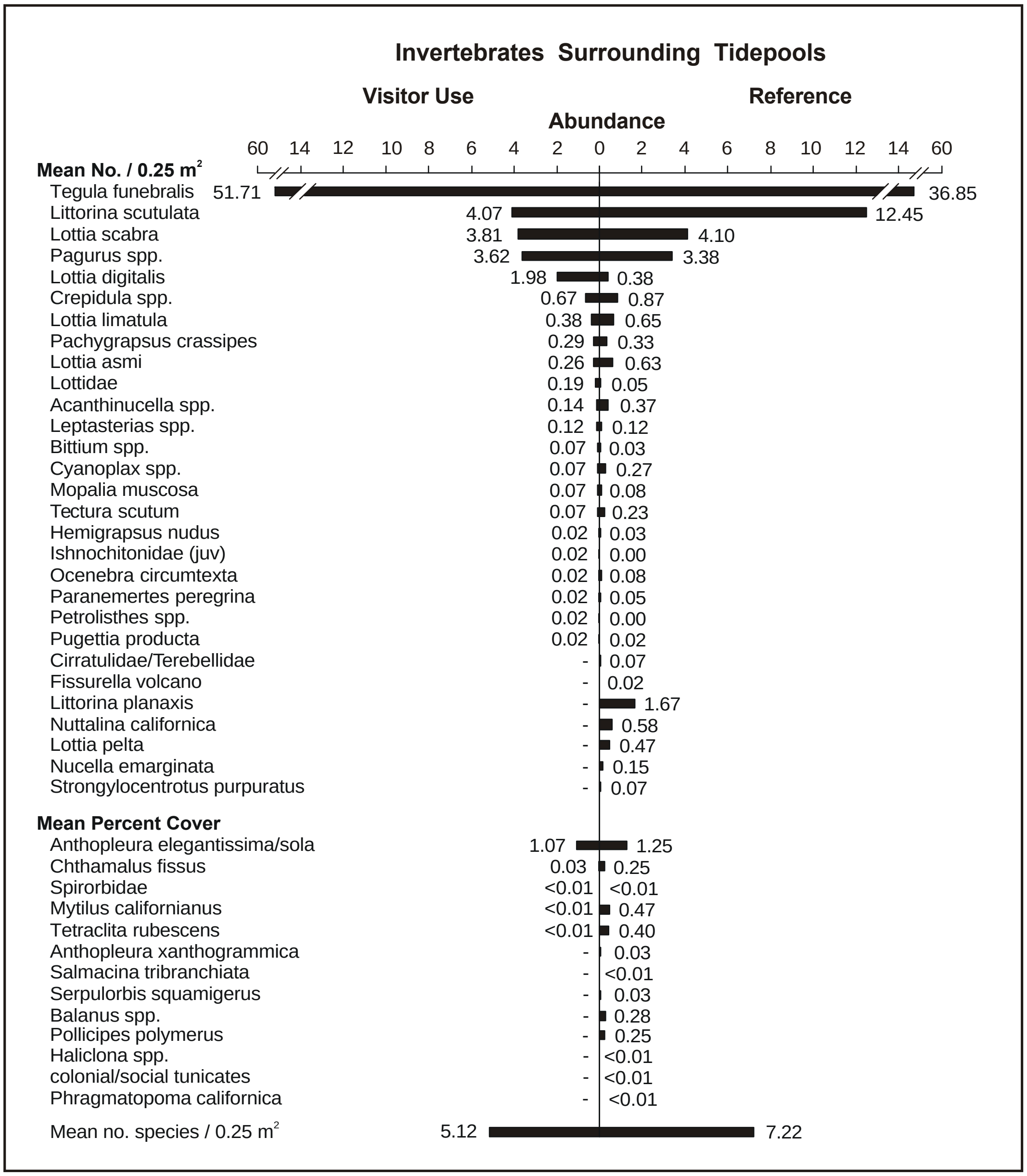

Figure 3-9. Invertebrate abundances on rocks surrounding tidepools in the visitor use and reference areas. No significant differences in abundance between areas were detected using ANOVA.

variation among the four reference and three visitor use sites (**Figure 3-12**). Although the visitor use sites had larger within-site variation than the reference sites, the slightly improved separation of scores in the analysis appears to indicate some differences between the visitor and reference areas in the relative abundances of algae. However, the moderate level of stress (0.18) for the analysis is indicative of the difficulty in representing the large amount of variation among sites in the two MDS dimensions. The average similarities among the sites within the reference and visitor use areas are close in

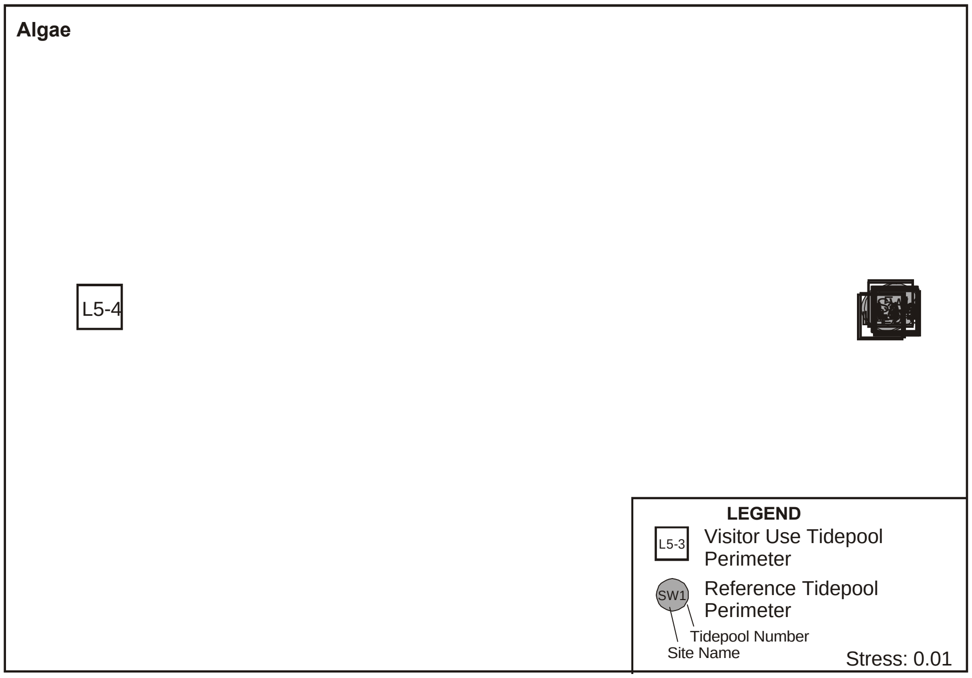

Figure 3-10. First MDS of Bray-Curtis distances of algal quadrat average percent cover surrounding tidepools.

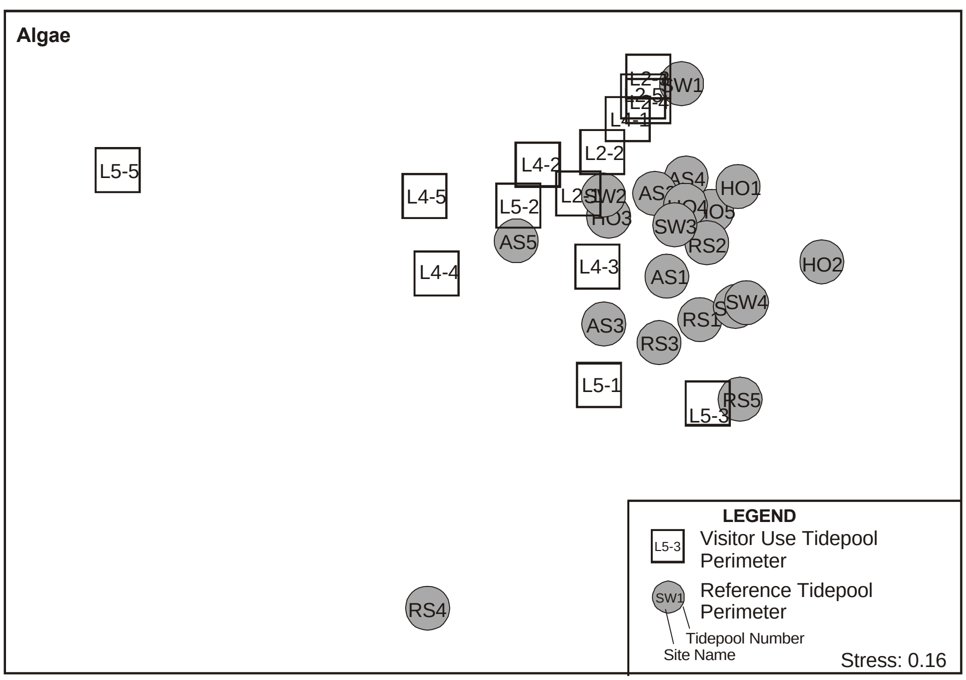

Figure 3-11. Second MDS of Bray-Curtis distances of algal quadrat average percent cover surrounding tidepools.

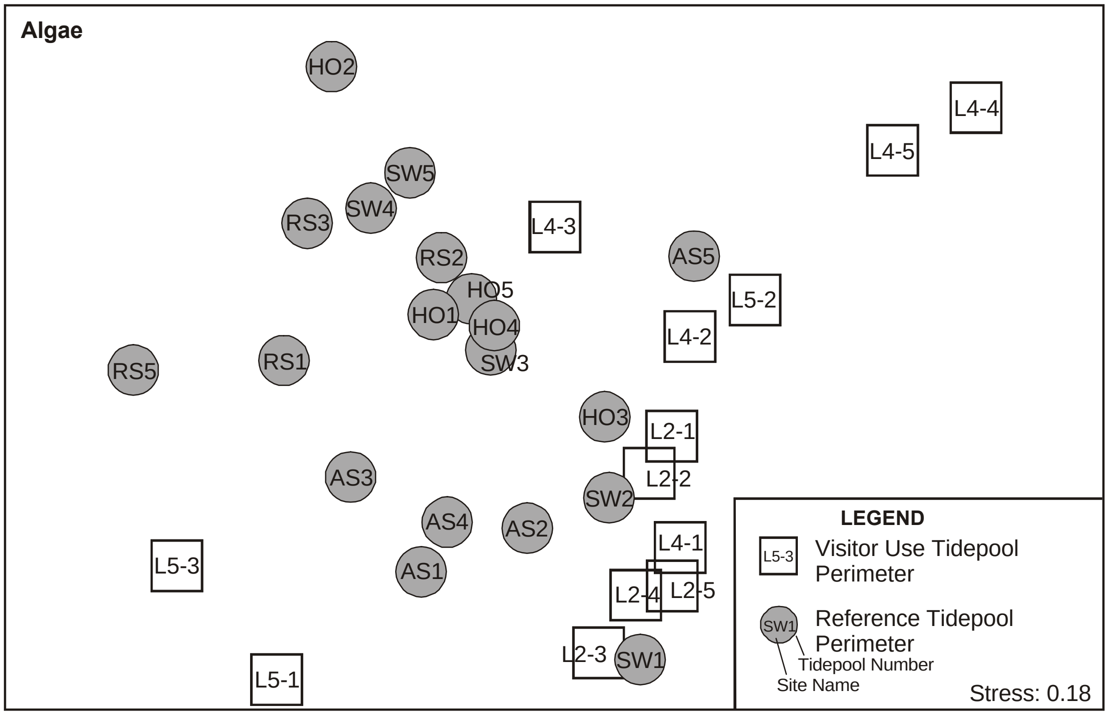

Figure 3-12. Third MDS of Bray-Curtis distances of algal quadrat average percent cover surrounding tidepools.

value, 48 and 41, respectively. Despite the large variation around tidepools within sites, a statistically significant difference (p=0.01) was detected in the algal assemblages between the reference and visitor use areas using ANOSIM.

SIMPER analysis of the dissimilarities used in the final MDS analysis showed that nine of the 23 algal species analyzed accounted for greater than 90 percent of the dissimilarity between sites within reference and visitor use areas (**Table 4**, **Appendix J**). *Endocladia muricata* and *Mastocarpus papillatus* alone accounted for over 50 percent of the dissimilarity. SIMPER also showed that a greater number of species accounted for the similarity among the reference sites in contrast to the visitor use sites.

A separate analysis of the average abundances from the tidepool perimeters at each site (site averages) was done to determine if differences between the visitor and reference areas were more apparent when within-site variation was pooled. This analysis provided a clearer separation of visitor site scores from the reference site scores, and the reduction in stress (0.09) indicates a better fit between the site distances and the MDS configuration (**Figure 3-13**). SIMPER analysis showed that many of the species responsible for the differences in the previous analysis remained important (**Table 5**, **Appendix J**). Despite the separation of the two groups of sites in the MDS, no statistically significant difference was detected in species abundances between the visitor and reference sites using ANOSIM, although the low number of possible permutations with the seven sites (n=35) did not provide for a very conclusive test. The much larger number of analytical permutations computed in the previous analysis of the quadrat averages from the tidepools at each site (n =2,000) provided for a much more reliable test for differences between areas.

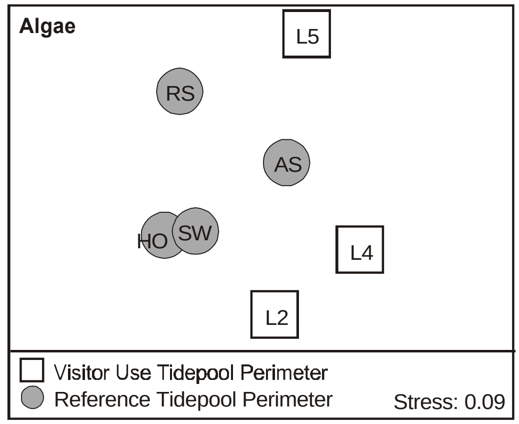

Figure 3-13. MDS of Bray-Curtis distances of algal site average percent cover surrounding tidepools.

Algal Select Species Analysis

The ten algal species that had the largest contributions to the dissimilarity between the visitor and reference sites from the SIMPER analysis, in addition to species richness (total number of species) and total upright algal cover, were statistically analyzed for differences between the visitor and reference sites. *Hesperophycus californicus*, a rockweed species, was not found in the tidepool perimeter quadrats at the visitor sites (**Figure 3-8**) and was therefore not statistically analyzed because it was only found in the reference tidepool perimeter quadrats where it was low in overall cover (<1.5 mean percent cover). Significant differences between the visitor and reference sites were only detected in *Endocladia muricata* (p=0.08) and *Mastocarpus jardinii* (p=0.07), which were both greater in cover at the reference sites (**Table 6**, **Appendix J**). *Endocladia* had the largest contribution to group differences in the SIMPER analyses (28 percent; **Table 5, Appendix J**). The SIMPER analysis showed that the similarity among the visitor use sites was characterized by fewer species than the reference sites.

Invertebrate Community Analysis

Invertebrate abundances were analyzed using the same data used in the algal community analyses after the outlier sites were removed. The MDS, based on the average abundances of 42 invertebrate species from the perimeter quadrats, shows large variation among the tidepools at the four reference and three visitor use sites (**Figure 3-14**). The analysis also does not show any apparent difference between the reference and visitor use sites, and no statistically significant difference was detected between the sites of the two areas using ANOSIM. SIMPER analysis showed that 14 of the 42 invertebrate species accounted for 80 percent of the dissimilarity between the reference and visitor sites (**Table 7**, **Appendix J**). The top five species of those 14 accounted for greater than 50 percent of the total and included black turban snails (*Tegula funebralis*), littorine snails (*Littorina scutulata*), rough limpets (*Lottia scabra*), hermit crabs (*Pagurus* spp.), and anemones (*Anthopleura elegantissima/sola*). The high natural variability in the abundances of these species probably accounts for the moderate level of stress in the MDS analysis and the difficulty in summarizing the large amount of variation within and

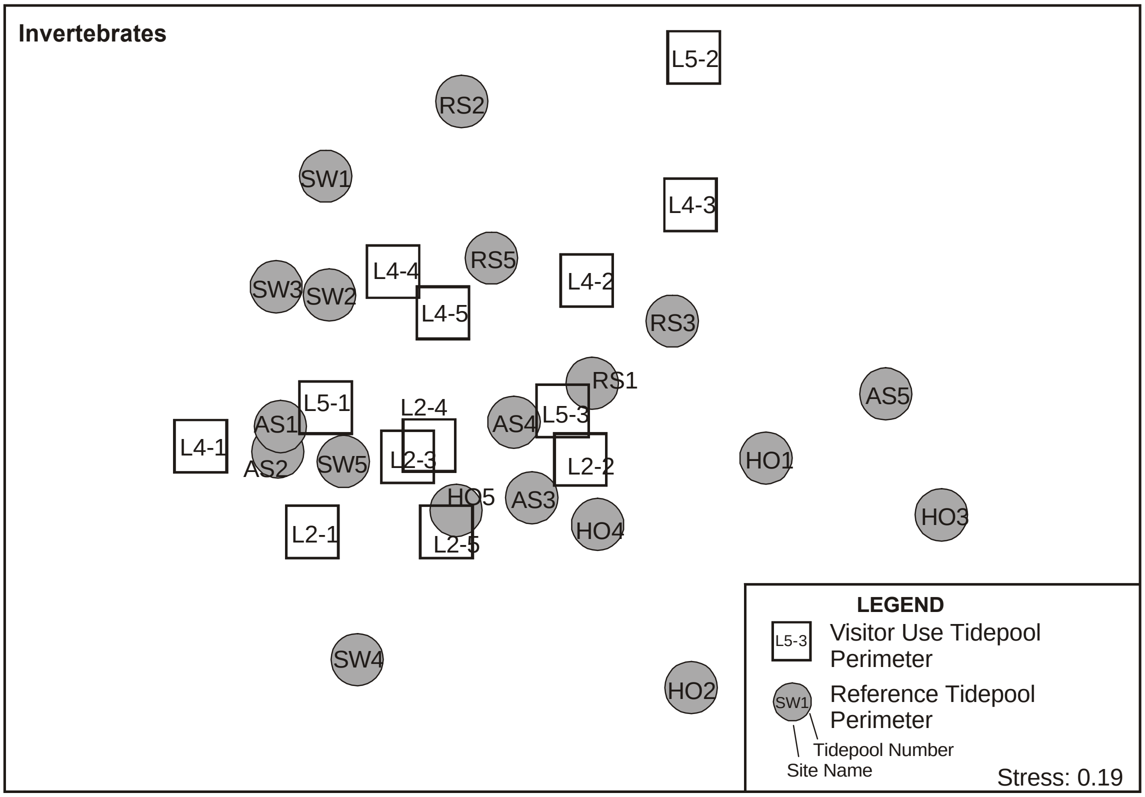

Figure 3-14. MDS of Bray-Curtis distances of invertebrate quadrat average abundances surrounding tidepools.

among sites. The species accounting for the similarity within the two areas are contrasted by larger numbers of species at the reference sites. The tidepool perimeters within the reference sites had an average similarity of 51 percent, and the tidepool perimeters within the visitor sites had an average similarity of 58 percent. Only four species accounted for almost 90 percent of the similarity at the visitor use sites, which may explain the increased similarity within the visitor sites relative to the reference sites where six species accounted for slightly greater than 80 percent of the similarity within the group.

The site averages were also analyzed with MDS to determine if any difference between visitor and reference sites could be detected when within-site variation was pooled, rather than separated. This analysis more clearly separated the visitor use and reference areas from one another, and the reduced stress (0.05) indicates a good fit between the site distances and the MDS configuration (**Figure 3-15**). SIMPER analysis showed that many of the species responsible for the differences between the reference and visitor areas in the previous analysis of the tidepools at the sites remained important in this analysis of the site averages, but the contribution of several species of limpets was reduced (**Table 8**, **Appendix J**). The differences between visitor and reference sites now included a more diverse group consisting of 20 invertebrate taxa (**Table 8**, **Appendix J**) compared to the previous analysis, in which differences were based on 14 taxa (**Table 7, Appendix J**). In this latter analysis, nine species account for similarities within the reference area group, but still only four species account for similarities within the visitor use group. No differences were detected between the visitor and reference sites using ANOSIM, although the low number of permutations (n=35) possible with only seven sites resulted in low test power.

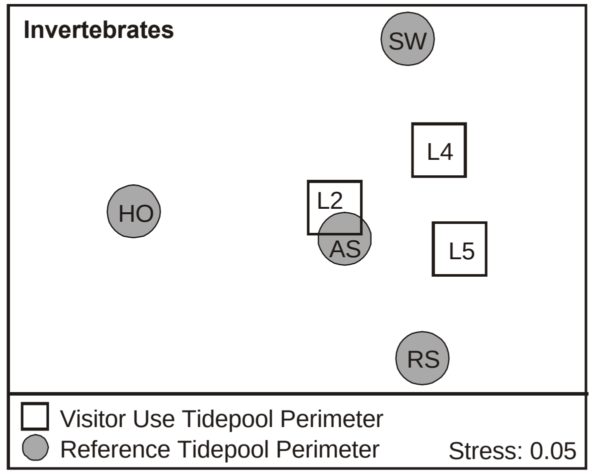

Figure 3-15. MDS of Bray-Curtis distances of invertebrate site average abundances surrounding tidepools.

Invertebrate Select Species Analysis

No significant differences were detected in individual species abundances between the visitor and reference sites (**Table 9**, **Appendix J**). However, invertebrate species richness was significantly greater at the reference sites (p=0.01). This result is consistent with the SIMPER results that indicated higher species richness at the reference sites.

Discussion

The results for the algae are consistent with potential impacts of visitor use. Differences in species abundances between the algal communities on flat rocks surrounding tidepools at the reference and visitor use sites were detected with ANOSIM. The algal species most responsible for the difference was *Endocladia muricata*, which had less cover around the visitor use area tidepools (by about 15 percent cover), compared to the reference area tidepools. This species is one of the most abundant habitat-forming algal species in the mid- to upper intertidal zone. A significant difference between reference and visitor use areas was also detected for this alga using ANOVA. *Endocladia* is potentially vulnerable to trampling effects because, unlike many other algae, it is not slippery and provides good footing for someone walking through the intertidal. Sand sometimes collects among its branches and this may also increase the potential for erosion when stepped on. Total upright algal cover and species richness were highly variable among sites, and the differences were not statistically significant. The rockweed, *Hesperophycus californicus*, was not analyzed because it was absent around the tidepools sampled in the visitor use areas, and low in overall cover (about 1.4 % cover) around the reference area tidepools (**Figure 3-8**). The difference, however, may reflect the effects of trampling, as each plant grows from a single stipe and holdfast, which can be easily damaged from trampling (Murray and Gibson 1979).

Areas around three tidepools were unique in having large amounts of bare rock or diatom cover. These were excluded from the community analyses to allow the analyses to focus on other differences among the remaining sites. Large amounts of bare rock cover were represented around one tidepool in the visitor use area and around one tidepool in the reference area. Because high amounts of bare rock were represented in both areas, the data for those quadrats were excluded. In contrast, high amounts of diatom cover were present around the perimeter area of a single tidepool in the visitor use area (Tidepool 4 at PP Lot-5 North). High diatom cover was also found within the tidepool (see *Section 3.1 - Tidepool Study*). This may indicate that this one particular tidepool area had received exceptionally high visitor use. The trampling could have created more bare rock space around the tidepool perimeter, which allowed for the diatom growth. Reductions in invertebrate grazer abundance from trampling and collecting could have also allowed for the growth of diatoms. However, grazing limpets were relatively common around the perimeter of the tidepool, but the absence of grazing turban snails was unique to these quadrats (**Table 14, Appendix H**). Therefore, it is possible that Tidepool 4 at PP Lot-5 North was affected by visitor use. Turban snails are often collected for souvenirs and food, but can also be easily knocked off rocks from foot traffic. In contrast, other quadrats surrounding nearby tidepools at the same site were not covered with diatoms and had high abundances of invertebrate grazers, indicating high spatial variation in the occurrence of species inhabiting the perimeter of tidepools.

No statistically significant differences between the visitor and reference sites could be detected for individual invertebrate species. The high variability in the data and low ANOVA test power made it difficult to detect any differences if, in fact, there were any. However, the community comparisons did show that visitor use sites generally had fewer invertebrate species than the reference areas. The statistically significant difference between areas in invertebrate species richness detected with ANOVA is also consistent with the SIMPER results that showed lower species richness at the visitor use sites (**Table 8, Appendix J**). While it was difficult to detect statistically significant differences between areas for individual species due to the large amounts of variation, community-level variables, such as species richness that may be less variable within areas, may be more sensitive indicators of differences between areas. In addition, lower algal cover in the visitor use areas may have also contributed to the lower invertebrate richness at the visitor use sites.

3.3 Band Transect Study

Purpose

The purpose of this study was to characterize the algae and invertebrate communities along the Point Pinos rocky shoreline and to determine if any differences in species composition could be detected between areas with varying levels of visitor use and the reference areas with minimal visitor use.

Background

Intertidal organisms tend to occur in bands that are parallel to shore and correspond to tidal elevation zones (Ricketts et al. 1985). As a result, the upper intertidal zone has a different mix of species than the lower zone. Areas of mixed bedrock and boulder fields characterize much of the intertidal zone at Point Pinos. The transect study element complemented the tidepool study (*Sections 3.1 and 3.2*) by sampling the biota along this broader habitat and including a greater species assemblage than represented in the tidepool studies alone.

Methods

Sampling

Algae and invertebrates were sampled in areas of mixed bench rock and boulder fields at five stations within the visitor use area and five stations within the reference area (**Figure 3-1**). Each station consisted of an upper and lower 20 m transect with both transects oriented parallel to the shoreline. This stratified sampling approach reduced the variation due to tidal elevation. The transects were deployed to sample areas of bedrock and boulder fields, and therefore, to the best extent possible, they did not cross over surge channels, tidepools, sand flats, rubble fields, ridges, and tall outcroppings. The upper transects sampled elevations at approximately the +3.0 to +4.0 ft MLLW where rockweeds (*Silvetia compressa* and *Fucus gardneri*) tend to be most abundant. The lower transects sampled the zone characterized by iridescent seaweed (*Mazzaella flaccida*) (approx. +1 ft MLLW) that is above the surfgrass zone (*Phyllospadix* spp.).

Twenty-0.25 m^2 quadrats were randomly positioned along each transect. Random numbers were used to position the quadrats according to distances along each transect. At the random position, a side of the quadrat frame was placed along the line and the quadrat laid offshore, onshore, or centered on the line according to another set of random numbers. The quadrat had to lay relatively horizontal at rest (e.g., less than a 30 cm, 12 in., difference from horizontal). Alternate random locations were used when the original quadrat location had greater than a 30 cm difference from horizontal, occurred in a surge channel, rubble field, tidepool, or overlapped the sampling area of other quadrats.

In each quadrat, the percent cover of algae and attached invertebrates, distinguished to the lowest taxonomic level practical, including substrate composition and uncolonized substrates, were each were visually estimated. The larger overstory algae (e.g., *Mazzaella flaccida*, *Silvetia compressa*) were sampled first, then the fronds brushed aside to sample the shorter-statured understory algae and substrates. Therefore, the amount of total algal cover (all species combined) added to uncolonized substrate cover could exceed 100 percent cover. Motile invertebrates were counted within each quadrat, and sessile forms were enumerated as percent cover, as in the algae. The larger motile macroinvertebrates (e.g., abalone, sea stars) that tend to be widely distributed and under-estimated in 0.25 m^2 quadrats were also sampled by searching a larger area 1 m to either side of the 20 m transect. These larger sampling areas are referred to as 2 m x 20 m band transects or plots.

Analysis

The multivariate (MDS) and univariate (ANOVA) statistical analyses and criteria for species selection used for the transect data were done using the same methods used for the tidepool study (see *Section 3.1 – Tidepool Study*). The MDS and SIMPER analyses were based on the data from the 0.25 m^2 quadrats.

The transect study design allowed for additional analyses to test for differences between the visitor use and reference areas. In the first analysis, the upper and lower transects in the visitor use area were compared to the transects at the corresponding elevation in the reference area. We expected that any differences between areas would at least be detected in the upper transects, as that zone receives the greater amount of visitor use (see *Section 2.1 – Visitor Distribution*).

Separate MDS analyses were done for algae and invertebrates at the two tidal levels. Data from the 20 quadrats along each transect for each taxa were averaged prior to analysis. Invertebrate average transect abundances were log transformed (log[value+1]) for the upper level transects and square root transformed ($\sqrt{[value+1]}$) for the lower level transects to account for the large differences in abundances among taxa. Algal data were not transformed for analysis at either tidal level. The Bray-Curtis measure of dissimilarity was used in the MDS analyses. The taxa contributions to the pattern in the MDS analyses were examined using the SIMPER routine in PRIMER. MDS was also used to contrast patterns of variation between upper and lower tidal elevations by combining data from both elevations into separate analyses for algae and invertebrates. Average abundances for both algae and invertebrates were square root transformed ($\sqrt{[value+1]}$) for this analysis. The MDS configurations and SIMPER analyses were used to determine if differences between upper and lower elevation transects varied between reference and visitor sites.

The differences in abundances of a particular species between the paired upper and lower transects (deltas) were also analyzed. We hypothesized that the average abundance difference between elevations may be greater in the visitor use areas than in the reference areas. The analysis was based on the premise that the lower elevation transects are impacted less by visitor use and therefore may serve as ‘controls’ for the upper elevation transects where visitor impacts are expected to be greater. Furthermore, analyzing the deltas between the upper and lower elevation transects eliminates the need that the lower elevation transects have similar species abundances between the visitor use and reference areas.

There are usually large differences in species composition and abundance between the upper and lower intertidal. Therefore, the analysis of deltas was only conducted on species that are generally common at both tidal elevations (e.g., turban snails, certain species of algae). For example, the removal of all turban snails from the upper intertidal would result in a larger delta between elevations at the visitor use sites than at the reference sites. Total upright algal cover and algal and invertebrate species richness were also analyzed in this manner, and data were also included from the larger 2 x 20 m plots for the larger, more conspicuous invertebrates. These were black abalone (*Haliotis cracherodii*), bat star (*Asterina miniata*), and ochre sea star (*Pisaster ochraceus*), which are highly susceptible to collecting.

The abundance deltas from the 0.25 m^2 transect quadrats and 2 m x 20 m plots were analyzed using analysis of covariance (ANCOVA) with sites (transects) as a random factor nested within the reference and visitor use areas. We used an index of visitor use as a covariate, which was determined from surveys that quantified the number of visitors per 100 m segment of shoreline over the survey period (**Figure 3-2**). An analysis was conducted to determine if the covariate was significant. If the covariate was not significant, a nested ANOVA model without the covariate was used to analyze for differences between the visitor and reference sites. If the covariate was significant, another test was conducted to determine if the two groups had a common slope. Data sets that had a common slope were analyzed with the covariate; otherwise they were analyzed without the covariate because there were too few sites to analyze the data at various levels of the covariate.

A relatively low probability level of 80 percent was used in the covariate tests. This was done because the small number of sites and variability between the visitor and reference sites in levels of the covariate would have made it difficult to detect significant contributions of the covariate. In addition, increasing the likelihood of a Type I error for these analyses did not affect the main hypothesis being tested (a difference between visitor and reference sites). Therefore, the probability level was lowered to increase the chance of including the covariate to help explain some of the variation and to increase the chance of detecting a difference between areas.

Results

Overview of Algae and Invertebrates

The algal community at the upper elevation transects (**Figure 3-16**) had larger abundance differences in the individual species between visitor use and reference areas than the

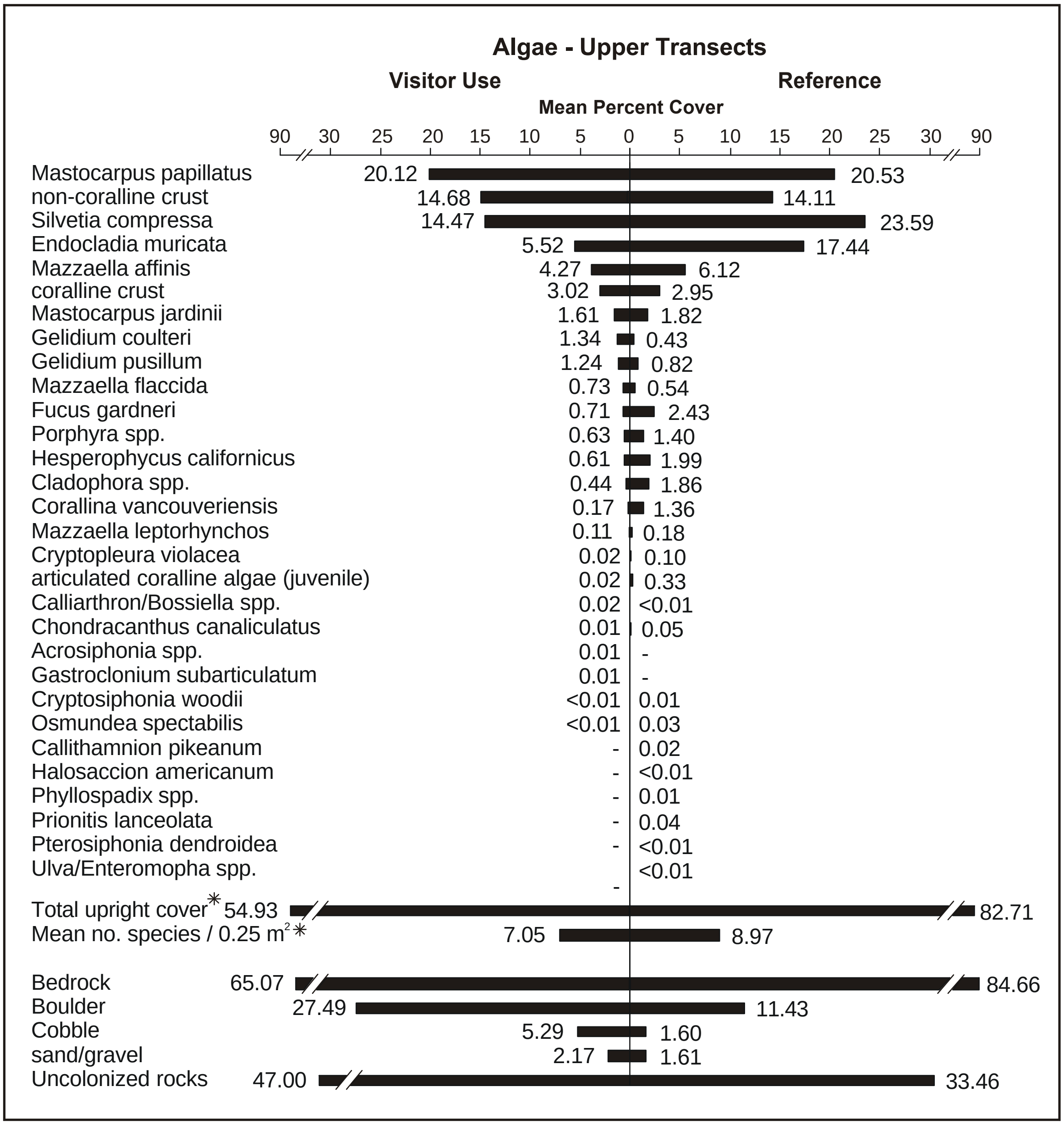

Figure 3-16. Algal and substrate cover in upper transects. Asterisk denotes a statistically significantly difference in abundance between areas was detected using ANOVA.

lower elevation transects (**Figure 3-17**). In particular, the rockweed *Silvetia compressa* and nail brush seaweed *Endocladia muricata* were less abundant in the upper elevation visitor use area, compared to the reference area at the same elevation. The differences in these species largely account for the lower total upright algal cover (all upright algal species combined) in the visitor use area. The amount of uncolonized substrates was also greater in the visitor use area, relative to the reference area.

Figure 3-17. Algal and substrate cover in lower transects. Asterisk denotes a statistically significantly difference in abundance between areas was detected using ANOVA.

The abundances of individual algal species in the lower transects were very similar between the visitor use and reference areas (**Figure 3-17**). Although total upright algal cover was slightly less in the visitor use transects, both areas had greater than 100 percent total cover due to multiple layers of different algal species. Some species were slightly more abundant in the reference transects while others were slightly more abundant in the visitor use transects (**Figure 3-17**).

In the invertebrates, there were no unusually large differences in species composition and abundance between the visitor use and reference transects at either elevation (**Figures 3-18 and 3-19**).

Algal Analysis

Upper Transects: The MDS distribution of scores based on 28 algal species at the upper elevation transects shows large variation among the transects in both the reference and visitor use areas (**Figure 3-20**). There is some separation of scores between the two areas, but there are also several transects from both areas (SW, AS, RS, L1, L4-E, L5) that are more similar to each another than to the other transects within their respective area. Although the differences among reference transects appear to be greater than the visitor use area transects, the average similarities among transects within the reference and visitor areas were close in value, 59 and 62 percent similarity respectively. There was no statistically significant difference between reference and visitor areas detected using ANOSIM.

SIMPER analysis showed that 10 of the 28 species accounted for greater than 90 percent of the dissimilarity between the reference and visitor upper intertidal transects (**Table 10**, **Appendix J**). *Silvetia compressa* and *Endocladia muricata* alone accounted for greater than 50 percent of the dissimilarity between the two groups of sites.

Significant differences between the upper transects in the visitor and reference areas were detected for total upright algal cover (p=0.01) and algal species richness (p=0.02) (**Table 11**, **Appendix J**), which were both lower in the visitor use upper transects.

Endocladia muricata with the second highest contribution to the dissimilarity between visitor and reference areas in the SIMPER analyses, just below *Silvetia compressa*, also had the lowest p-value of the individual species in the analysis (p=0.15). The covariate for level of visitor use was only significant for *Mastocarpus papillatus*, but the interaction, or varying response, of the covariate within the visitor use and reference sites did not allow us to include the covariate in the analysis.

Lower Transects: The MDS distribution of scores based on 42 algal species from the lower elevation transects also shows large variation among transects in the reference and visitor use areas with no pattern that would indicate they were unique from one another (**Figure 3-21**). The similarities among the transects within the reference and visitor use

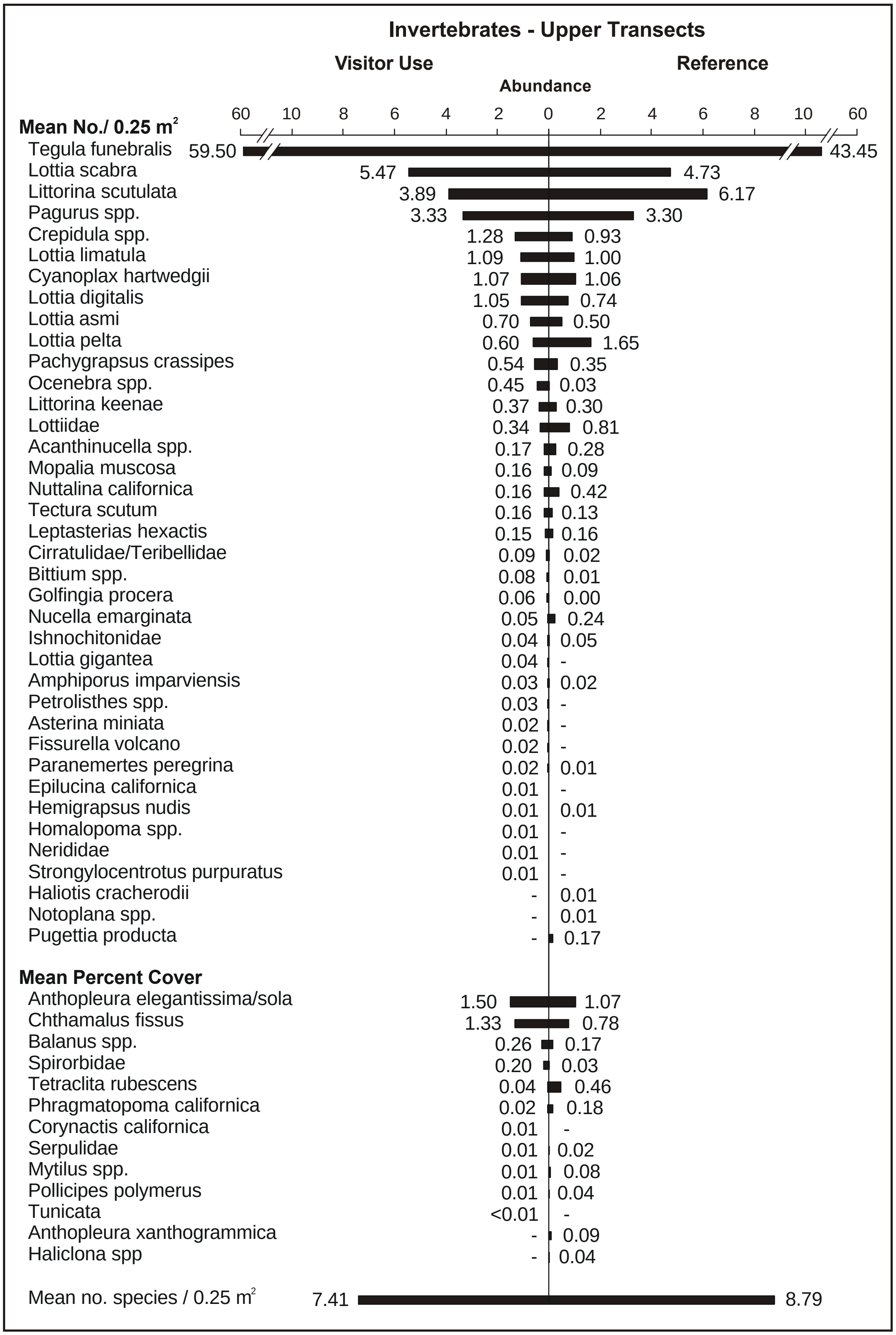

Figure 3-18. Invertebrate abundances in upper transects. No statistically significant differences in abundance were detected between areas using ANOVA.

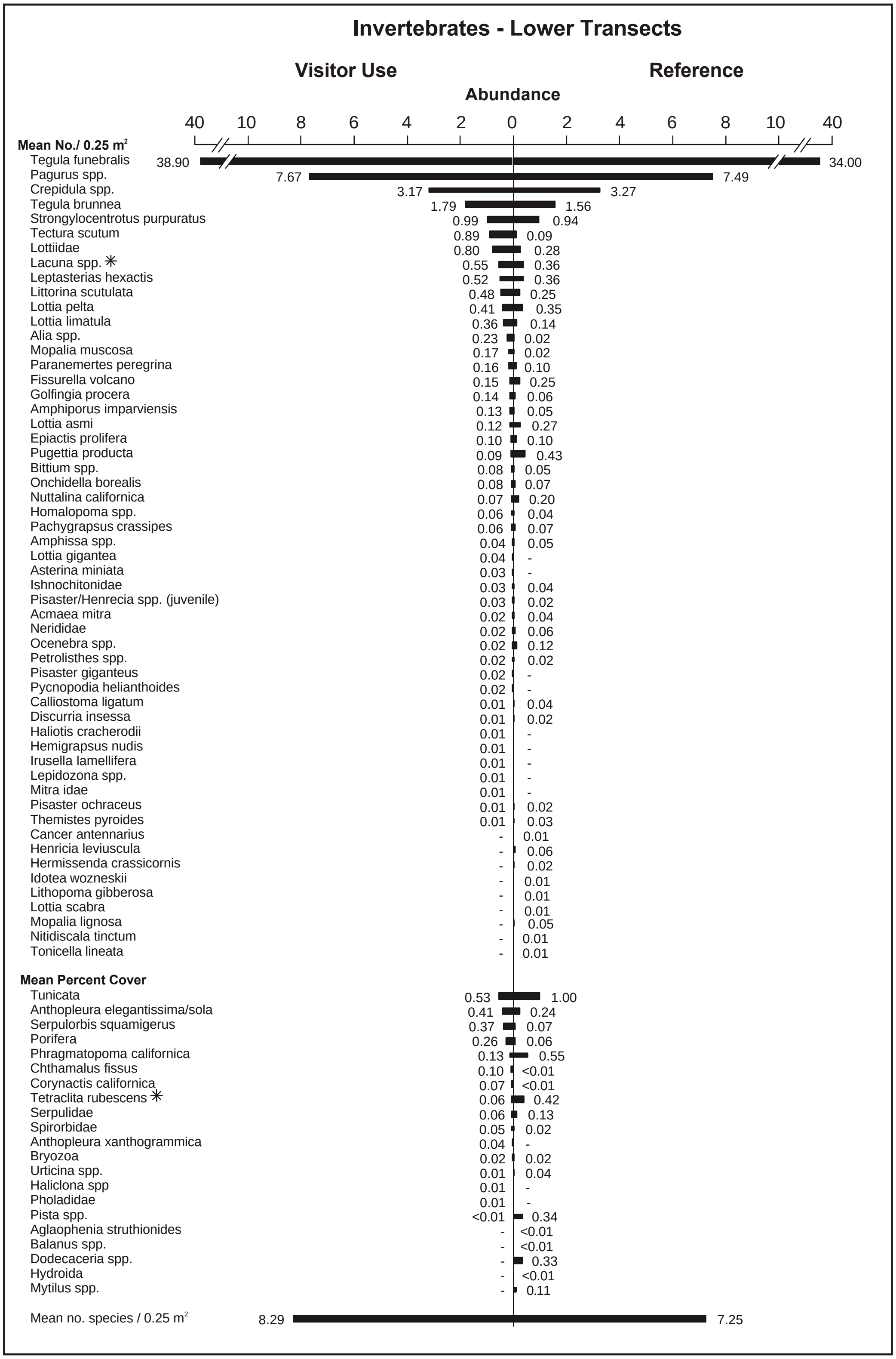

Figure 3-19. Invertebrate abundances in lower transects. Asterisk denotes a statistically significantly difference in abundance between areas was detected using ANOVA.

areas are close in value, 60 and 64 percent respectively. SIMPER analysis shows that 15 of the 46 species accounted for greater than 90 percent of the dissimilarity between the reference and visitor use areas, with *Mazzaella flaccida* having the largest contribution (20 percent) to the dissimilarity between areas (**Table 12**, **Appendix J**). There was no statistically significant difference between reference and visitor areas detected using ANOSIM for the low elevation transects.

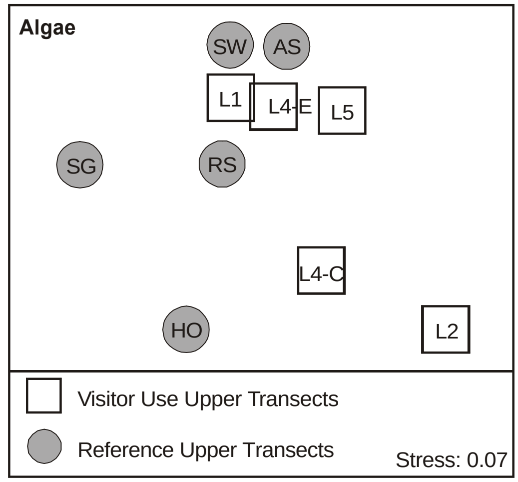

Figure 3-20. MDS of Bray-Curtis distances of average algal percent cover from upper transects.

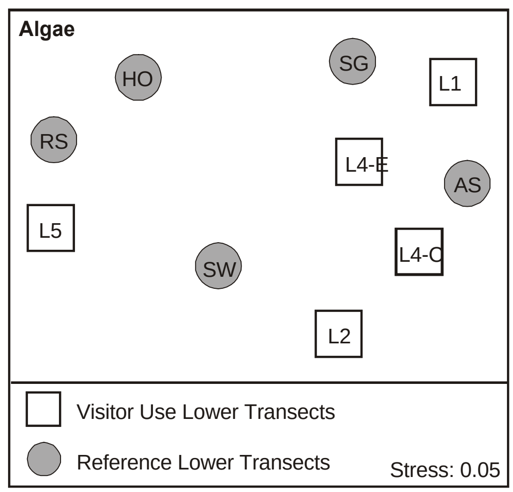

Figure 3-21. MDS of Bray-Curtis distances of average algal percent cover from lower transects.

Significant differences in the algae between the visitor use and reference areas at the lower transects were detected for three of the ten species analyzed (**Table 13**, **Appendix J**). The nested ANOVA model detected significantly higher abundances in the visitor use area relative to the reference area for *Mazzaella affinis*. Differences were only detected for *M. flaccida* and *M. phyllocarpa* after including a covariate for varying levels of visitor use at the sites. After adjusting for the covariate the estimated abundance at the reference area was greater for *M. flaccida,* while it was greater at the visitor use area for *M. phyllocarpa*. These bladed foliose algae were among the most abundant species in the lower intertidal zone (**Figure 3-17**).

Upper and Lower Transect Comparison: MDS was also used to examine the relative variation among the upper and lower transects for both areas (**Figure 3-22**). The analysis clearly distinguishes the upper and lower transects from each other, due to the different algal communities at the two levels. The variation among the upper level transects was greater than the lower elevation transects, with the greatest variation in the upper intertidal occurring in the visitor use area.

Invertebrate Analysis

Upper Transects: The MDS distribution of scores based on 51 invertebrate species from the upper elevation transects shows large variation among reference and visitor use sites

(**Figure 3-23**). SIMPER analysis showed that 14 of the 51 species accounted for greater than 70 percent of the dissimilarity between the reference and visitor areas (**Table 14**, **Appendix J**). *Littorina scutulata* and *Lottia scabra* contributed mostly to the dissimilarity between areas. Overall, the 14 species represent a variety of forms consisting of snails, limpets, anemones, barnacles, and hermit crabs. This diversity probably accounts for the large variation among sites in the MDS and why no statistically significant differences between the reference and visitor use areas were detected using ANOSIM.

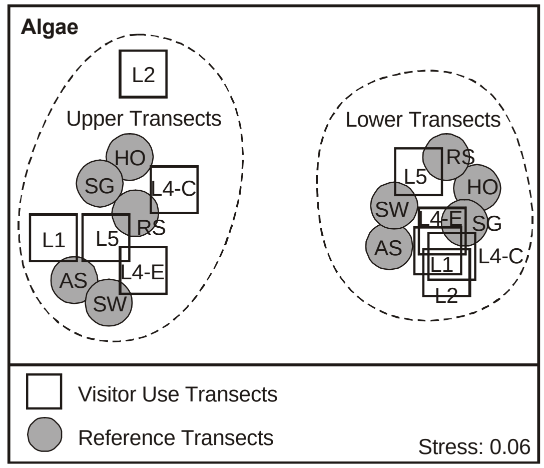

Figure 3-22. MDS of Bray-Curtis distances of average algal percent cover from upper and lower transects.

The ten invertebrate species that had the largest contributions in the SIMPER analysis to the dissimilarity between areas were analyzed for statistically significant differences using ANOVA and ANCOVA. No statistically significant differences between the visitor and reference areas were detected for the upper elevation transects for either the species from the 0.25 m^2 quadrats or the three species from the 2 m x 20 m plots (**Table 15**, **Appendix J**).

Lower Transects: The MDS distribution of scores based on 76 invertebrate species from the lower elevation transects shows greater variation among the reference area transects when compared to the transects in the visitor use area (**Figure 3-24**). SIMPER analysis showed that 26 of the 76 species accounted for greater than 70 percent of the dissimilarity between the reference and visitor use areas (**Table 16**, **Appendix J**). The black turban snail (*Tegula funebralis*), which can be highly variable in abundance and distribution, had the largest contribution to the dissimilarity between areas. There was no statistically significant difference between reference and visitor areas detected using ANOSIM.

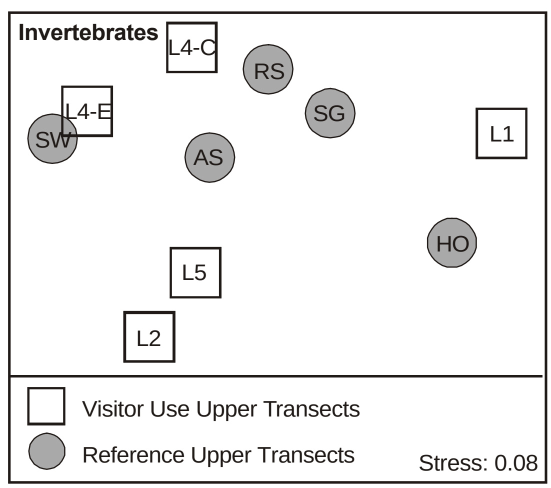

Figure 3-23. MDS of Bray-Curtis distances of average invertebrate abundances from upper transects.

Statistically significant differences (ANCOVA) between the visitor and reference lower elevation transects were detected for the small snail *Lacuna* spp. and the barnacle *Tetraclita rubescens* (**Table 17**,

Appendix J). *Lacuna* was greater in abundance in the low elevation transects in the visitor use area, but *Tetraclita* was greater in abundance in the reference transects (**Figure 3-19**). However, both of these species were very low in abundance at both groups of transect sites. Larger invertebrates were sampled in the 2 m x 20 m plots associated with the transects, and no statistically significant differences between the visitor and reference areas were detected for the three species analyzed.

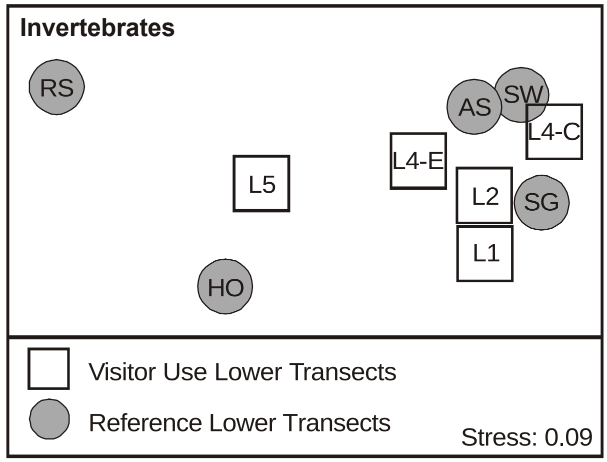

Figure 3-24. MDS of Bray-Curtis distances of average invertebrate abundances from lower transects.

Upper and Lower Transect Comparison: MDS was also used to examine the relative variation in invertebrate abundances among the upper and lower transects in both areas in a single analysis (**Figure 3-25**). As in the algae, the analysis clearly distinguished the upper and lower transects from each other, due to the different invertebrate communities at the two levels. In contrast to the results for the algae, variation within the upper and lower elevation transects for the invertebrates appears to be approximately equal.

Results of the analysis of differences (deltas) between tidal levels are portrayed in **Figure 3-26**. Although there were few differences between the visitor use and reference areas for the low elevation transects, the variation among stations was reduced in the deltas by subtracting the lower elevation data. The reduced among-station variation increased our statistical power to detect differences between the visitor use and reference areas. Statistically significant differences were detected only for *Mastocarpus papillatus* and invertebrate species richness (**Table 18**, **Appendix J**). The analysis for *Mastocarpus* used the covariate for visitor use so the average values

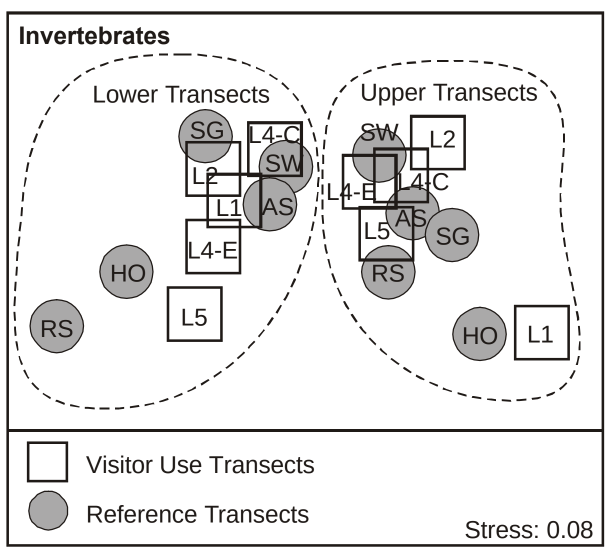

Figure 3-25. MDS of Bray-Curtis distances of average invertebrate abundances from upper and lower transects

shown in **Figure 3-26** do not reflect the adjusted values used in the analysis. The p-value for total algal cover (p=0.13) is also close to the statistical level of significance (p=0.10).

Discussion

The only statistically significant differences that we were able to detect between the visitor use and reference areas in the transect data were reduced algal cover and species richness in the visitor use area. The reduced algal cover in the visitor use area can be primarily attributed to lower abundances of *Endocladia muricata* and *Silvetia compressa*. These two algae had the largest contributions to the difference between visitor use and reference area transects in the MDS. The result for *Endocladia* is consistent with those found in the sampling of rocks surrounding tidepools in the present study (see *Section 3.2 – Tidepool Perimeter Study*). The result for *Silvetia* is consistent with an earlier study at Point Pinos that found rockweeds to be lowest in abundance in areas of highest visitor use (Clowes and Coleman 2000). However, Clowes and Coleman (2000) and subsequently Clowes (2002) attributed the differences to possible varying levels of sand movement and scour among the areas, rather than visitor traffic.

However, both *Silvetia compressa* and *Endocladia muricata* are likely to be susceptible to trampling effects. The relatively long bushy fronds in *Silvetia* originate from a single holdfast. Any damage to the holdfasts or small primary stipes can result in losses of entire

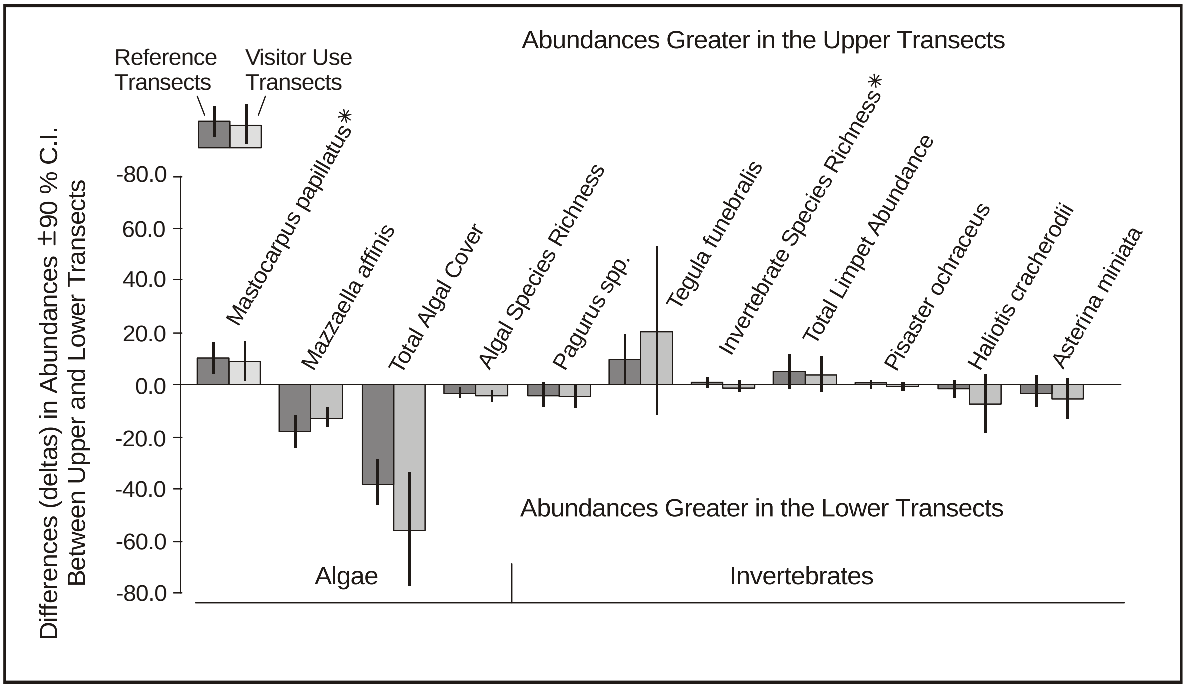

Figure 3-26. Differences (deltas) in algal and invertebrate abundances between upper and lower transects. Asterisk denotes a statistically significantly difference in abundance between areas was detected using ANOVA.

plants (Murray and Gibson 1997). In contrast, *Endocladia* is a turf-forming alga, with clumps of plants attached at multiple points. The clumps, however, entrap sand particles that may abrade the plants when they are exposed to foot traffic. Furthermore, *Endocladia* is not slippery, and people may find that this species provides stable footing in an otherwise slippery environment.

Impacts to the algae that might be related to visitor use were generally restricted to the upper intertidal transects, even though statistically significant differences were detected in three algal species at the lower tidal level transects. The analysis results showed that *Mazzaella phyllocarpa* was more abundant in the visitor use area while another, *M. affinis*, was more abundant in the reference area, likely from natural spatial variation. The third alga, *M. flaccida*, had similar abundances in both areas, but after adjustment by the covariate for visitor use it was estimated to be higher in abundance in the reference area. The mixed results indicate the differences are probably not related to visitor use because all of these particular species should be similarly susceptible to trampling effects, or similarly avoided because they are slippery.

The community analysis of algal and invertebrate data from the transects at the two tidal elevations did not provide any strong indication of a difference between the reference and visitor use area communities. The analyses depicted large variation among transects in both areas that obscured any potential differences due to visitor use. The variation was largely due to motile species such as *Tegula funebralis* and *Pagurus* spp. that can have large variation within and among transects.

MDS analysis comparing patterns of variation in algal communities between the upper and lower elevation transects showed greater variation at the upper elevation (**Figure 3-22**). Warwick and Clarke (1993) have noted that impacted areas often reflect increased variability. At Point Pinos, visitors have less access to lower tidal elevations. This may result in greater overall similarity among low elevation transects that are distributed across reference and visitor use areas. At the upper tidal levels, however, varying levels of visitor impacts may result in greater variation among transects, and contribute to increased differences between transects. Although visitor use transects showed greater variation than the reference transects at the upper elevation, the levels of visitor use did not correspond to the MDS configuration. For example, the PP Lot 5-North and PP Lot 4-Center sites on the Point Pinos shore had much higher levels of visitor use than the PP Lot 2 site located nearby. However, the MDS configuration showed the PP Lot 2 site was less similar to the reference sites than the sites with higher visitor use (**Figure 3-21**). This indicates that large natural spatial variation was a confounding factor in this study. The pattern may also not reflect visitor impacts at the sites, since the invertebrate community analysis (**Figure 3-25**) showed similar patterns of variation at both tidal levels.

The absence of any patterns indicative of visitor use impacts in invertebrate communities is indicated by analyses of individual invertebrate species and species richness at the two tidal levels. No statistically significant differences between the visitor and reference areas were detected at the upper tidal level for invertebrates, including species richness. Although differences were detected in the small cryptic snail *Lacuna* spp. and the barnacle *Tetraclita rubescens* at the lower tidal level, neither of these invertebrates are likely to be affected by visitor use and therefore probably reflect natural variation among the transects. In fact, abundances of *Lacuna* spp. were greater at the visitor use transects.

Including the level of visitor use as a covariate in the ANCOVAs was generally not effective in accounting for variation among transects. This was consistent with MDS results that did not show any patterns consistent with the varying levels of visitor use among sites. Also, the use of lower elevation transect data as a covariate to compute differences between areas did help account for some of the high among-site variation. Variation among sites of both areas was probably greater than the variation within the visitor use area alone, and may explain why incorporating a covariate for visitor use into the analyses was generally ineffective in detecting impacts. Unfortunately, the small number of species with adequate abundances at both tidal levels to test for differences between elevations limited the use of the elevation deltas to seven individual algal and invertebrate species, including algal and invertebrate community metrics. In addition, significant differences detected for some of the algae at the lower transects may indicate the assumption that visitor impacts are largely limited to the upper tidal levels may not be entirely valid. However, the differences detected from the lower elevation transects may also be due to natural variation that was not fully accounted for, due to limited sampling replication. Nonetheless, this approach appears promising and could be resolved by increased sampling at both tidal levels.

Although it is important to be cautious in drawing strong conclusions or implying cause and effect relationships from this type of observational study, the results are consistent with visitor impacts on intertidal algae. Mean abundances for the algae at the upper transects in the visitor use areas were lower than at the reference transects (**Figure 3-16**). In contrast, several low intertidal algae were greater in abundance at the visitor use transects than at the reference transects (**Figure 3-17**). The results are also consistent with the community analysis that depicted greater variation at the upper tidal level transects where visitor use tends to be greater. Therefore, differences between the visitor use and reference areas that could have been caused by visitor use at Point Pinos appear to be largely restricted to trampling effects on intertidal algae. Results for invertebrates were more variable at both tidal levels, and therefore do not provide strong indications of visitor impacts.

3.4 Owl Limpet and Black Abalone Shell Measurements

Background

Owl limpets (*Lottia gigantea*) and black abalone (*Haliotis cracherodii*) are two species of shellfish commonly collected for human consumption. Black abalone have been legally protected in California since 1998 due to significantly reduced population levels, and owl limpets, as well, are protected within the Pacific Grove Marine Refuge Fish Gardens. Poaching (illegal harvesting) can appreciably reduce the abundance of a local population, particularly for long-lived animals such as abalone and owl limpets. A slow decline in abundance, however, may not be apparent without historical data, and we had no baseline data to quantitatively evaluate population trends. On the other hand, a lack of larger individuals in the population is an indicator that poaching may have occurred because collectors typically remove the largest individuals until all of them are removed from an area (Hockey and Bosman 1986, Underwood and Kennelly 1990, Pombo and Escofet 1996, Griffiths and Branch 1997, Lindberg et al. 1998).

Owl limpets and black abalone have clumped distributions and typically occur on high relief substrate and in areas with moderate to high wave action (Ambrose et al. 1995, Lindberg et al. 1998) (**Figure 3-27**). Owl limpets range from Washington to Baja California (Morris et al. 1980). They live out in the open and tend to be most common in upper elevation zones on stable rocks and vertical walls that are smooth, but in areas that are exposed to waves (Ambrose et al. 1995). Black abalone range from Oregon to Baja California (Morris et al. 1980). They can be found in the same areas as owl limpets, but generally lower in the intertidal zone, in cracks and crevices, on the undersides of ledges, and between large boulders.

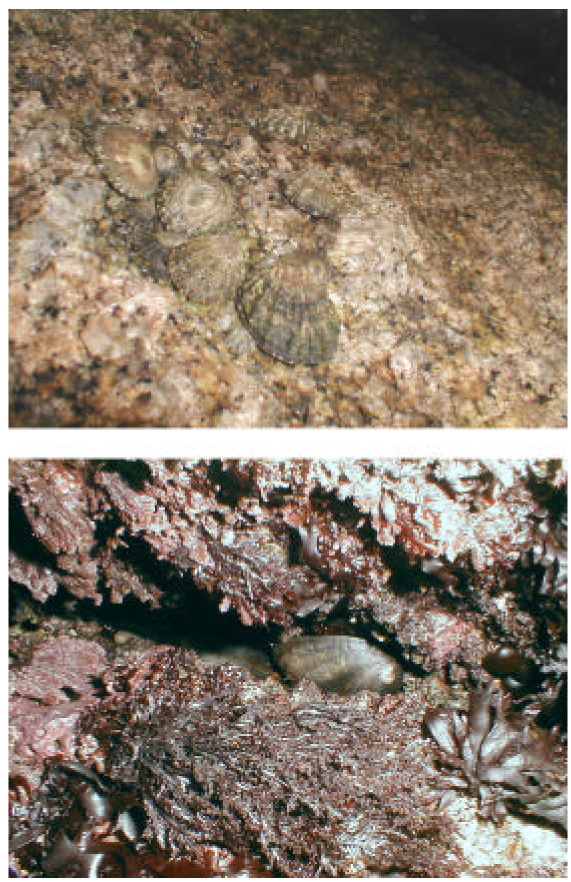

Figure 3-27. Owl limpet (above) and black abalone (below) in rocky habitats at Point Pinos.

Black abalone south of Point Pinos have experienced reductions in abundance, from a disease (withering syndrome) that causes the foot tissue and internal organs to slowly shrink (Haaker et al. 1992, Steinbeck et al. 1992). This eventually prevents the animal from clinging to the rocks and it dies from starvation or predation. The disease continues, and has caused mass mortalities of black abalone in southern and central California south of Point Pinos (Lafferty and Kuris 1993, Tissot 1995, Altstatt et al. 1996, Tenera 1997), possibly related to water temperature increases stemming from El Niño events (Raimondi et al. 2002.).

Methods

We sampled within rock outcroppings surrounded by boulder fields; habitats suitable for both owl limpets and black abalone. The sites mostly ranged in size from about 25 m^2 (30 yd^2) to 472 m^2 (565 yd^2) based on cross width dimensions, but the largest site was 1,000 m^2. Nine sites were sampled in the visitor use areas and eight sites were sampled in the reference areas. (**Figure 3-1**). The sites generally had high within-site topographical relief (approximately 3 m, 6 ft) with vertical walls containing cracks, crevices, and ledges. The top portions of the sites were generally populated with patches of mussels, the mid-levels with foliose red algae, and the bases near MLLW with surfgrass.

Shell lengths of all owl limpets within each defined area (site) were measured to the nearest millimeter using calipers. Black abalone were often difficult to measure with the same level of accuracy because they were mostly nestled in tight crevices or beneath boulders where calipers could not be used. In these cases, measurements were made by holding a ruler beside the exposed portion of the shell and visually estimating the length to the nearest 5 mm (0.2 in.) or 10 mm (0.4 in.) increment. Each abalone was also pulled, if possible, to test their adherence to the substrate as a preliminary sign of withering syndrome.

The owl limpet and black abalone data were statistically analyzed using analysis of variance (ANOVA) to test for significant differences in mean shell lengths between the reference and visitor use areas. A Brown-Forsythe test was first used to determine if both data sets met the assumption of variance homogeneity for ANOVA. The length frequency distributions were tested for statistically significant differences using the Kolmogorov-Smirnov (K-S) non-parametric test.

Results

Owl Limpets

A total of 1,393 owl limpets was measured at the reference sites and 891 were measured at the visitor use sites. The mean sizes were almost identical between areas (40.0 mm and 40.4 mm; 1.6 in.) (**Figure 3-28**), and a lack of significant difference was confirmed by the statistical tests (**Table 19, Appendix J)**. The reference areas had a slightly greater frequency of smaller individuals, many of which were found at Hopkins Marine Life

Refuge (**Figure 1, Appendix K**) but the K-S tests did not detect any significant differences in size frequency between the visitor use and reference sampling areas.

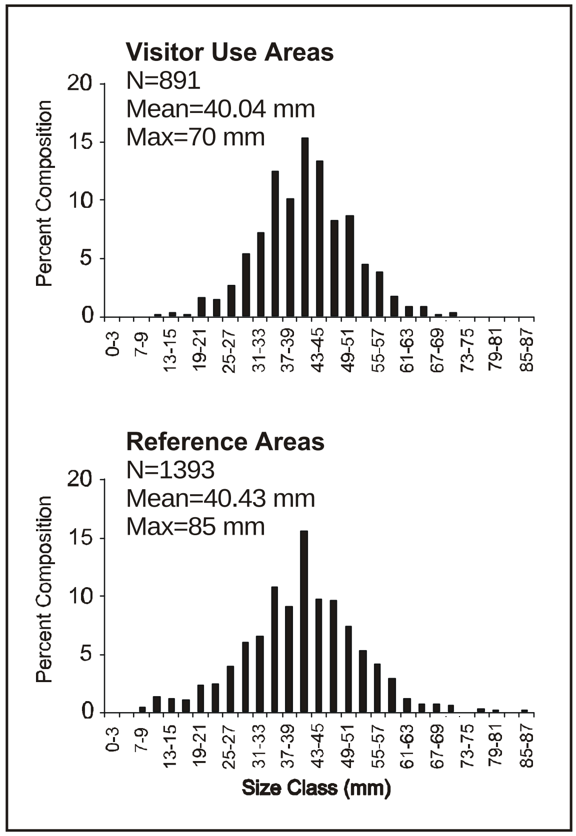

Figure 3-28. Owl limpet shell size frequencies at the visitor use and reference areas.

Black Abalone

A total of 136 black abalone was measured at the reference sites and 129 were measured at the visitor use sites (**Figure 3-29**). The largest abalone found in the high use areas was 147 mm (5.8 in) and the largest in the reference areas was 129 mm (5.1 in) (**Figure 2, Appendix K**). There was no significant difference in the K-S test in mean shell length between the visitor use and reference populations (**Table 19, Appendix J**). We found no black abalone with symptoms of withering syndrome at any of the study sites.

Discussion

We did not find any differences between the visitor use and reference areas that might be indicative of local population effects on owl limpets or black abalone due to harvesting. It is also possible that no appreciable harvesting occurs in the area. Similar shell size distributions were found in both areas for each species. Although we had no difficulty in finding both species, we could not determine if there were any differences in their densities between Point Pinos and reference areas with this study design. The study design was to obtain measurements of as many animals as possible. Accordingly, we sampled selected sites that varied in size and amount of suitable habitats, and the counts were not standardized in relation to the amount of suitable habitat present, due to the three-dimensional aspect of the sampling sites.

A limitation of using size frequency data to describe a population distribution is that some size classes will be either underestimated or overestimated depending on the number of measurements taken. Despite several gaps in the size frequency histograms of the black abalone, particularly at the larger size classes, the number of measurements was adequate to approximate a curve of the size frequency distributions in each area. Had a larger total area been surveyed, more large individuals would likely have been found, but the frequency curve would be expected to remain approximately the same.

Illegal harvesting tends to occur in areas that are hidden from open public view. It may also occur out of view during the night in easily accessible areas such as Point Pinos. Our sites in all areas were distributed so that some were away from open view and others easily seen from accessible cliff top vantage points. Therefore, we do not believe that our specific sampling sites potentially biased or affected our conclusions.

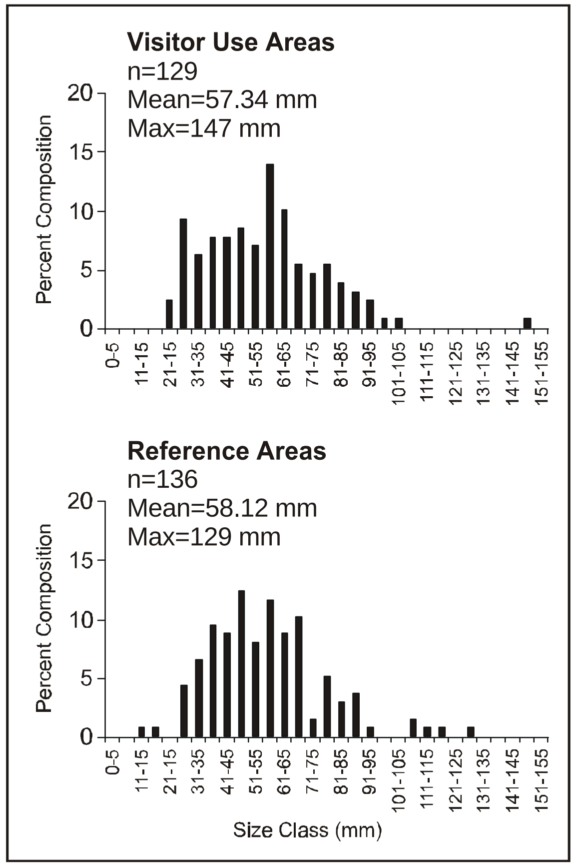

Figure 3-29. Black abalone shell size frequencies at the visitor use and reference areas.

The owl limpet populations in both the visitor use and reference areas appeared to be typical of a population with little or no exploitation. The mean size of approximately 41 mm (1.6 in.) in both areas is larger than the mean size of 26-35 mm (1.0-1.4 in.) reported from exploited areas in southern California and Mexico (Murray et al. 1999). Owl limpets can grow up to a maximum size of over 90 mm (3.5 in.), and those near this size are likely 10-15 year old (Morris et al. 1980). Although we found only one individual near this maximum size, there were many at 50 mm (2 in.) and larger, suggesting that they were at least several years old with some perhaps approaching 10 years old. This is much larger than the size of reproductive maturity of 25 mm (1 in.) suggesting that there is some capacity for localized recruitment (Pombo and Escofet 1996). Few if any large individuals would be found in areas with significant harvesting. The larger animals are nearly always females, because *Lottia gigantea* are protandrous hermaphrodites (Wright and Lindberg 1982). Consequently, significant harvesting of large owl limpets could affect population reproduction (Ambrose et al. 1995).

Black abalone populations along the Monterey coastline, including the study area, have undoubtedly been reduced over the long-term by human harvesting and predation from sea otters. Although we found several abalone of legal size (>127 mm, 5 in.) at both Point Pinos and in reference areas, these comprised a very small percentage (<1%) of the total population. However, poachers will often ignore legal size limits. In largely unexploited populations, legal size abalone comprised approximately 25-30% of the total abundance prior to the onset of the withering syndrome disease epidemic (Haaker et al. 1992).

No abalone were found with symptoms of withering syndrome disease in our study. This disease, which can cause near extinction of populations and may be linked with warm water El Niño conditions, was first observed on the California Channel Islands in the mid-1980s (Richards and Davis 1993, VanBlaricom et al. 1993). It has since spread to the mainland and has moved northward up the coast (Tenera 1997, Raimondi et al. 2002). The present northern range where abalone with symptoms of this disease have been observed is Cayucos, approximately 177 km (110 miles) south of Point Pinos. It has not appeared to have spread any farther northward over the past five years (Pete Raimondi, U.C. Santa Cruz, pers. com.).

3.5 Invertebrate Composition Associated With Habitats Under Turnable Substrates

Purpose

The purpose of this study was to describe the fauna that occurs underneath rocks in the intertidal zone. Species on the tops of rocks or associated with foliose algae are most vulnerable to trampling effects and collecting. However, portions of many of these populations also occur underneath boulders and cobbles where they may be less exposed to visitor impacts. Unaffected species in these habitats represent local larval supply sources to help sustain species abundances. Therefore, sampling was completed to provide an initial evaluation of the proportions of populations above and underneath turnable substrates. The study was not intended to test potential differences in under-rock faunal composition between visitor use and reference areas because the design lacked adequate replication for this purpose.

Background

Diverse assemblages of intertidal invertebrates occur not only on the exposed surfaces of rocks but also underneath boulders and cobbles (Davis and Wilce 1987, McGuinness 1987, Addessi 1994). Many of the invertebrates inhabit both the tops and under substrate habitats, but some species that need constant shade and moisture are more frequently found in under-substrate habitats (McGuinness 1987, Chapman and Underwood 1996). For example, porcelain crabs (*Petrolisthes* spp.) are more commonly found underneath turnable substates than on the upper surfaces. At the same time, many motile species may be active on the tops of rocks at high tide but then retreat to the undersides of rocks for protective cover during low tide. Some fishes too, notably members of the prickleback, gunnel, and clingfish families, specifically use the under-rock intertidal habitat for protection from predation and desiccation at low tide (Gibson and Yoshiyama 1999).

The refuge underneath turnable substrates also enables portions of populations to persist in areas of visitor use, providing that rock turning and collecting activities are not extensive. When a rock is inverted, motile individuals may fall off the rocks and move away underneath adjacent rocks. However, the sessile organisms on the undersides of rocks can become exposed to prolonged light and desiccation that can lead to mortality if left exposed (Chapman and Underwood 1996). Overall however, under-rock fauna provide a local source of larvae for recruitment, and can enhance recovery potential in areas subjected to disturbances.

Methods

Six 0.25 m^2 quadrats were randomly placed in boulder/cobble habitats in both the upper and lower intertidal zones within a visitor use area and reference area (**Figure 3-1**). Each quadrat had to contain at least 70% turnable substrate without an underlying base of sand, otherwise an alternate random location was used. The 'turnable' substrates had to be moveable by hand and included small boulders and large cobbles in the range of approximately 15-50 cm (6-20 in.) in greatest dimension.

Invertebrates occurring on the tops and sides of rocks were enumerated as 'above substrate' fauna while fauna attached to the undersides of the moveable substrates or on the surfaces of the underlying rocks were enumerated as 'under turnable substrate' fauna. Motile species were counted individually and the abundance of each sessile/colonial species was estimated as percent cover in each quadrat.

Results

Forty-seven invertebrate and two fish species were sampled in both the 'above substrate' and 'under turnable substrate' categories. In all quadrats, more organisms were found underneath the turnable substrates than above (**Figures 3-30** to **3-33**). Several species were found almost exclusively underneath turnable substrates (or in shaded areas) including: *Notoplana* (flatworm), *Stenoplax* (chiton), Porifera (sponge), Tunicata (tunicate), *Ophionereis* (brittle star), *Petrolisthes* (porcelain crab), and fishes.

Discussion

The results of this study show that under-rock habitats at Point Pinos provide a refuge for many intertidal organisms, both juveniles and adults, from immediate trampling and collecting impacts. For example, common species subjected to collecting include sea urchins, shore crabs, turban snails, and hermit crabs. Substantial portions of their populations were found underneath turnable substrates. The organisms that occupy these habitats can help to replenish losses from collecting through immigration and reproduction (Kingsford et al. 1991, Pombo and Escofet 1996).

Although species on the undersides of turnable substrates may be less prone to collecting, the movement of rocks when stepped on and rock turning can potentially injure these

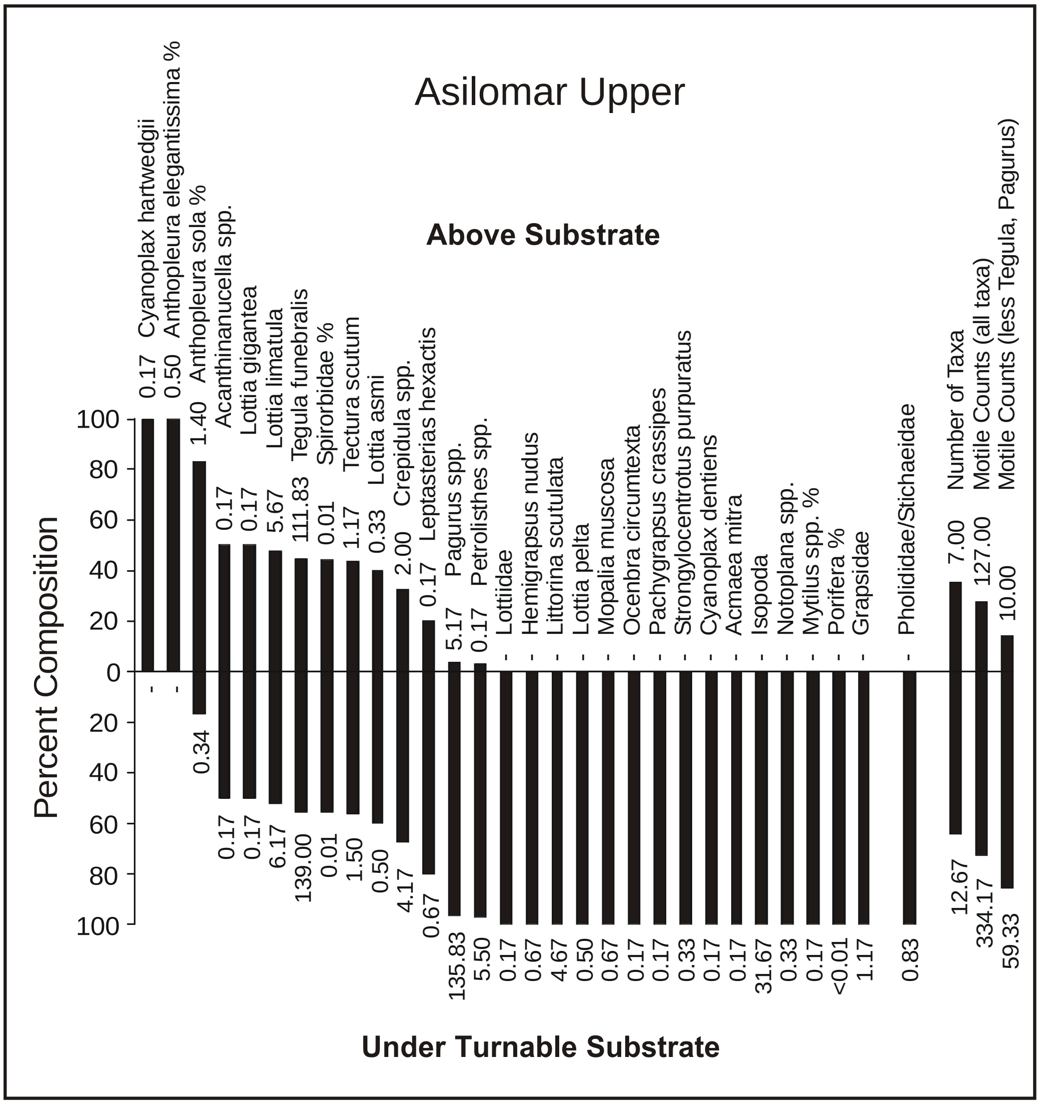

Figure 3-30. Invertebrates and fishes above and underneath turnable substrates at the Asilomar upper elevation sampling station. Numbers with columns are mean no. individuals per 0.25 m^2 or mean percent cover where indicated.

species (Addessi 1994, Chapman and Underwood 1996). However, wave action also moves rocks and can cause substantial damage during storm events, which can occasionally overturn very large boulders greater than 1 m (1.1 yd) (McGuinness 1987). These disturbances result in a mosaic of algal and invertebrate composition both above and underneath moveable boulders and cobbles (Davis and Wilce 1987).

In our data, there were fewer species above and underneath rocks in the upper elevation of the visitor use area (PP Lot 2) compared to the reference area (Asilomar). Due to limited study resources, a limited number of quadrats were sampled, and thus we cannot

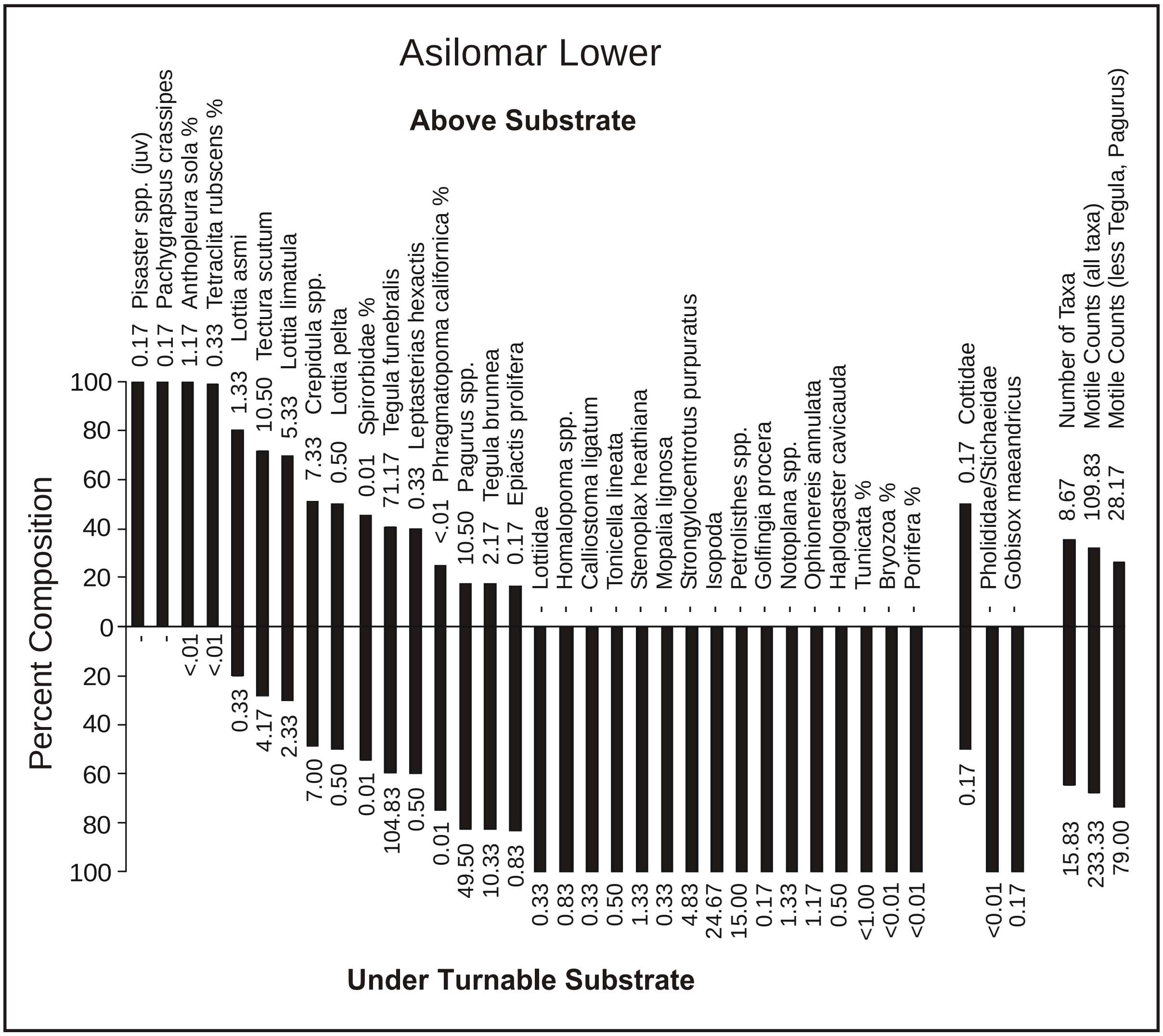

Figure 3-31. Invertebrates and fishes above and underneath turnable substrates at the Asilomar lower elevation sampling station. Numbers with columns are mean no. individuals per 0.25 m^2 or mean percent cover where indicated.

attribute the differences to the effects from collecting and rock turning. Anecdotal information suggests that the abundance of certain biota occurring underneath boulders and cobbles is now lower in abundance than historically (John Pearse, U.C. Santa Cruz; Chuck Baxter, Hopkins Marine Station, pers. com.) (see *Section 3.8 – Scientist Interviews*). These observations were made in several areas over many years. No explanations were given on the causes for the changes, but they may possibly reflect declines in recruitment, growth, and persistence from regional effects not related to visitor impacts. Results from other studies in the San Diego region noted a long-term decline between 1971 and 1991 in under substrate biota (Addessi 1994). Possible explanations for the decreases included continued habitat disturbance from rock turning and collecting by visitors or from long-term changes resulting from elevated water temperatures during El Niño events. Consequently, the changes in the San Diego study do not help to identify a cause and effect relationships for the suspected declines in our study area.

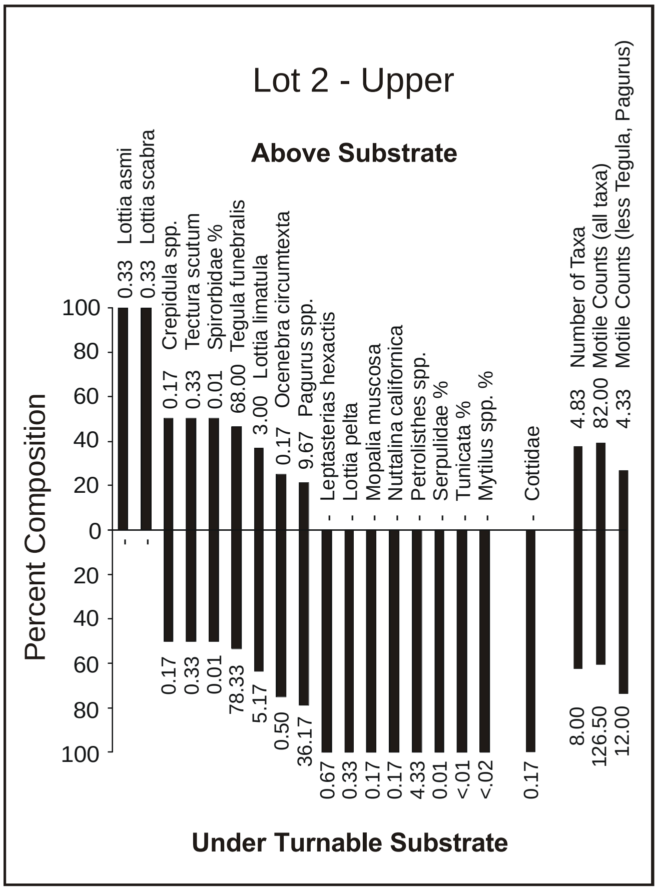

Figure 3-32. Invertebrates and fishes above and underneath turnable substrates at the PP Lot 2 upper elevation sampling station. Numbers with columns are mean no. individuals per 0.25 m^2 or mean percent cover where indicated.

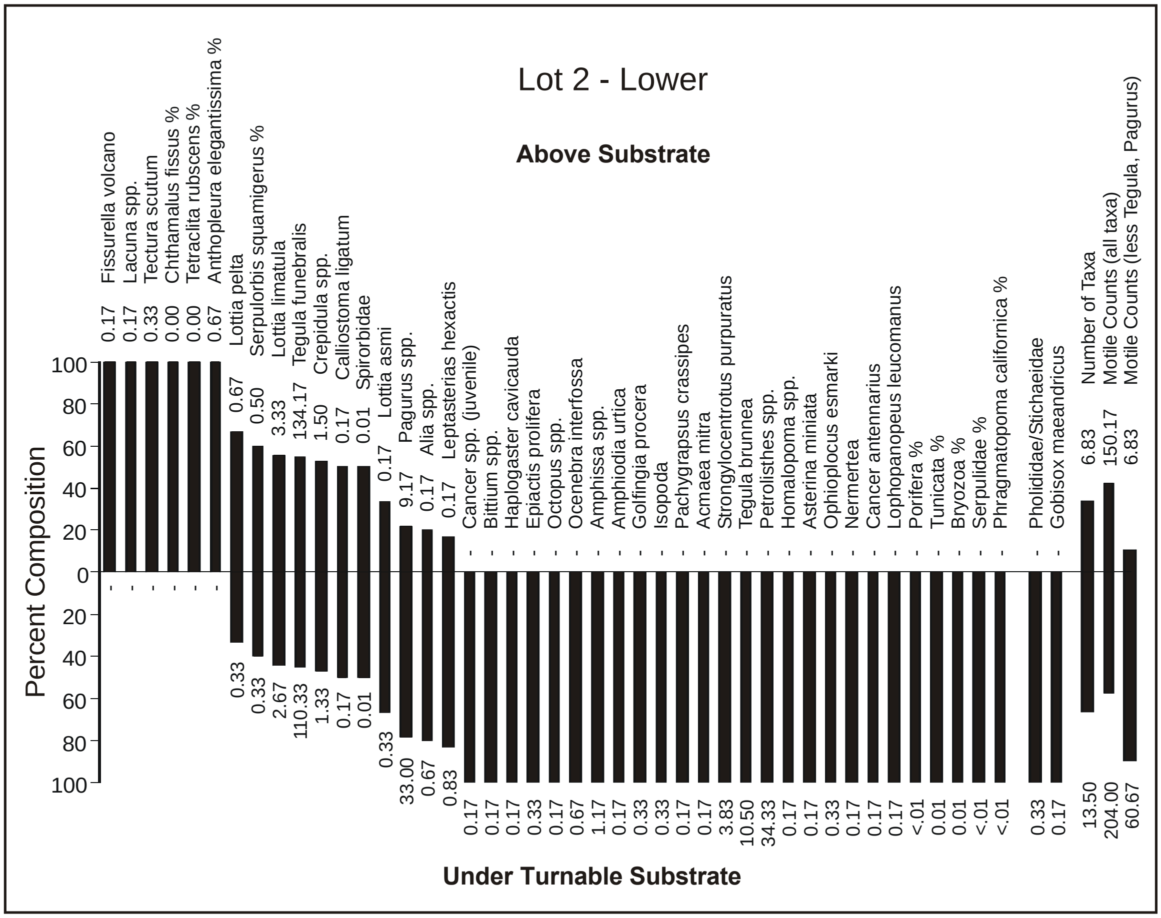

Figure 3-33. Invertebrates and fishes above and underneath turnable substrates at the PP Lot 2 lower elevation sampling station. Numbers with columns are mean no. individuals per 0.25 m^2 or mean percent cover where indicated.

3.6 1977-2002 Site Comparison

Purpose

The purpose of this study was to compare site descriptions from a recent survey with descriptions from a California State Water Resources Control Board (CSWRCB) study at Point Pinos and vicinity that was completed in 1977.

Background

A literature search was done to determine whether any early biological studies had been conducted at Point Pinos that would offer comparative data to assess long-term changes (**Appendix E**). An ideal example would be the quantitative study completed at Hopkins

Marine Station by Barry et al. (1995) and Sagarin et al. (1999), that sampled, using the same methods, a transect previously sampled in 1930 by Hewatt. This allowed them to make direct comparisons concerning long-term changes in faunal composition. However, no similar quantitative studies with sufficient replication and descriptions to relocate the sampling sites were found for Point Pinos (**Appendix E**).

Nonetheless, a study conducted in 1977 provided historical qualitative descriptions for a site at Point Pinos and four nearby sites (California State Water Resources Control Board 1979). The study was conducted as a reconnaissance survey in the Board's Area of Special Biological Significance (ASBS) at Point Pinos and immediate vicinity, and was limited to an inventory of species occurring at specific sites. There was sufficient detail on the locations sampled to allow us to relocate the same areas for follow-up observations (**Figure 3-1**).

Methods

Five sites surveyed by the CSWRCB (1979) were revisited in July 2002 (**Figure 3-1**). One of the five sites was located at Point Pinos (PP Lot 2) and the other four sites were situated along shoreline between Point Pinos and Hopkins Marine Station. A species list was developed for each site by walking the area and noting all species encountered. All identifications were made in the field. In contrast, it was not clear in the original study if samples had been collected for laboratory identification. The tide level was slightly above MLLW (above the surfgrass zone) during the present survey. Two biologists worked separately in the search effort at each site in the present study and created a combined species list for each site. The combined search effort at each site was between 1-2 hr.

Results

The total number of algal and invertebrate species found at the Point Pinos site (PP Lot 2) was similar between the 1977 and 2002 surveys (**Tables 3-2** and **3-3**, respectively). In contrast, more species were found at each of the four other sites in the 2002 survey compared to the 1977 survey, but all of the sites also had species that were unique to one or the other survey.

Discussion

We found it difficult to use the 1977 and 2002 data to make direct comparisons over time, as the species lists were undoubtedly affected by differences in the intensity of search effort, time spent at each site, tidal levels during the surveys, and desired detail to characterize the sites. Certainly the most common species were still present in all areas in both surveys, but there is uncertainty concerning the continued or past occurrences of less common species. Without the same sampling effort in both surveys, there is no assurance in whether a species was not present or simply overlooked.

Table 3-2. Algae observed in 1977 and 2002 at five sites.*

		Point Pinos Lot 2		Coral Street		Lover's Point North		Green Gables West		Green Gables East	
Scientific Name	Common Name/Description	02	77	02	77	02	77	02	77	02	77
Acrosiphonia spp.	green algae						+				
Botryocladia peudodichotoma	sea grape				+						
Calliarthron spp.	articulated coralline	+		+				+			
Chaetomorpha spp.	green algae	+	+	+	+				+		
Chondracanthus canaliculatus	red algae	+		+	+	+		+		+	
Chondracanthus exasp./corymb.	foliose red algae	+	+							+	
Chondracanthus spinosus	foliose red algae	+		+	+						
Cladophora spp.	pin cushion green algae	+		+		+	+	+		+	+
Codium fragile	dead man fingers	+		+							
Colpomenia spp.	brown saccate algae					+					
Corallina officinalis	articulated coralline	+									
Corallina vancouveriensis	articulated coralline	+		+		+		+		+	
coralline crust		+							+		
Cryptopleura lobulifera	foliose red algae				+						+
Cryptopleura ruprechtiana	foliose red algae	+		+							
Cryptopleura violacea	foliose red algae	+		+		+		+			
Cystoseira osmundacea	bladder kelp				+						
Desmarestia ligulata	brown foliose algae										+
Dictyoneurum californicum	brown foliose algae		+								
Egregia menziesii	feather boa kelp	+	+	+	+	+		+		+	+
Endocladia muricata	nail brush seaweed, turf algae	+	+	+		+	+	+	+	+	
Erythrophyllum delesseriodes	foliose red algae	+									
Farlowia conferta	foliose red algae						+				
Fucus gardneri	rockweed			+	+	+		+			
Gastroclonium subarticulatum	hollow branch seaweed	+		+				+	+	+	
Gelidium coulteri	branched red algae	+		+		+		+		+	
Gelidium robustum	branched red algae	+									
Gelidium spp.	branched red algae				+						
Gracilariopsis lemaneiformis	angels hair					+	+				
Hesperophycus harveyanus	rockweed			+						+	
Hymenena flabelligera	foliose red algae		+								
Laminaria farlowii	oar kelp				+						
Laminaria setchellii	oar kelp	+		+							
Leathesia nana	brown saccate algae				+						
Macrocystis pyrifera	giant kelp				+						
Mastocarpus jardinii	foliose red algae			+				+			
Mastocarpus papillatus	foliose red algae	+		+	+	+		+		+	+
Mazzaella affinis	foliose red algae			+	+	+		+	+	+	
Mazzaella flaccida	iridescent seaweed	+	+	+		+		+			
Mazzaella leptorhynchos	fluffy red algae				+	+		+	+	+	
Mazzaella linearis	foliose red algae		+								
Mazzaella phylloocarpa	foliose red algae	+									
Mazzaella spp.	foliose red algae				+		+		+		+
Microcladia borealis	branched red algae	+									
Microcladia coulteri	branched red algae			+		+					
Nemalion helminthoides	red algae					+					
Osmundea pacifica	branched red algae					+				+	
Osmundea spectabilis	branched red algae	+		+		+				+	
Osmundea spp.	branched red algae										+
Pelvetiopsis limitata	rockweed						+				
Phyllospadix spp.	surfgrass	+		+	+	+		+	+	+	
Polysiphonia spp.	filamentous red algae					+					
Porphyra spp.	foliose red algae			+		+		+		+	
Postelsia palmaeformis	sea palm		+		+						+
Prionitis lanceolata	branched red algae	+		+	+			+	+	+	
Rhodomela spp.	branched red algae		+								
Rhodymenia spp.	foliose red algae	+									
Sarcodiotheca gaudichaudii	branched red algae	+		+	+	+			+	+	
Scytosiphon lomentaria	brown algae					+					
Silvetia compressa	rockweed			+	+	+		+			
Ulva/Enteromorpha spp.	sea lettuce		+	+	+	+	+		+		
upright coralline algae			+		+		+		+		
TOTAL TAXA		28	12	28	23	25	9	20	12	18	8

* Source of 1997 data from California State Water Resources Control Board (1979)

Table 3-3. Invertebrates observed in 1977 and 2002 at five sites.*

		Point Pinos Lot 2		Coral Street		Lover's Point North		Green Gables West		Green Gables East	
Scientific Name	Common Name/Description	02	77	02	77	02	77	02	77	02	77
Acanthinucella spp.	unicorn snail									+	
Acmaea mitra	white-cap limpet									+	
Aegires albopunctatus	nudibranch				+						
Amphissa spp.	wrinkled dove snail			+							
Anisodoris nobilis	nudibranch				+				+		+
Anthopleura elegantissima	aggregating anemone	+		+	+	+		+	+	+	
Anthopleura sola	solitary anemone					+		+		+	
Anthopleura xanthogrammica	green anemone	+	+			+	+	+		+	+
Asterina miniata	bat star	+	+	+	+		+	+	+		
Balanus spp.	barnacle		+	+	+	+		+			
Bryozoa	bryozoan	+	+								
Cadlina flavomaculata	nudibranch				+						
Calliostoma annulatum	snail		+								
Calliostoma canaliculatum	snail				+						
Calliostoma ligatum	blue top shell			+							
Ceratostoma foliatum	hornmouth snail		+								
Chthamalus fissus	barnacle	+		+		+		+		+	
Cirratulidae/Terebellidae	burrowing worm							+			
Corynactis californica	strawberry anemone	+	+	+							
Crepidula spp.	slipper shell		+	+				+		+	
Diaulula sandiegensis	nudibranch				+						
Diodora aspera	rough keyhole limpet		+								
Discodoris heathi	gritty dorid nudibranch				+						
Discurria incessa	seaweed limpet			+							
Doriopsilla albopunctata	nudibranch	+			+		+		+		
Epiactis prolifera	proliferating anemone		+								
Fissurella volcano	key hole limpet	+		+						+	
Haliclona permolis	sponge									+	
Haliotis cracherodii	black abalone		+					+		+	
Haplogaster cavicauda	crab				+						
Hermissenda crassicornis	nudibranch		+	+	+						+
Hopkinsia rosacea	bubble gum nudibranch		+		+		+		+		+
Hydroida	hydroid	+	+								
Laila cockerelli	Cockerell's nudibranch		+								
Leptasterias hexactis	six-armed star			+	+					+	
Littorina keenae	eroded periwinkle snail			+		+		+		+	
Littorina scutulata	checkered periwinkle snail			+		+		+		+	
Littorina spp.	periwinkle snail				+						
Lottia asmi	black limpet			+				+		+	
Lottia digitalis	ribbed limpet	+		+	+	+		+		+	+
Lottia gigantea	owl limpet	+				+				+	
Lottia limatula	file limpet		+					+		+	
Lottia pelta	shield limpet	+	+	+		+		+		+	
Lottia scabra	rough limpet	+		+		+		+		+	
Mopalia lignose	chiton					+					
Mopalia muscosa	mossy chiton		+			+				+	
Mytilus californianus	California mussel	+	+	+		+		+		+	+
Nucella emarginata	dogwinkle snail					+		+		+	
Nuttalina californica	chiton	+		+				+		+	
Pachycheles spp.	porcelain crab						+				
Pachygrapsus crassipes	lined shore crab	+	+			+		+		+	
Pagurus spp.	hermit crab	+	+	+		+		+		+	
Paranemertes peregrina	worm			+							
Petrolisthes cinctipes	porcelain crab				+						
Phidiana hiltoni	fighting nudibranch		+								
Phragmatopoma californica	sand tube worm							+		+	
Pisaster giganteus	giant spined sea star						+				
Pisaster ochraceus	ochre sea star	+	+	+	+	+		+		+	+
Pollicipes polymerus	leaf barnacle	+		+	+	+				+	+
Porifera	sponge	+	+	+	+	+	+	+		+	+
Pseudomelotoma torosa	knobbed drill snail			+							
Pugettia producta	kelp crab		+		+		+				
Pycnopodia helianthoides	sunflower star	+									
Rostanga pulchra	red sponge nudibranch		+		+		+				

Table Continued

Table 3-3. (continued). Invertebrates observed in 1977 and 2002 at five sites.*

		Point Pinos Lot 2		Coral Street		Lover's Point North		Green Gables West		Green Gables East	
Scientific Name	Common Name/Description	02	77	02	77	02	77	02	77	02	77
Serpula vermicularis	tube worm					+					
Serpulidae	tube worm		+							+	
Serpulorbis squamigerus	tube snail			+		+		+			
Spirobranchus spinosus	tube worm	+									
Spirorbis spp.	tube worm		+								
Strongylocentrotus purpuratus	purple sea urchin	+		+						+	
Styela montereyenis	stalked tunicate								+		
Tectura scutum	plate limpet	+		+				+		+	
Tegula brunnea	brown turban snail	+		+	+	+	+	+		+	
Tegula funebralis	black turban snail	+	+	+				+	+	+	
Tethya aurantia	sponge	+									
Tetraclita rubscens	barnacle	+		+		+		+		+	
Tonicella lineata	lined chiton	+	+								
Triopha catalinae	sea-clown nudibranch	+									
Tubelariidae	hydroid		+								
Tunicata	tunicate	+	+	+	+		+	+		+	+
TOTAL SPECIES		31	32	33	24	24	11	30	7	36	10

* Source of 1997 data from California State Water Resources Control Board (1979)

The appendices in the California State Water Resources Control Board report (1979) contain other species lists. These cannot be used for comparison with the current survey. The list of intertidal invertebrates for several areas in the Board report is based on the cumulative listings from 27 literature and museum references dating in the 1940s-1960s. The species were tabulated for large general areas (Point Pinos, Monterey Peninsula, Pacific Grove, Hopkins Marine Station). Because the collecting locations were not specified, the data were of limited use in comparing changes in faunal composition over time. Also, the number of species found in each area probably reflects the number of times each area was sampled. It is apparent, however, that Point Pinos was a popular study area in the 1940s-60s, as the species list for Point Pinos is the longest. An expanded list of intertidal algal species is also provided in the appendices of California State Water Resources Control Board (1979), but the methods used to develop the list and data sources are not provided. We can only generalize from our observations that overall diversity has not changed at the Point Pinos site (PP Lot 2) since the survey in 1977.

We found only one conclusive difference, however, between the 1977 and 2002 surveys. This was a lack of sea palms (*Postelsia palmaeformis*) in the present survey (**Table 3-2**), although we were not able to conclude whether its absence was due to visitor impacts or to natural causes. Although not listed as a species of special concern or of rare, endangered, or threatened status by the CDF&G or the U.S. Fish and Wildlife Service, California Code of Regulations prohibit cutting or disturbing this species. Regardless, this species is illegally collected for consumption (Tim Olivas, CDF&G, pers. com.).

When present, *Postelsia* is conspicuous on rocky shores. It occurs well above the MLLW tide level on wave exposed outcroppings and headlands. All sites were specifically searched in the present study for the occurrence of sea palms, but none were found. Sea palms were apparently common at Point Pinos and vicinity in 1977, as they were observed at three of the five sites surveyed (**Table 3-2**). Furthemore, sea palms are spring-fall annuals, and we sampled in summer, the period when sea palm sporophytes would be visible. (Sea palms are normally absent in winter.)

We conclude that the absence of *Postelsia* was probably not due to visitor impacts, because sea palms occupy hazardous wave exposed habitats that people largely avoid. However, aggressive collectors may take the risk in these hazardous habitats to remove large numbers of these plants. The take may affect population reproduction. *Postelsia* has limited spore dispersal capabilities so that each year's population is highly dependent on the reproductive success from the preceding year's population (Dayton 1973). Consequently, large harvesting could be detrimental to population reproduction and thus affect the occurrence of the following year's population. On the other hand, natural factors, such as grazing and mussel encroachment, can also prevent the re-establishment of sea palms (Paine 1979). In addition, this species is sensitive to warm water conditions. It became locally extinct at the southernmost margin of its range in San Luis Obispo County during the 1983 El Niño (S. Kimura, pers. obs.).

3.7 Trampling Effects Supplemental Study

Purpose

A supplemental study on trampling effects was completed to quantify how certain habitats are affected by foot traffic at Point Pinos. While our study using 0.25 m^2 quadrats provided information on biological composition around tidepools and in the general intertidal zone, we noticed that smaller quadrats with more stringent random placement criteria may be more effective in examining trampling effects. This is due to the high topographical relief at Point Pinos often results in only small portions (tops) of rocks being trampled (**Figure 3-34**), which large quadrats may be ineffective in detecting this pattern. Ms. Chante Davis, a Moss Landing Marine Laboratories undergraduate student, completed a special trampling effect study as a class project using small quadrats that were randomly placed according to the criteria that they sample only the tops of rocks susceptible to foot traffic (Davis 2002).

Figure 3-34. Suspected trampled top of rock with broken stem of rockweed at PP Lot 5-North. Note rockweeds are abundant on the sides of the rock. (Ruler=15 cm, 6 in.)

Background

One effect of high levels of visitor use on rocky shores is trampling whereby organisms are crushed or dislodged from the substrate. Trampling effects occur with any visit to the shore but the damage is often unintentional (Bally and Griffiths 1989). One consequence of frequent foot traffic is sometimes the creation of barren pathways through the intertidal zone. These are most discernable on smooth, benchrock platforms. However, Point Pinos is composed of high relief, mixed substrates (e.g., outcroppings, boulders, and cobbles). On high relief shores, people traverse the intertidal zone by stepping from one rock to the other, such that only the tops of the rocks are stepped on (**Figure 3-34**). People avoid the sides of the rocks, boulders, and cobbles that appear loose. The trampling pattern results in a mosaic patchwork of bare spots rather than bare pathways.

Methods

The sampling used small quadrats (0.05 m^2) to match the disturbance patch size. Basically, the quadrat approximated the size of a footprint. Larger quadrats, similar to those used in the tidepool and band transect studies, would have sampled areas not affected as greatly by trampling (i.e., sides of rocks).

Sampling was completed in October and November 2002, and occurred in the upper intertidal zone characterized by *Endocladia muricata* and *Mastocarpus papillatus*. This was the zone most frequented by visitors and would therefore have the greatest amount of foot traffic (see *Section3.1 – Visitor Distribution*). A 30 m transect line was deployed parallel to shore in three areas of high visitor use near access points and in three reference areas of lower visitor use (**Figure 3-1**). Fifteen random 0.05 m^2 quadrats were placed along each transect. The randomly placed quadrats had to completely lie on the tops of stable boulders or on the top surfaces of flat benchrock, otherwise alternate random locations were used. Surge channels, sides of rocks, and tide pools were not sampled.

Visual estimates of the percent cover of each algal species, bare rock, and sessile invertebrates were recorded for each quadrat. Motile invertebrates were counted. Trampling may not necessarily reduce the spatial extent of algal cover, but it may reduce the height of the algal canopy (Harding Lawson Associates 1993, Liddle 1975). Therefore, canopy height was also measured. When present in the quadrats, the height of the algal canopy was estimated by measuring the length of the longest branch or frond for several of the most common species (*Endocladia muricata*, *Mazzaella affinis*, and *Mastocarpus papillatus*).

A nested analysis of variance (ANOVA) was used to test for differences in the percent cover and frond lengths of algal species between the high use sites and reference sites. Sites and treatments (high visitor use and reference areas) were the two factors, with the sites nested within the treatment. All results were evaluated at an alpha level of 0.05. Cochran's statistic was used to test for homogeneity of variances. When variances were not equal, a log transformation was used and then the data analyzed with ANOVA. Mobile organisms were low in abundance, and were analyzed using a two sample t-test.

Results

The abundance of predominant algal species was similar in the visitor use and reference areas (**Figure 3-35**). The most common upright algae (foliose and turf species) were *Mastocarpus papillatus*, *Mazzaella affinis*, and *Endocladia muricata*. There were no statistically significant differences detected in the cover of the individual algal species between the visitor use and reference areas. Collectively, total upright algal cover was slightly lower (by approximately 10 percent) in the visitor use areas (**Figure 3-35**), but the difference was not statistically significant, due to large variation in the data. Differences in the height of the algal canopy between the visitor use and reference areas were also not statistically significant. The only statistically significant difference detected in the study was a greater amount of bare rock space in the visitor use areas.

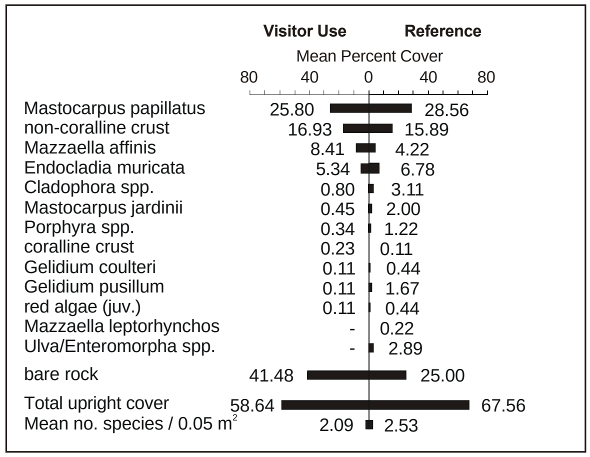

Figure 3-35. Abundance of algae and bare rock in the trampling effects supplemental study.

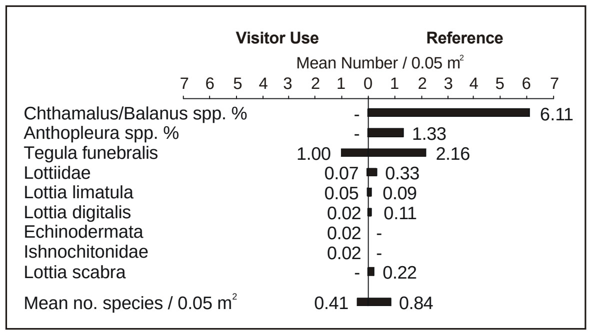

Figure 3-36. Abundance of invertebrates in the trampling effects supplemental study. Note *Chthamalus/Balanus* and *Anthopleura* are percent cover measurements.

The most common invertebrates were motile organisms, with black turban snails (*Tegula funebralis*) being the most common. The only apparent difference in the invertebrates was the lack of barnacles and anemones in the quadrats sampled in the visitor use areas (**Figure 3-36**). Barnacles and anemones were relatively frequent in occurrence in the reference quadrats, present in over 50 and 33 percent of the quadrats, respectively. However, the coverage of both species was relatively low. In contrast, no barnacles or anemones were present in the quadrats sampled in the visitor use areas.

Discussion

The results indicate that barnacles and anemones are two invertebrate groups that may be susceptible to trampling effects in the *Endocladia-Mastocarpus* zone at Point Pinos. The absence of these organisms may account for the greater amount of open bare rock space found in the visitor use areas. However, the sampling included only the small portions on the tops of rocks in the upper intertidal zone, and these same species also occur in many other habitats throughout the intertidal zone (e.g., sides and undersides of rocks, depressions, outcroppings) where they are not subject to trampling.

Many investigators have addressed the effects of trampling through manipulative field experiments, where plots were subjected to specified levels of trampling. The studies have shown that the extent of impact varies with foot traffic intensity (Brosnan and Crumrine 1994, Brosnan et al. 1994, Brown and Taylor 1999, Schiel and Taylor 1999, Clowes 2002). Subsequent recovery depends on the initial severity of damage, the species involved in the recovery process, and the habitat type (Povey and Keough 1991, Keough and Quinn 1998, Walder and Foster 2000). The results of manipulative trampling experiments, however, are difficult to use in explaining observational results of trampling effect studies where spatial variation is not controlled and the level of trampling varies.

The trampling experiment completed by Clowes (2002) completed nearby at Hopkins Marine Station involved the same species assemblages found at Point Pinos. She found that five footsteps / day / 0.25 m^2 for five consecutive days significantly reduced the abundance of algae. Fewer footsteps did not result in any significant differences compared to controls. Based on our counts of people in the intertidal zone (see *Section 3.1 – Visitor Distribution*), we believe that most rocks at Point Pinos do not experience five footsteps per day. There are numerous rocks that afford stable footing at Point Pinos, such that visitor traffic is not confined to walking paths. Furthermore, trampling is not equally distributed over all of the rocks. Larger impacts would be incurred and possibly revealed if all of the rocks were repeatedly stepped on at a frequency that maintained them in a persistent barren condition (e.g., five footsteps per day).

The lack of significant differences in algal abundance between areas also may be due to high variation caused by shifting substrate and sand burial among areas (Clowes and Coleman 2000, Clowes 2002). Sediment movement and sand scour are known to exert significant spatial and temporal variation on intertidal algal abundances (Daly and Mathieson 1977, Seapy and Littler 1982, Littler et al. 1983, Stewart 1983, Shanks and Wright 1986).

The results of the present trampling effect study did not furnish strong evidence of trampling effects, despite the fact that foot traffic areas can be discerned in some places, particularly in the upper intertidal (**Figure 3-34**). The variable patterns of visitor traffic, substrate heterogeneity and rugosity, and biological community variation all likely contribute to the inconclusive results. Bally and Griffiths (1989) found that, compared to trampling, equivalent ecological damage can occur from natural causes (e.g., from storms and surf action rolling boulders, scouring rocks, and shifting sand). Accordingly, it can be difficult to separate trampling effects from effects caused by natural disturbances in a wave-swept heterogeneous environment.

3.8 Scientist Interviews

Background

Numerous scientific studies and observations have been completed at Point Pinos over the years by researchers and educators. Some of the observations and research results have been published, but a great deal of information is unavailable in the literature. The purpose of this task was to obtain historical information about the biological condition of Point Pinos from those who had worked along the Monterey shoreline for many decades. The goal was to compile the information, compare observations, and construct a description, if possible, on how the intertidal assemblages have changed over time.

Methods

Thirteen people familiar with the area's local marine ecology were contacted and agreed to be interviewed. The same set of interview questions was presented to each participant. The interviews were conducted independently so that the responses from one individual would not influence how another individual might respond. Each participant was first contacted by phone or email about completing an interview. The interviews were then completed either by phone or by the participant filling out and returning a questionnaire via email. The interviews included name, affiliation, credentials, period of visits to the Point Pinos area, and any relevant observations. The responses did not have to be restricted to Point Pinos, but could include other nearby sites (e.g., Point Lobos, Asilomar, Hopkins). Each participant was also given the opportunity to speculate on mechanisms for any changes, whether from long-term natural shifts in environmental condition or from human effects.

Results

The responses from the 13 interviews are summarized in **Table 3-4** and are presented in unabridged form in **Appendix L**. One of the more common habitat-based observations (from four interviews) was a decrease in under-boulder habitat biota. The responses from a different set of four interviews included examples of general decreases in macroinvertebrate abundances in the intertidal zone. Only one species, the tube snail *Serpulorbis squamigerus*, was thought to have increased in abundance, which was a response in two interviews. Seven of the 13 people interviewed expressed concern for visitor impacts and the need for increased resource protection.

Mr. Pat Hathaway, a local photo-historian, was able to provide some early black and white photographs of the Point Pinos tidepools and shoreline. One photograph was taken in 1907 near the foghorn building and showed piles of abalone shells. He thought this was from abalone harvesting in the mid-1800s by the Rumsen Indians and possibly other locals.

Table 3-4. Summary of anecdotal observations on changes in biota at Point Pinos and vicinity from personal interviews. Full responses provided in **Appendix L**.

	Abbott	Baldridge	Baxter	Chamberlain	Chapman	Haderlie	Nybakken	Pearse	Radakovich	Silberstein	Watenabe	Webster	Willoughby
Changes at Point Pinos	1	-	2,3	4	1,5	1	6	1,2,7, 8,9, 10	9,10, 11	1	2,12, 13	2,3,9	9,14
Comments on visitor use	1	2	-	-	3	-	-	2,4	4	-	5	-	6

Changes at Point Pinos

1 increases in diversity after abandonment of the Point Pinos sewer outfall
2 decrease in invertebrate abundances in under-boulder habitats
3 increase in tube snails (*Serpulorbis*)
4 different nudibranch abundances sampled between two locations during the 1960s
5 upper intertidal algae reduced by trampling in 1970-80s
6 observations in areas other than Point Pinos: decreases in several macro-invertebrates
7 Point Pinos with highest invertebrate diversity in the late 1990s compared to other rocky sites
8 Point Pinos with second highest algal diversity in the late 1990s compared to other rocky sites
9 decreases in several macro-invertebrates
10 increases in visitor use
11 increase in sea birds
12 species zonation moved lower in elevation
13 limpets, sea stars, other species still conspicuous
14 owl limpets smaller in size
\- no pertinent recollections

Comments on Visitor Use

1 concern for trampling and rock turning
2 concern for poaching/collecting
3 indications of trampling effects in the upper intertidal
4 need for increased resource management
5 fishing appears the most extractive activity
6 visitor impacts responsible for many of the decreases over natural variation
\- no comment

Mr. Hathaway also had another picture near the Tinnery Restaurant (at Lover's Point) showing the intertidal zone being used as a garbage dump. A horse-drawn garbage cart was backed up to a chute leading to the ocean. Mr. Hathaway thought that this area was used as a garbage dump through the 1920s. Rock bolts that supported the discharge chute are still protruding from the seawall.

Mr. Hathaway also had a picture of Ed 'Doc' Ricketts in 1947 sitting on a rock at Hopkins Marine Station and a picture of Ed Ricketts Jr. taken at the same angle sitting on the same rock in May 2000. The rock was largely barren in both pictures although a few barnacles were missing from the rock in 2000, and a small band of algae, which looks like *Porphyra* spp., appears on the rock in the recent picture. Mr. Hathaway also said that Ed Ricketts Jr. had mentioned that his father, who was famous for his association with author John Steinbeck and who was the proprietor of his own biological collecting business, regularly collected organisms from the Great Tidepool at Point Pinos until about 1930.

Mr. Tim Thomas of the Monterey Maritime Museum was also contacted for historical anecdotal information, as he retains a 1920s photograph collection from Ms. Julie Phillips (CDF&G) that shows local fishing and waterfront scenes of the area. He commented that there are no detailed pictures in the collection depicting tidepool life at Point Pinos.

Discussion

The interviews provided only general descriptions on the changes at Point Pinos over the years. One of the more consistent remarks applicable to the present study was that the biota under turnable substrates appeared to have decreased in overall diversity and abundance, along with some macroinvertebrates that are common on the tops of rocks. This was an interesting finding, because under substrate biota had measurably decreased between 1971 and 1991 in an area of high visitor use in San Diego (Addessi 1994). The decrease was attributed to potential impacts of habitat disruptions from rock turning by collectors, but long-term ocean warming trends were also cited as potentially contributing to the change. In our interviews, over half of the participants also commented that increased resource protection is needed at Point Pinos because suspected changes may be related to visitor use, and species are at risk to human impacts.

4.0 Integrated Discussion of Visitor Use and Biological Impacts

4.1 Assessment of Visitor Impacts

The following section addresses the questions developed by the MBNMS and Point Pinos Tidepool Task Force Subcommittee on Research that were originally presented in the Request for Proposals for this project. These questions formed the basis for our studies on potential biological impacts of visitor use at Point Pinos.

Question 1: How has the biodiversity and abundance of marine life changed over time at the Point Pinos tidepools?

One issue pertinent to answering this question and Question 4 below is what point in time do we choose to serve as the baseline for evaluating changes that may be due to visitor impacts. The Point Pinos intertidal community has changed over geological time scales with humans utilizing intertidal zones in the Monterey area for subsistence living and shell collecting starting back as far as about 10,000 B.P. Spanish settlers arrived in the area several hundred years ago, and exploited resources through hunting sea otters and harvesting abalone for trade with coastal Native Americans. The Russian sea otter fur trade in California began in the early 1800s. While historical events as these are of interest and can demonstrate that baselines constantly shift, the information is of limited value in the present context for evaluating recent impacts from visitor use. Our focus in these questions is the changes that have occurred within the past century and in particular the past several decades. Accordingly, we refer to long-term changes as those that have occurred within this time frame.

The Point Pinos intertidal community has changed over the past several decades with some of the changes resulting from natural factors and others from human use. Portions of Point Pinos changed following the termination of sewage effluent discharges in the vicinity. The Pacific Grove sewage treatment plant once discharged 1º treated effluent into Monterey Bay from the outfall terminus located on the eastern side of the Point Pinos headland. Discharge operations were terminated from that location in the mid-1970s when the effluent was redirected to another facility and outfall on the eastern side of Monterey. The sewage discharge area was a focal area of research by staff and students of Hopkins Marine Station and other research institutions. The most noticeable effects, consisting of stunted algae and reduced invertebrate diversity, were localized within a 100 m (109 yd) radius of the outfall due to the rapid dilution of the effluent in the receiving water. The area around the outfall has since recovered with dense populations of species typical of the area (Pearse et al. 1998).

Effects of ocean warming (**Table 4-1**) also contribute to long-term changes, probably on regional-scales (Barry et al. 1995, Sagarin et al. 1999), while El Niños, La Niñas, and recurring storms likely result in changes over shorter temporal and smaller spatial scales (Dayton and Tegner 1984a, Gunnill 1985, Ebling et al. 1985, Tegner and Dayton 1991, Dayton 1992, Tenera 1997). The findings of Barry et al. (1995) and Sagarin et al. (1999) on ocean warming-related changes in the nearby Hopkins Marine Life Refuge are particularly relevant to the present study. They found that water temperatures had increased by 0.75 C (1.4 F) from 1921 to 1993. Related to the ocean warming, eight invertebrate species more common to the warmer waters of southern California became more abundant, while five northern California colder water species decreased in abundance (**Table 4-1**). Algae were not sampled during the study, but older photographs of the area show that rockweed (*Silvetia compressa*) had declined in cover since the early survey, and was replaced by shorter-statured algae (e.g., *Endocladia muricata*). The shifts in abundance among the invertebrate and algal species did not affect the overall biological diversity since the changes involved shifts in the relative abundance of species present in the area and not local extinctions or new species introductions. In another study at the Hopkins Marine Life Refuge, Leydig (1996) found that the tidal elevation of the *Endocladia-Balanus* community was approximately 1 ft lower than surveys in 1965 completed by Glynn (1965). The cause of the shift remains uncertain, but it has undoubtedly resulted in considerable ecological change involving the distribution and abundance of a number of species. Similar changes have likely occurred in the nearby Point Pinos area.

Our interviews provided anecdotal information on potential changes at Point Pinos and vicinity over the past several decades based on recollections and recent observations (**Appendix L**). Four interviewees suspect that fewer species of under-rock fauna now occur at Point Pinos and vicinity than historically (from about the mid-1970s), based on recollections and their current observations. A similar decline in under-rock fauna was described from a study completed between 1971 and 1991 in a high visitor use area in

Table 4-1. Species that significantly increased and decreased in abundance at Hopkins Marine Station between 1931 and 1994 (source: Barry et al. 1995)

Southern Species That Increased		Northern Species That Decreased	
Scientific Name	**Common Name**	**Scientific Name**	**Common Name**
*Acanthina punctulata**	carnivorous snail	*Anthopleura xantogrammica*	green anemone
Anthopleura elegantissima	aggregating anemone	*Leptasterias hexactis*	six armed star
Corynactis californica	strawberry anemone	*Petrolisthes cintipes*	porcelain crab
Cyanoplax hartwegii	chiton	*Pisaster ochraceus*	ochre sea star
Fissurella volcano	volcano limpet	*Tectura scutum*	plate limpet
*Ocenebra circumtexta**	carnivorous snail		
*Serpulorbis squamigurus**	tube snail		
Tetraclita rubsescens	barnacle		

* Not reported in the initial survey

San Diego approximately 692 km (430 miles) south of Point Pinos (Addessi 1994). The study was unable to determine if the changes were due to human impacts or to natural variation and disturbance.

Interview respondents also suspected that a decline in bat stars (*Asterina miniata*) and other macroinvertebrates had occurred since the early 1970s. Aside from bat stars, causes for long-term shifts are often difficult to determine. A wasting disease associated with warmer water El Niño conditions caused sharp declines in bat star abundance in southern California (Tegner and Dayton 1991, Engle 1997). Declines were also observed in central California in San Luis Obispo County during the 1983 El Niño where bat stars have not recovered to former levels of abundance (**Figure 4-1**). Similar changes combined with collecting in reducing sea star abundances in the intertidal zone at Point Pinos remains uncertain, but it appears that bat stars may be slow to recover.

We also found through our literature review that the sea palm *Postelsia palmaeformis* was relatively common in the Point Pinos area in 1977. However, it was absent in surveys of the same areas in 2002, which occurred in the summer when the large adult plants (sporophyte generation) should be present. The cause for its absence at many places on the Point Pinos shore and vicinity was probably unrelated to visitor use since *Postelsia* occurs only on the most wave exposed rocky outcroppings and headlands, places that people generally avoid.

In addition to the above point on temporal variation, there is also spatial variation that includes shifts in the latitudinal and elevational distribution of species composition and abundance in the community. For example, favorable environmental conditions can result in sporadic recruitment pulses of certain species that may not occur with regularity. Therefore, conclusions based on observations made over a few visits are not necessarily representative of what may occur during other years. This is why long-term quantitative monitoring is so important for providing baseline data to evaluate changes and to identify trends.

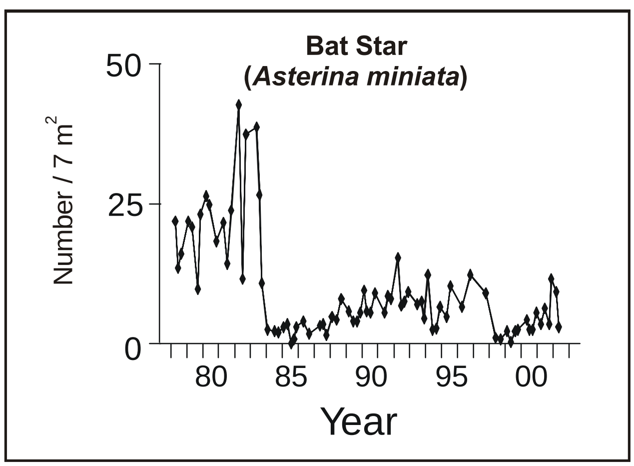

Figure 4-1. Abundance of bat stars at a shallow subtidal control station near the Diablo Canyon Power Plant in San Luis Obispo County. (Data courtesy of Pacific Gas and Electric Company.)

One of the most recent obvious indications of human effects at Point Pinos is a picture belonging to Mr. Pat Hathaway (local photo-historian) that shows piles of abalone shells near the Point Pinos foghorn building that was created by harvesting. Mr. Hathaway believed that the Rumsen Indians and possibly other local residents created the piles in the mid-1800s. The abalone population has continued to be subjected to harvesting in the form of poaching and predation pressure from sea otters. The historical presence, loss, and now the recent return of sea otters into the Monterey area has triggered changes in both subtidal and intertidal marine communities as the otters prey on abalone, urchins, crabs, snails, and other macroinvertebrates, resulting in a shifting ecological baseline and dramatic changes in community composition.

Question 2: How does Point Pinos compare in biodiversity and abundance of marine life to other nearby areas with similar physical characteristics but with different levels of human use?

The results of the present study address this question within the context of the areas that we sampled, which were chosen based on the distribution of visitor use. Accordingly, only generalities can be made when comparing our results with those of others, due to differences in habitat characteristics sampled, intensity of sampling, and sampling methods. Here we further integrate our study findings and include information from two other comparative studies that included sampling at Point Pinos.

A general comparison of the findings indicates that the biological communities in the vicinity of Point Pinos are very similar in species composition and abundance to other exposed rocky areas of the central California coast, even though each area has certain habitat characteristics and species occurrences that differentiate it from the other areas. On a more localized scale, we found in our study that the biological assemblages at Point Pinos were very similar in species composition and abundance to the biological assemblages in reference areas with lower levels of visitor use.

Dr. Fiorenza Micheli (Hopkins Marine Station) has completed surveys in the area at eight sites; four areas where there are no visitor access restrictions (Cannery Row, Point Pinos, Carmel Point, Pescadero Point) and four sites with limited access (Hopkins Marine Station, Pescadero Point, Point Lobos north shore, Yankee Point). The surveys used similar methods as the present study with transects oriented parallel to the shore at multiple elevations. Also similar to the present study, larger areas (30 x 2 m plots) were sampled for abalone and other macroinvertebrates. A difference in the study design to ours, however, was that each of her sites consisted of both a wave-sheltered and wave-exposed sub-site. At present, four surveys have been completed since the study began in 2001. Preliminary analyses have been completed using data from the first two surveys.

The following study findings were obtained from personal discussions with Dr. Micheli. As in the present study, the biological communities at the sites in both the visitor and restricted areas were very similar, although each area had unique characteristics. Statistical analyses of community composition provided no clear patterns that would suggest that any of the differences between areas were due to levels of visitor access.

However, differences between the two groups of sites were found for two species that are susceptible to visitor impacts. Mussels that are sometimes collected by fishers for bait and collected by others for consumption were less abundant at the wave-exposed sub-sites with unrestricted access compared to the wave-exposed sub-sites with restricted access. However, she suspected that the difference may have also been due to slight differences in wave energy between the two types of wave-exposed sub-sites. A more striking difference between sites was the lower numbers of larger size abalone at the sites that have unrestricted visitor access. This may indicate that abalone harvesting has reduced the abundance of the larger animals.

In response to a request by the Point Pinos Tidepool Task Force Subcommittee on Research, we included an investigation of the Point Lobos State Reserve located 14.5 km (9 miles) south of Point Pinos to evaluate whether the area was suitable for establishing reference stations to compare with the Point Pinos visitor use stations. Collecting is not allowed in the reserve except with a scientific collecting permit, and the intertidal zone experiences very little public use (Chuck Bancroft, Park Ranger, pers. com.). We found a candidate area on a rocky platform at Weston Beach located on the south side of Point Lobos. Transect sampling was completed using the same methods used at Point Pinos, except that only one transect was sampled. The single transect was established in the low intertidal zone at an equivalent tidal elevation to the low elevation transects sampled at Point Pinos (approx. +1 ft MLLW). This particular transect area at Point Lobos was biologically diverse, but we also found it to be quite different from both our Point Pinos study sites and reference areas, in terms of species composition and abundance (S. Kimura, unpubl. data). We attribute the differences to substrate composition and possibly wave exposure. The area that we sampled at Point Lobos is hardened smooth sandstone (Carmelo Formation). The sampling area had very little micro-habitat relief and few crevices, quite different from the high habitat rugosity and heterogeneous granite characteristic of Point Pinos. Some of the species that were abundant at Point Pinos were not abundant at our Point Lobos transect. In particular, limpets and black turban snails were scarce or absent. In contrast, *Katharina tunicata*, a large, smooth black chiton, was abundant along the Point Lobos transect. Numerous abalone in crevices and large numbers of black turban snails clustered at the bases of the rocks were found in a field of large boulders (approx. 1-2 m, 3-6 ft diameter boulders) near the Weston Beach transect, which represented habitat more similar to Point Pinos.

We did not include the Point Lobos transect and boulder field data in our reference station database. The inclusion of these data would have increased the variation among our reference stations, resulting in less ability to detect visitor impacts at Point Pinos. An alternative sampling design would have been to have all of our reference stations at Point Lobos. This would have required that multiple sites be sampled, as one transect would not have been representative of the conditions at Point Lobos. Also, the resources available for the study did not allow for a larger sampling effort with more stations at Point Lobos. Higher wave exposure and the different substrate characteristics compared to Point Pinos may have also resulted in differences independent of visitor use. Our observations at Point Lobos, however, did reveal that Point Lobos, overall, is a biologically diverse area with its own particular biological and habitat qualities.

Dr. John Pearse (University of California, Santa Cruz) completed a series of class projects over several years comparing species lists at Point Pinos with other sites; Natural Bridges (Santa Cruz), Carmel Point (Carmel), Big Creek (Big Sur coast), and Franklin Point (outer coast of San Mateo County). He provided an overview of the species comparisons that is included with the other interviews as part of this project (**Appendix L**). The surveys (years) analyzed (1993 and 1994) showed that Point Pinos and Carmel Point had the highest diversity of the sites, with Point Pinos highest in overall invertebrate diversity. Point Pinos was also very diverse in algae, but lower than Carmel Point. The results also show that all of the areas support a diverse array of organisms with many species common to all areas (J. Pearse, unpubl. data).

Question 3: To what extent are these patterns attributed to human impact?

Detecting human induced impacts is very difficult in communities with high levels of spatial and temporal variation (Gunnill 1985; Paine 1986; Stewart-Oaten et al. 1986; Underwood 1992, 1993, 1994; Green 1993; Schroeter et al. 1993; Wiens and Parker 1995). A common approach used to partition natural variation from variation resulting from human-induced disturbances is to use a before-after-control-impact (BACI) analysis, based on the sampling of both control and impact areas for a period of time before and during or after an impact (Stewart-Oaten et al. 1986). However, the absence of any historical data for the Point Pinos areas precluded this approach for our study.

Our study relied on statistical comparisons of the composition and abundance of intertidal species assemblages in areas that differed in the intensity of visitor use. The natural variation between areas in itself may result in statistically significant differences between areas. Therefore, any differences detected between areas that could be attributed to visitor use also had to be consistent with impacts that could result from human activities. In addition, differences in a large number of susceptible species would provide for stronger evidence of visitor impacts than a difference in one or two species. For example, strong evidence for visitor impacts would be present if we detected lower abundances in visitor use areas, relative to reference areas, in a suite of invertebrates susceptible to collecting (e.g., seastars, sea urchins, shore crabs, turban snails, hermit crabs). However, we did not find this.

We sampled tidepools that are frequently a focus of visitor activity and found no statistically significant differences in the invertebrates and fishes that could be associated with visitor impacts, with the exception of purple sea urchins. Purple sea urchins had significantly lower abundances in the visitor use area tidepools, relative to tidepools in reference areas. While sea urchins may be of interest and curiosity to visitors, they are difficult to collect, since they have spines and are often tightly nestled in crevices and small depressions in the rocks. Accordingly, they can be easily damaged and killed when trying to extract them from their crevices and depressions. However, in the absence of significant differences in other species susceptible to visitor impacts, we attribute the difference in purple sea urchins between areas to natural spatial variation and not specifically to collecting.

We found that, overall, invertebrate species composition and abundance at Point Pinos was very similar to our reference areas. The statistically significant differences among other species that were detected also could not be explained exclusively by differences in visitor use. For example, species accounting for some of the minor differences between areas included *Lacuna* spp., a snail 1-2 mm (0.06 in.) in size, and barnacles, *Tetraclita squamosa*, in the low intertidal zone, species which are not likely to be affected by visitor use. We used levels of visitor use as a covariate in our analyses to help explain some of the variation among sites. We found that visitor use generally did not explain significant levels of biological variation among areas. This indicates that while each area was represented by a variety of species, much of the biological variation among areas was independent of levels of visitor use.

Our surveys did detect some differences in algal communities in areas of high visitor use. We believe that these differences were partially related to trampling effects by visitors to the intertidal. *Endocladia muricata* was less abundant, by about 15 percent cover around tidepools, relative to the reference areas, and in other areas of the upper intertidal, *Silvetia compressa* (rockweed) was less abundant by about 10 percent cover, relative to reference areas. However, many rocks mixed within these locations had lush growth of *Endocladia*, rockweeds, and other species (**Figure 4-2**). Some degree of trampling effects undoubtedly occurs on the lower shore, but a very large sample size would be required to detect any potential impacts because there is less foot traffic in the lower zone and the magnitude of any effects would be less. The areas of trampling and other types of visitor disturbances (e.g., rock turning) results in a patchwork mosaic of biota in different states of biological maturity, development, and recovery. This pattern is overlain on a normal patchy array of rocks supporting a variety of species. This high spatial variation contributed to the difficulties in detecting other possible visitor impacts.

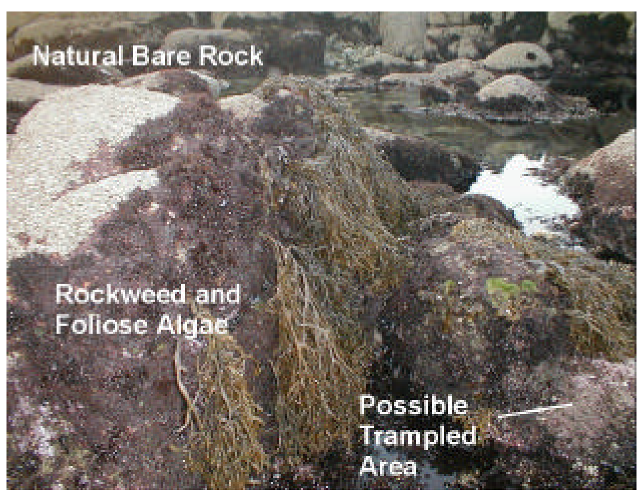

Figure 4-2. Rocks covered with rockweeds and turf algae intermixed with areas of natural bare rock and possible trampled patches.

Another possible reason why we were unable to detect additional visitor impacts is that several conservation measures had come into place 1-3 years prior to our studies. The cumulative effect of these efforts may have allowed potentially impacted species to recover. In 1999, the CDF&G issued a moratorium on scientific collecting. About a year before we began our studies, three signs explaining proper tidepool etiquette and restrictions were installed along the Point Pinos shore. The City of Pacific Grove Police Department had begun more routine surveillance of the area and with shorter response time to call-ins on violations in progress. In addition, Bay Net and the Tidepool Coalition had already begun observations in the area, distributing information on proper tidepool etiquette and advising people not to collect.

The initiation of these resource protection actions prior to our studies may have allowed species to recover to the degree that impacts were no longer present or could not be detected. If this were true, it would underscore the benefits and positive consequences of increased resource protection. Many intertidal species are capable of rapid recolonization, due to abundant larvae and spores transported from unaffected areas. This, combined with rapid growth, facilitates rapid recovery. However, recovery rates can vary among communities with recovery occurring within 1-6 years in some communities, and up to 10 years or more in mussel bed assemblages on wave-exposed shores (Kinnetics 1989). On the other hand, recovery in rocky intertidal communities in Alaska that consisted mainly of mussels, barnacles, and rockweeds, occurred within several years following the Exxon Valdez oil spill (Coats et al. 1999).

The results of the above studies underscore the high recovery potential of rocky intertidal communities that have experienced complete experimental clearings or catastrophic disturbances. Recovery may be more rapid at a location like Point Pinos where disturbances due to visitor use and natural causes are not as extreme. Another explanation may be that previous visitor impacts were not large to begin with, and therefore the amount of recovery needed was not large.

However, another possible change that might have occurred at Point Pinos, but which the present study cannot address, is that the Point Pinos shore could have at one time been significantly more diverse, relative to other areas, such as our reference stations, and that species composition and abundance have been reduced from visitor impacts at Point Pinos to levels similar to our reference areas. Consequently, the finding of many insignificant differences between areas in our study does not necessarily imply that impacts from visitor use have not occurred. Rather, the findings of many insignificant differences between areas implies that the Point Pinos shore remains as diverse as other areas.

The biological communities at Point Pinos were found to be very diverse, even with the levels of visitor use we measured. Natural productivity is high because Point Pinos is situated along a coast that receives nutrient-rich, upwelled water, particularly during the windy months of spring and summer. In some areas of southern California where waters are warmer and less productive, recovery from disturbance may take longer. However, a patchwork with different components of the community in various stages of recovery or succession is one element of a diverse community. In scientific and ecological terms, the word disturbance does not have positive or negative connotation. Disturbance creates constant species turnover that does not allow one species, or group of species, to completely dominate an area (**Figure 4-3**). Disturbance coupled with periodic recruitment, predation, and competition for resources allows multiple species to persist in various stages of age and growth. This relationship between disturbance and diversity is explained by the 'intermediate disturbance' hypothesis (Connell 1978, Sousa 1979). This hypothesis predicts that low levels of disturbance allow for a few competitively dominant species to exist, while excessive disturbance favors only those ephemeral species capable of rapid colonization. Intermediate levels of disturbance allow for the greatest mix of species to colonize and persist in an area. It appears that disturbances caused by current levels of visitor use at Point Pinos are still within the 'intermediate' range that favors high biodiversity.


Figure 4-3. Overturned boulder from storm waves at Point Pinos. This boulder is approximately 1 m in diameter.

To assess the magnitude of impacts resulting from the collection of specimens from the intertidal, one must take into account several factors that includes the size and distribution of the target population, rates of recruitment, ages to maturity, fecundity, longevity, mobility of the organisms, and intensity of extraction. In a simple example, we estimate that approximately 23,000,000 black turban snails (*Tegula funebralis*) were present in the intertidal zone of the Point Pinos shore during our surveys by using our band transect data and data on abundances underneath turnable substrates and extrapolating those numbers to the spatial area of the Point Pinos intertidal zone. The spatial area of the intertidal zone was estimated to be approximately 15 acres (6.0 ha) (Clowes and Coleman 2000). Removal of 1,000 black turban snails would reduce the standing stock of the population by 0.004 %. Black turban snails are one of the most widely distributed and abundant species in the intertidal zone, and as a result, they may be among the least harmed by collecting. However, collecting would have greater effects on organisms that have smaller populations, are long-lived, and are slow to reproduce, such as abalone and sea stars. In addition, indirect effects may occur, as changes in an algal habitat-forming species or dominant invertebrate species may result in secondary effects to associated organisms (Dayton 1971, Moreno et al. 1984, Keough and Quinn 1998, Brown and Taylor 1999, Schiel and Taylor 1999). Consequently, collecting could be detrimental to all organisms if not regulated and enforced.

Collection of scientific specimens, casual collecting for souvenirs by visitors, and illegal harvests of species are done for different reasons and result in different types of potential impacts. Scientific collecting is done for voucher collections, taxonomic research, maintaining museum and aquaria specimens, and for laboratory studies. These collections often require limited numbers of animals and plants. Also, scientific collecting is generally spread out over an area, because scientists often seek variation in their samples.

It is our opinion that the effects of scientific collecting are minimal compared to other forms of collecting. Scientists are generally cognizant of the ecological consequences resulting from collecting. Furthermore, scientific collecting is regulated by the CDF&G. In contrast, poaching is probably the most harmful type of collecting because poachers will often seek the largest specimens and concentrate the collections in a single area until the organisms are depleted (Underwood and Kennelly 1990, Pombo and Escofet 1996, Griffiths and Branch 1997). Population reproduction may be negatively affected by the selective removal of the larger older animals (Ambrose et al. 1995).

Incidental collections by casual visitors and by group trips with school children can also be potentially harmful to the marine communities because they occur essentially every day. Casual visitors and bus visits tend to collect or handle the more ubiquitous and conspicuous species because they are most readily found. Sea stars, while not particularly abundant, are usually conspicuous and are at risk of being depleted in an area. Furthermore, collecting may cause indirect effects, and in the case of sea stars, prey items, such as turban snails, would benefit from reduced sea star abundance.

Question 4: What are the patterns of change in biodiversity and abundance at Point Pinos?

Much of the discussion on this topic is presented in the responses to the three previous questions. In terms of recent changes, that is changes over the past several decades, a commonly voiced opinion among local residents, including scientists in the local community is that: “Things just don’t seem as abundant as they use to be”. Even if some conspicuous species have been reduced in abundance over time, it would be extremely difficult to determine if these changes were the result of human impacts. Species undergo both short- and long-term natural changes that are related to factors that we do not always understand or can predict. Furthermore, the 1970s is not necessarily any better than any other period as a baseline. Regardless, any background variation must be distinguished from variation caused by visitor impacts to determine if a change can be, even partially, attributed to visitor use. Consequently, only severe, large-scale visitor impacts can be most easily detected in areas with mixed substrates, variable topographical relief, and high natural biological variation.

Long-term impact studies at the Diablo Canyon Power Plant in San Luis Obispo County have monitored the abundances of many of the same intertidal species present at Point Pinos since the mid-1970s, and show that large seasonal and inter-annual variation in species abundances can occur (**Figure 4-4**). Three examples are shown from control areas, which are inaccessible to the public, to illustrate how species abundances can vary naturally over decadal time scales. Black turban snails and rough limpets exhibited a multi-year increase and then declined to former levels of abundance while hermit crab populations nearly doubled in abundance in the early 1990s. Such natural changes can often confound the interpretation of visitor use effects in a highly variable species assemblage as this, or make it problematic to define 'normal' population levels without a long-term database. However, even with a long-term database it is often difficult to define 'normal', since nature is dynamic and not static. What is assessed in environmental impact studies is whether changes in impact areas have fallen outside the range of natural variation for a given time period.

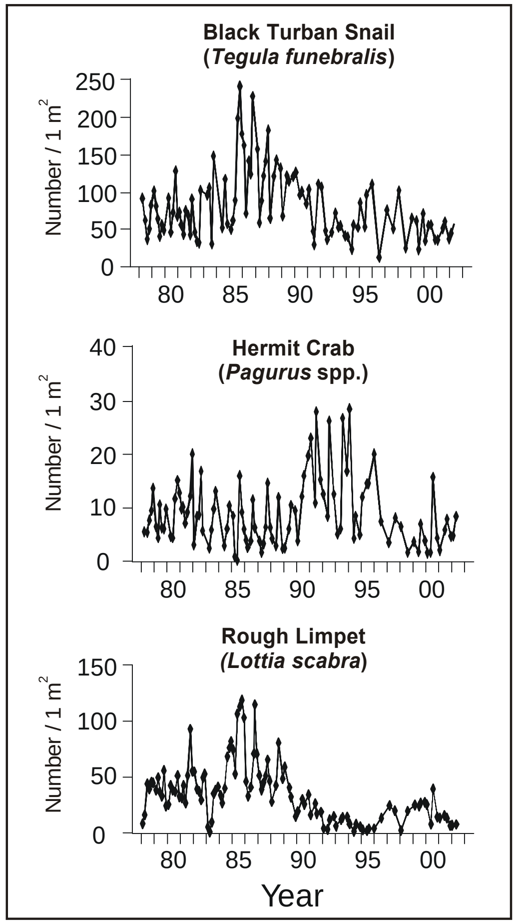

Figure 4-4. Long-term changes in common intertidal species in permanent 1 m^2 quadrats at a control transect (n=10 per transect) located near the Diablo Canyon Power Plant, San Luis Obispo County. (Data courtesy of Pacific Gas and Electric Company).

Long-term studies combined with experiments are therefore needed in visitor impact studies to help separate natural variation from changes caused by visitor use. One experimental approach is to exclude areas from visitor use and compare the responses against the changes in control areas. Another option would be to manipulatively increase visitor use. Tests of parallelism can then be used to examine whether the manipulated areas converge, track, or depart from changes in 'control' areas (Coats et al. 1999).

Question 5: What are the human uses, frequency of use, and other human uses at the Point Pinos tidepools?

Our study found that most people visit Point Pinos for relaxation and its outstanding scenic value. They often remain above the shoreline, walk along the trails, sit on benches, or picnic on the beaches. Others explore the tidepools when the tides are low enough to do so. Bus visits (mainly from schools) bring groups of people that venture out into the rocky intertidal zone. Some illegal collecting occurs, both knowingly and unknowingly, as a result of harvesting species such as abalone or owl limpets for food, and also sea stars and other species as souvenirs of the visit. However, the number of collectors at Point Pinos does not appear excessive, especially in comparison to many areas in southern California.

We found that while many people visit the Point Pinos area, the majority (approximately 85 %) do not venture out into the intertidal. We estimate that between 30,000 and 50,000 people actually visit the intertidal areas of the shoreline annually. Most use of the intertidal zone occurs in spring and winter, due to the mid-day occurring low tides. Tides in summer during the mid-day are higher, affording the intertidal species greater natural protection from visitors during the peak tourist season. We also found that the Point Pinos intertidal zone is not as heavily used as other popular intertidal areas in California (e.g., Fitzgerald Marine Reserve and rocky shores in southern California).

4.2 Assessment of Ecological Significance of Findings

Any human activity within a natural habitat will cause some degree of change to the components or processes of the ecosystem. However, a fundamental part of the impact assessment process is to determine whether such changes are ecologically significant and affect the sustainability, persistence, and maintenance of the structure and function of the ecosystem (Menge 1976, Underwood and Kennelly 1990). Statistically significant changes in the abundances of certain species may not necessarily be ecologically significant. Conversely, the lack of statistical evidence for impacts does not necessarily imply that adverse ecological impacts are absent (Schroeter et al. 1993). Below we discuss the relevance of our study findings in context with ecological significance assessment criteria.

Community Functioning

A change that is ecologically significant implies that the community has changed in diversity, food web structure, or productivity (Connell and Sousa 1983, Lubchenco et al. 1984). Aside from limited trampling effects in the upper intertidal, the results of the Point Pinos study do not indicate that other community parameters have been appreciably altered, have shifted, or are in imminent jeopardy from visitor use. This is not to conclude that Point Pinos has not been impacted to some degree by human use or may once have supported a more diverse community. Rather, there is evidence of sufficient redundancy and complexity in the community whereby many species and assemblages perform and fulfill similar functions. The existing diversity of organisms creates food webs and interactions that buffer changes and ameliorate some visitor impacts. Consequently, we believe that the Point Pinos intertidal community is able to compensate for stress-related pressures that occur with the current levels of visitor use.

Spatial Scale of Effects

The ‘spatial scale’ of an impact refers to whether the affected area is small or large in relation to similar habitat and range of involved species (Dayton and Tegner 1984b). The area of effect at Point Pinos is relatively small in relation to the continuum of adjoining shoreline consisting of similar habitats and species assemblages that are less affected by visitor use. The number of species and habitats at risk at Point Pinos are definable in the sense that upper intertidal habitats near access points and associated species are most susceptible to visitor use effects. Furthermore, any effects of visitor use at Point Pinos has not created a gap that interferes with transport corridors of propagules or mechanisms of reproduction required for successful recruitment and persistence of organisms within and beyond the boundaries of the Point Pinos area.

The relatively small spatial scale of impacts at Point Pinos, however, is not rationale in itself for not considering the need for conservation measures. Other factors need to be weighed, which include predicted increases in visitation that could result in greater impacts over larger spatial scales and increases in the magnitude of changes within the areas of visitor use.

Limitations of the Study

Some amount of uncertainty will always be a factor in assessing impacts even with an extensive database. Furthermore, limited-term studies, such as the present study, can create an incomplete or even misleading picture of the ecological condition of an area that results in an inaccurate impact assessment (Hirst 1984). However, decisions regarding the ecological significance of impacts are always made with some element of uncertainty. Therefore, impact evaluations must include professional judgment with supportive evidence, and taking into account societal values and concerns (Hirst 1984, Underwood and Kennelly 1990, Endter-Wada et al. 1998).

Comparison of Human Induced Impacts with Natural Disturbances

A key point relevant to the present impact assessment is that some disturbances caused by visitors, such as rock turning, are very similar to disturbances caused naturally by storms.

Open coast rocky intertidal communities are comprised of species adapted to wave stress, sand scour, scraping from drift logs, and rock displacement (Dayton 1971, Seapy and Littler 1982, Shanks and Wright 1986, McGuinness 1987, Chapman and Underwood 1996). In contrast, some human-induced impacts such as oil spills, sewage effluent, or vessel groundings would represent unnatural stresses that the community is not adapted to and could therefore pose significantly greater threats.

Temporal Scales and Recovery Potential

Ecosystems are dynamic, and even under natural conditions they are constantly changing, both seasonally and annually (Dayton et al. 1998, Tenera 1997). Therefore, it is not realistic to assume that a system should remain static. The adaptations of a system to resist alteration under a stress, or its recovery following cessation of the stress, is a measure of the ecosystem’s resilience in the face of change (Orians 1975, Connell and Sousa 1983). The community at Point Pinos is constantly in the process of recovery from natural and visitor induced disturbances. The reproduction and growth potential of many species in the region is high, due to strong upwelling and propagules for recruitment. However, the specific recovery times depend on the individual species involved, their life history characteristics, spore and larval dispersal capabilities, and the nature of the substrate types affected (Kinnetics 1989, Walder and Foster 2000). Any disturbances from visitor effects, whether ecologically significant or not, should be quickly followed with processes towards recovery, provided that the disturbances are not chronic or sufficiently frequent to maintain the area in an alternate state.

4.3 Conclusions

We conclude the following based on our field sampling results, literature analysis, and interviews:

- In the absence of historical baseline data, we completed biological surveys in summer 2002 to compare species composition and abundance between areas of high visitor use at Point Pinos and areas of lower visitor use in adjoining shoreline areas. Accordingly, the study could not fully account for how Point Pinos has changed over the long-term. The possibility exists that Point Pinos may have been more diverse than at present, and has since declined from visitor impacts. This could explain the many statistically insignificant differences between areas in our analysis findings. However, the occurrence of many insignificant differences between areas provides evidence that the Point Pinos shore has remained as diverse as adjoining shoreline areas.
- We sampled over 150 species of invertebrates, algae, and intertidal fish species. The only visitor use impact that we were able to detect with these data, based on comparisons between areas, was lower algal cover in high use areas mainly along

the upper shore near access points. We attribute the differences to chronic trampling effects.

- Rocks where trampling was detected had immediate neighoring rocks that supported fully developed algal assemblages.
- Similar to other rocky intertidal areas, the biodiversity at Point Pinos is partially maintained by natural disturbances, predation, competition, parasitism, and disease. With the exception of trampling affecting certain upper portions of the shore, additional disturbances from current levels of visitor use do not appear to exceed the range of disturbances that occur naturally.
- Nearby intertidal areas in the Hopkins Marine Life Refuge have changed to some extent over many decades, probably as a result of long-term ocean warming trends and periodic El Niño events. Sea otter predation has also affected nearby subtidal and intertidal areas with cascading effects on a wide range of biota. Point Pinos has likely been affected by these events but remains an area of high biodiversity with adjoining shorelines.
- Collecting organisms, whether for consumption, souvenirs, or scientific specimens, has not significantly affected the overall biodiversity of Point Pinos.
- The existing levels of resource conservation enforcement actions and education outreach help to minimize visitor impacts. However, certain species, such as sea stars and black abalone, may benefit from additional monitoring because they are at higher risk of depletion from over-collecting. These species may be at risk to collecting because they are not overly abundant and are easily found when present in an area like Point Pinos.

In closing, there is an inherent challenge to balance allowable uses while maintaining resource protection. Current levels of human use and visitor impacts at Point Pinos may continue with the habitat and biota capable of absorbing the stresses without compromising the present ecological values of the shoreline. Although there are no guidelines on how to balance resource conservation with existing uses, some form of management oversight will always be necessary because excessive, non-monitored visitor use could potentially result in degradation of habitat and therefore harm existing human benefits. Population growth in Monterey County and surrounding areas will continue to rise, and likely lead to increased visitor use at Point Pinos. The intertidal assemblages at Point Pinos may be able to accommodate the impacts associated with increased visitor use for some time to come, but not necessarily on an indefinite time scale.

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Table 1. Persons Contacted in Completing the Project

Name	Title	Affiliation
Abbott, Dr. Isabella	Professor	Hopkins Marine Station, Univ. Hawaii
Ambrose, Dr. Rich	Professor/Director, Env. Sci. and Engr.	University of California, Los Angeles
Ammar, Moe	President	Pacific Grove Chamber of Commerce
Bailey, Dr. Steven	Director	Pacific Grove Museum of Natural History
Baldridge, Dr. Alan	Librarian (retired)	Hopkins Marine Station
Bancroft, Chuck	Ranger	Point Lobos State Reserve
Baxter, Dr. Chuck	Professor (semi-retired)	Hopkins Marine Station
Bell, Rita	Education Program Manager	Monterey Bay Aquarium
Bleisner, Alyss	Education Outreach Specialist	Maritime Museum of Monterey, Monterey History and Art Association
Bonnin, Winter	State Park Interpreter	Irvine Coast Marine Life Refuge, County of Orange
Breen, Bob	Senior Staff Ranger,	Fitzgerald Marine Reserve, San Mateo County
Brennan, Kate	Program Technician II	License and Revenue Branch, Special Permit Unit, Calif. Dept. of Fish and Game
Chamberlain, Richard	Teacher (semi-retired)	Pacific Grove High School
Chapman, Faylla	Lab Technician	Hopkins Marine Station
Clark-Gray, Pat	District Interpretive Specialists	Monterey State Parks
Clowes, Sarah	Graduate Student	Hopkins Marine Station
Coelho, Darleta	Executive Secretary	City of Pacific Grove
Haderlie, Dr. Eugene	Professor (retired)	Naval Postgraduate School, Monterey
Hanson, Dennis	Superintendent	Asilomar State Beach and Park
Hathaway, Pat	Photo Archivist	California Views
Hunt, Luke	Graduate Student	Hopkins Marine Station
Jacobus, Roxann	Ranger, Education Outreach Specialist	Asilomar State Beach and Park
Kelly, Donald	Lieutenant, Marine Region	California Department of Fish and Game
Kettlewell, Ron	Education Outreach Specialist	Pacific Grove Museum of Natural History
Lewengrub, John	Marine Life Refuge Project Manager	Dana Point Marine Life Refuge, County of Orange
Louis, Angela	Associate Marine Biologist	California Department of Fish and Game
Love, Liz	Education Coordinator	Monterey Bay National Marine Sanctuary
Micheli, Dr. Fiorenza	Professor	Hopkins Marine Station
Miller, Capt. Carl	Environmental Resource Protection Officer	City of Pacific Grove Police Department
Moss, Tom	District Ecologist	Asilomar State Park
Murray, Dr. Steve	Professor	California State University, Fullerton
Nitzberg, Martha	Education Outreach Specialists	Natural Bridges State Beach
Nybakken, Dr. James	Professor (semi-retired)	Moss Landing Marine Laboratories
Olivas, Tim	Captain, Marine Region	California Department of Fish and Game
Parker, Joan	Librarian	Moss Landing Marine Laboratories
Pearse, Dr. John	Professor (semi-retired)	University of California, Santa Cruz
Radakovich, Milos	Program Manager	Bay Net, The Ocean Conservancy
Raimondi, Dr. Pete	Professor	University of California, Santa Cruz
Schonfeld, Cheri	Marine Life Refuge Supervisor	Little Corona Marine Life Refuge, City of Newport Beach
Silberstein, Mark	Executive Director	Elkhorn Slough Foundation
Smith, Jason	Graduate Student	University of California, Los Angeles
Smith, Terri	Supervisor	License and Revenue Branch, Special Permit Unit, California Department of Fish and Game
Sommer, Freya	Hopkins Marine Life Refuge Manager	Hopkins Marine Station
Spruance, Roxaynne	Environmental Compliance Officer	Pebble Beach Company
Thomas, Tim	Historian	Maritime Museum of Monterey, Monterey History and Art Association
Watanabe, Dr. Jim	Professor	Hopkins Marine Station
Webster, Dr. Steve	Senior Marine Biologist	Monterey Bay Aquarium
Wible, Dr. Joe	Librarian	Hopkins Marine Station
Willoughby, Jim	Principal	Coalition to Preserve Point Pinos Tidepools
Willoughby, Lee	Principal	Coalition to Preserve Point Pinos Tidepools
Wilson, Carrie	Associate Biologist	California Department of Fish and Game
Worley, Penny	Membership Director	Pacific Grove Chamber of Commerce

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Attachment 1 – Regulations Pertaining to the Pacific Grove Marine Gardens Fish Refuge

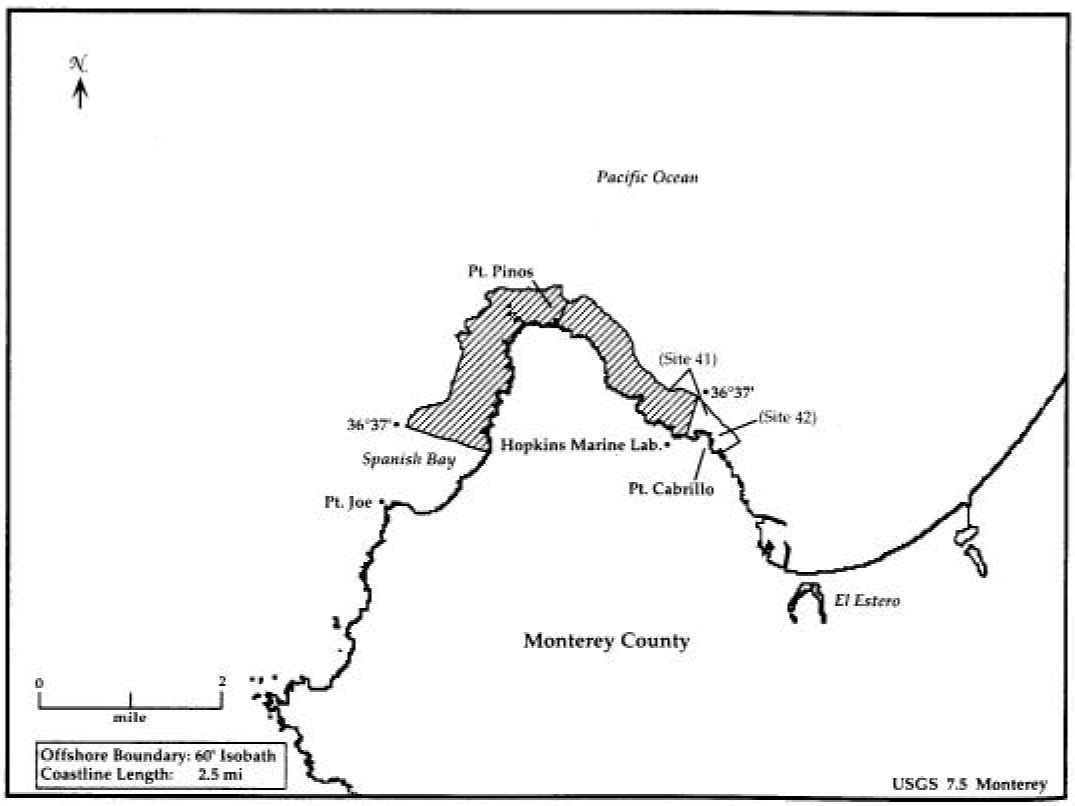
Source: McArdle, D. A. 1997. California Marine Protected Areas. Publication No. T-039. California Sea Grant Publication, San Diego, CA. 268 pp.

Site 43: Pacific Grove Marine Gardens Fish Refuge

Site Description

Name	Pacific Grove Marine Gardens Fish Refuge
Type	Refuge: Fish
Established By	State legislature
Primary Agencies Responsible	Fish and Game Commission California Department of Fish and Game
Secondary Agency Responsible	None
County	Monterey County
Date Established	~~1984~~ ? 1963

Overlapping MPA Boundaries
Monterey Bay National Marine Sanctuary (Site 36)
Pacific Grove Marine Gardens Fish Refuge and Hopkins Marine Life Refuge ASBS (Site 41)



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Attachment 1 (continued) – Regulations Pertaining to the Pacific Grove Marine Gardens Fish Refuge (McArdle 1997)

Fishing Related Regulations

General Commercial and Recreational
Except under a permit or specific authorization, it is unlawful: (c) To take or possess any species of fish or amphibia, or part thereof, in any fish refuge, or to use or have possession in such refuge any contrivance designed to be used for catching fish. (Fish and Game Code 10500)

Site Specific Commercial and Recreational
(a) Fish, other than mollusks and crustaceans, may be taken under the authority of a sportfishing license. (b) Notwithstanding any other provision of this section, holders of scientific collectors' permits issued by the Fish and Game Commission, or students working under their direction, may take marine life for scientific purposes in this refuge. (c) In this refuge, sardines, mackerel, anchovies, squid and herring may be taken by ring net, lampara net or bait net as authorized by this code. (Fish and Game Code 10660)

Site Summary

	Recreational Fishing	*Commercial Fishing*
In General	Allowed, but limited†	Allowed, but limited✦
Finfish	Allowed	Allowed, but limited✦
Invertebrates	Allowed, but limited†	Prohibited

†Mollusks and crustaceans may not be taken.	✦Only sardines, mackerel, anchovies, squid, and herring may be taken by ring net, lampara net, or bait net.

Kelp Harvest and Aircraft Regulations

Kelp Harvest (Recreational) None; fish refuge designation does not regulate recreational kelp harvesting.

Kelp Harvest (Commercial) None; fish refuge designation does not regulate commercial kelp harvesting.

Aircraft None; fish refuge designation does not regulate aircraft. (See the overlapping Monterey Bay National Marine Sanctuary designation for aircraft regulations.)

Central Coast Region

Attachment 2 – Monterey Bay National Marine Sanctuary Description of Regulations in the Pacific Grove Marine Gardens Fish Refuge

Source: MBNMS 1999

Jurisdiction and Authority within the Pacific Grove Marine Gardens Fish Refuge

The following information has been compiled from an analysis of Federal, State, and Local statutes and regulations and conversations with government agency personnel.

A. DEFINITION

1. The Pacific Grove Marine Gardens Fish Refuge is classified specifically as a "fish refuge" by Division 7, Chapter 2, Article 2 of the California Fish and Game Code and is the only fish refuge in the State. "Fish refuge" is a unique term within the California Fish and Game Code and is not inclusive within other descriptive terms such as marine refuges, marine life refuges, state beaches, state preserves, state underwater parks, etc..[1]

2. The Pacific Grove Marine Refuge (established by the City of Pacific Grove in 1952) is a separate and distinct protected area from the Pacific Grove Marine Gardens Fish Refuge established by the State of California in 1984). The Pacific Grove Marine Refuge encompasses intertidal and subtidal lands granted to the City by the California Legislature in 1931 (see B1. below).

B. JURISDICTION

1. The City of Pacific Grove (PG) holds title and authority over certain lands within the Fish Refuge and thus has authority to regulate disposition of substrate within its land holdings. A 1931 act of the California Legislature (as corrected in 1935) granted to the City of Pacific Grove all the right, title, interest, and estate of the lands from the mean high tide line to the 60 foot depth contour (MLW) between the southeasterly corporate limit line and the westerly corporate limit line of the city. The California State Lands Commission (CSLC) acknowledges the City's authority over the identified lands and associated substrate. A current CSLC map of the grant lands depicts the eastern boundary of the grant as an extension of the Monterey/PG boundary line into Monterey Bay and depicts the western boundary of the grant as an extension of the northern Asilomar Boulevard right of way into Monterey Bay. Thus, the grant lands lie within a portion of the Pacific Grove Marine Gardens Fish Refuge.

2 The California Department of Fish and Game (CDFG) has authority to regulate all living marine resources (animals and plants) within the sovereign waters of the State of California, including the Fish Refuge. Fish and game resources are regulated by two primary sources of state law:

- "The California Fish and Game Code" established by the State Legislature
- "The California Code of Regulations (Title 14, CCR)" established by the Fish and Game Commission and the California Department of Fish and Game

3 The Monterey Bay National Marine Sanctuary (MBNMS) has authority to regulate the seabed and historical resources within the MBNMS (16 USC §1431 et seq. and 15 CFR Part 922, Subparts A, E, and M).

4. Asilomar State Beach boundaries do not extend seaward of the mean high tide line; therefore, State Park jurisdiction and regulations do not apply within the boundaries of the Pacific Grove Marine Gardens Fish Refuge.

Attachment 2 (continued) – Monterey Bay National Marine Sanctuary Description of Regulations (MBNMS 1999)

C. REGULATIONS WITHIN THE FISH REFUGE

1. PG City ordinance prohibits take of substrate or marine plants within the marine refuge established by the City without a valid permit from the City (PG City Code, Chapter 14.04, Marine Refuge). According to a letter from CDFG General Counsel to the City of Pacific Grove dated June 5, 1997, the City cannot restrict the take of marine plants unless such restriction is consistent with regulations imposed by the State. The State allows a take of most marine plants within the area of the City's marine refuge (see C.3. below). PG City ordinance allows collection of up to one handful of "nonliving animals or portions thereof" within the City's marine refuge for non-commercial purposes; however, State regulations prohibit collection of shells or other parts of invertebrates (except for sand dollars, sea urchins, and worms) within the area of the City's marine refuge (see C.2. below).

2. CDFG (California Fish and Game Code and the California Code of Regulations) prohibit the taking of <u>any</u> invertebrate, without a scientific collection permit, <u>except</u> for sand dollars, sea urchins, and worms.[2] Anyone collecting sand dollars, sea urchins, and worms within the Fish Refuge must, at a minimum, have a sport fishing license and may collect no more than 35 individuals of each per day. Collection of shells or parts of invertebrates (except for sand dollars, sea urchins, and worms), is a violation of State regulations.

3. CDFG (California Code of Regulations) allow collection of up to 10 pounds (wet weight) of marine plants per person per day, with the exception that no eel grass, surf grass, or sea palm may be taken.[3] There is no licensing requirement. No sport fishing license is required to harvest the daily limit of marine plants from the Fish Refuge. Harvest of more than the daily limit requires a commercial harvesting license from the CDFG.

4. MBNMS regulations prohibit disturbance or alteration of the seabed within the Sanctuary without a permit or authorization from the MBNMS. MBNMS permits typically stipulate that an applicant must obtain permits and authorizations from all relevant government resource managers for the MBNMS permit to be valid.[4]

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[1] The Fish Refuge is <u>not</u> an Ecological Reserve as defined by Title 14, Chapter 11 of the California Code of Regulations (CCR).

The Fish Refuge is <u>not</u> a Marine Life Refuge as defined by Division 7, Chapter 2, Article 6 of the Fish and Game Code.

The Fish Refuge is <u>not</u> a marine refuge, state reserve, state underwater park, state park, state beach, or state recreation area as defined by Division 5, Chapter 1, Article 1.7. (Classification of Units of the State Park System) of the California Public Resources Code.

The Fish Refuge is <u>not</u> within the boundaries of a national park, national monument, or national seashore as defined by federal law or regulations of the US Dept of the Interior).

The Fish Refuge is <u>not</u> designated as ocean waters with restricted fishing as defined by Title 14, Chapter 4, Article 1 of the California Code of Regulations.

[2] According to 14 CCR §29.05(b), tidal invertebrates may not be taken in any tidepool or other areas between the high tide mark (defined as Mean Higher High Tide) and 1,000 feet seaward and lateral to the low tide mark (defined as Mean Lower Low Water). However, 14 CCR §29.05(b)(1) allows for an excepted take of a specified list of invertebrates within certain state park system reserves and national park system units.

Attachment 2 (continued) – Monterey Bay National Marine Sanctuary Description of Regulations (MBNMS 1999)

The fish refuge is not a unit of the state or national park systems, therefore, the excepted take in 14 CCR §29.05(b)(1) does not apply. However, the fish refuge is included under the excepted take provisions of 14 CCR §29.05(b)(2), which allows the take of abalone, limpets, moon snails, turban snails, chiones, clams, cockles, mussels, rock scallops, native oysters, octopuses, squid, crabs, lobsters, shrimp, sand dollars, sea urchins and worms. If not for Section 10660 of the FGC, the above list of invertebrates could be taken from the fish refuge with a valid sport fishing license. But Section 10660(a) of the FGC specifically states that "In the Pacific Grove Marine Gardens Fish Refuge, fish, other than mollusks and crustaceans, may be taken under the authority of a sport fishing license as authorized by this code." After excluding mollusks and crustaceans from the above list of invertebrates, only sand dollars, sea urchins and worms remain for lawful take under a sport fishing license within the fish refuge. According to 14 CCR §29.05(a), a licensed sport fisher can lawfully harvest up to 35 sand dollars, 35 sea urchins, and 35 worms in a single day within the fish refuge.

[3] According to 14 CCR §30.00, there is no closed season, closed hours or minimum size limit for any species of marine aquatic plant (except that no eel grass (Zostera), surf grass (Phyllospadix) or sea palm (Postelsia) may be cut or disturbed). The daily bag limit on all marine aquatic plants for which the take is authorized, except as provided in Section 28.60, is 10 pounds wet weight in the aggregate. Marine aquatic plants may not be cut or harvested in marine life refuges, marine reserves, ecological reserves, national parks or state underwater parks. This exception does not include fish refuges as defined by Section 10801 of the FGC. Therefore, the harvest of marine plants (except for eel grass, surf grass, and sea palm) is authorized within the fish refuge within the limits stated above. Furthermore, commercial take of marine plants can occur in accordance with Sections 6650-6751 of the FGC.

[4] The issuance of a permit by the MBNMS does not preclude another government agency (federal, state or local) with shared jurisdiction from issuing a separate permit with more or less restrictive provisions. The applicant is obligated to meet any and all restrictions imposed by one or more government agencies with competent jurisdiction. If the applicant holds separate permits that contain differing requirements, the applicant is bound to observe the more restrictive requirements or face potential prosecution by the agency issuing the more restrictive requirements. For example, an applicant may meet requirements of both federal and state agencies, but still violate requirements of a local government. In such an instance, the local government could exercise its prerogative to prosecute the applicant under applicable "local" law. The local government would not have authority to invalidate permits issued by the federal and state agencies; however, the lack of such authority would not preclude the local government from prosecuting an individual for violation of a local ordinance.

Attachment 2 (continued) – Monterey Bay National Marine Sanctuary Description of Regulations (MBNMS 1999)

CALIFORNIA FISH AND GAME CODE

Selected Excerpts

DIVISION 0.5. GENERAL PROVISIONS AND DEFINITIONS
CHAPTER 1. GENERAL DEFINITIONS 1-89

45. "Fish" means wild fish, mollusks, crustaceans, invertebrates, or amphibians, including any part, spawn, or ova thereof.

51. "Kelp" means kelp or other marine aquatic plants and the seeds thereof.

DIVISION 6. FISH
PART 3. COMMERCIAL FISHING
CHAPTER 2. PARTICULAR VARIETIES OF FISH
Article 14. Tidal Invertebrates 8500

8500. Except as otherwise expressly permitted in this chapter, no mollusks, crustaceans, or other invertebrates may be taken, possessed aboard a boat, or landed for commercial purposes by any person in any tide pool or tidal area, including tide flats or other areas between the high tidemark and 1,000 feet beyond the low tidemark, unless a valid tidal invertebrate permit has been issued to that person that has not been suspended or revoked. The taking, possessing, or landing of mollusks, crustaceans, or other invertebrates pursuant to this section shall be subject to regulations adopted by the commission.

DIVISION 7. REFUGES
CHAPTER 1. REFUGES AND OTHER PROTECTED AREAS
Article 1. General Provisions 10500-10514

10500. Except under a permit or specific authorization, it is unlawful:

(a) To take or possess any bird or mammal, or part thereof, in any game refuge.

(b) To use or have in possession in a game refuge, any firearm, bow and arrow, or any trap or other contrivance designed to be, or capable of being, used to take birds or mammals, or to discharge any firearm or to release any arrow into any game refuge.

(c) To take or possess any species of fish or amphibia, or part thereof, in any fish refuge, or to use or have in possession in such refuge any contrivance designed to be used for catching fish.

(d) To take or possess any bird in, or to discharge any firearm or to release any arrow within or into, any fowl refuge.

(e) To take or possess any quail in a quail refuge.

(f) To take or possess any invertebrate or specimen of marine plant life in a marine life refuge.

(g) To take or possess any clam in a clam refuge or to possess in such a refuge any instrument or apparatus capable of being used to dig clams.

Attachment 2 (continued) – Monterey Bay National Marine Sanctuary Description of Regulations (MBNMS 1999

10508. The department and the district attorney, sheriff, and all peace officers of the county in which any refuge or part thereof is situated, shall enforce all of the provisions of this code relating to such refuge, and institute and assist in prosecutions for violations thereof.

DIVISION 2. DEPARTMENT OF FISH AND GAME
CHAPTER 5. FISH AND GAME MANAGEMENT
Article 4. Ecological Reserves 1580-1586

1580. The Legislature hereby declares that the policy of the state is to protect threatened or endangered native plants, wildlife, or aquatic organisms or specialized habitat types, both terrestrial and aquatic, or large heterogeneous natural marine gene pools for the future use of mankind through the establishment of ecological reserves. For the purpose of establishing those ecological reserves, the department, with the approval of the commission, may obtain, accept on behalf of the state, acquire, or control, by purchase, lease, easement, gift, rental, memorandum of understanding, or otherwise, and occupy, develop, maintain, use, and administer land, or land and water, or land and water rights, suitable for the purpose of establishing ecological reserves. Any property obtained, accepted, acquired, or controlled by the department pursuant to this article may be designated by the commission as an ecological reserve. The commission may adopt regulations for the occupation, utilization, operation, protection, enhancement, maintenance, and administration of ecological reserves. The ecological reserves shall not be classified as wildlife management areas pursuant to Section 1504 and shall be exempt from Section 1504.

1581. Any property acquired in fee for ecological reserves shall be acquired in the name of the state, and shall, at all times, be subject to such rules and regulations as may be prescribed from time to time by the commission for the occupation, use, operation, protection, and administration of such property as ecological reserves.

DIVISION 7. REFUGES
CHAPTER 1. REFUGES AND OTHER PROTECTED AREAS
Article 2. Special Provisions for Given Areas 10650-10667

10660. (a) In the Pacific Grove Marine Gardens Fish Refuge, fish, other than mollusks and crustaceans, may be taken under the authority of a sport fishing license as authorized by this code.

(b) Notwithstanding any other provision of this section, holders of scientific collectors' permits issued by the commission, or students working under their direction, may take marine life for scientific purposes in this refuge.

(c) In this refuge, sardines, mackerel, anchovies, squid and herring may be taken by ring net, lampara net or bait net as authorized by this code.

Attachment 2 (continued) – Monterey Bay National Marine Sanctuary Description of Regulations (MBNMS 1999

CHAPTER 2. SPECIFIC REFUGE BOUNDARIES
Article 2. Fish Refuges 10801

10801. The following constitutes the Pacific Grove Marine Gardens Fish Refuge:

All that area within the following boundaries as they existed April 1, 1963, not within the Hopkins Marine Life Refuge: Beginning at the point of intersection of the southeasterly corporate limit line of the City of Pacific Grove prolongated, and the line of mean high tide of the Bay of Monterey; thence northwesterly along said line of mean high tide to Point Pinos and continuing around said point in a westerly direction and continuing southwesterly along said line of mean high tide to the intersection with the southwesterly corporate limit line prolongated of said city; thence N. 70° 45' 00 W. along said southwesterly corporate limit line prolongated to a point in the Pacific Ocean where the depth of water in said ocean is sixty (60) feet measured from the level of mean low tide; thence northwesterly along the line in said ocean which line is at a constant depth of sixty (60) feet measured from the level of mean low tide to Point Pinos and continuing around said point in an easterly direction and continuing southeasterly along the line in said bay which line is at a constant depth of sixty (60) feet measured from the level of mean low tide, to the intersection with the southeasterly corporate limit line of said city prolongated; thence S. 58° 57' 45 W. along said southeasterly corporate limit line prolongated, to the point of beginning.

DIVISION 6. FISH
PART 2. SPORT FISHING
CHAPTER 1. GENERALLY
Article 3. Sport Fishing Licenses 7145-7155

7145. (a) Except as otherwise provided in this article, every person over the age of 16 years who takes any fish, reptile, or amphibia for any purpose other than profit shall first obtain a license for that purpose and shall have that license on his or her person or in his or her immediate possession or where otherwise specifically required by law to be kept when engaged in carrying out any activity authorized by the license. In the case of a person diving from a boat, the license may be kept in the boat, or in the case of a person diving from the shore, the license may be kept within 500 yards on the shore.

Attachment 2 (continued) – Monterey Bay National Marine Sanctuary Description of Regulations (MBNMS 1999

CALIFORNIA CODE OF REGULATIONS

Selected Excerpts
(Title 14, California Code of Regulations)

CHAPTER 4. OCEAN FISHING
Article 1. Ocean and San Francisco Bay District

INVERTEBRATES

29.05. General.

(a) Except as provided in this article there are no closed seasons, closed hours or minimum size limits for any invertebrate. The bag limit on all invertebrates for which the take is authorized and for which there is not a bag limit otherwise established in this article is 35. In San Francisco and San Pablo bays and saltwater tributaries east of the Golden Gate Bridge invertebrates may not be taken at night except from the shore.

(b) Tidal invertebrates may not be taken in any tidepool or other areas between the high tide mark (defined as Mean Higher High Tide) and 1,000 feet seaward and lateral to the low tide mark (defined as Mean Lower Low Water) except as follows:

(1) In state parks, state beaches, state recreation areas, state underwater parks, state reserves, national parks, national monuments or national seashores: Only abalones, chiones, clams, cockles, rock scallops, native oysters, crabs, lobsters, ghost shrimp and sea urchins may be taken. Worms may be taken except that no worms may be taken in any mussel bed, unless worms are taken incidental to the harvesting of mussels. Mussels may be taken in all areas except in state park system reserves or natural preserves.

(2) In all other areas, except where prohibited within marine life refuges or other special closures: Abalone, limpets, moon snails, turban snails, chiones, clams, cockles, mussels, rock scallops, native oysters, octopuses, squid, crabs, lobsters, shrimp, sand dollars, sea urchins and worms may be taken.

CHAPTER 4. OCEAN FISHING
Article 1. Ocean and San Francisco Bay District

NON-COMMERCIAL USE OF MARINE PLANTS

30.00. Kelp General.

(a) Except as provided in this section and in Section 30.10 there is no closed season, closed hours or minimum size limit for any species of marine aquatic plant. The daily bag limit on all marine aquatic plants for which the take is authorized, except as provided in Section 28.60, is 10 pounds wet weight in the aggregate.

(b) Marine aquatic plants may not be cut or harvested in marine life refuges, marine reserves, ecological reserves, national parks or state underwater parks.

30.10. Prohibited Species.

No eel grass (Zostera), surf grass (Phyllospadix) or sea palm (Postelsia) may be cut or disturbed.

Attachment 3 – Regulations Pertaining to the Pacific Grove Marine Refuge

Source: Brown, Jennifer. 2001. A Review of Marine Zones in the Monterey Bay National Marine Sanctuary. Marine Sanctuaries Conservation Series MSD-01-2. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Marine Sanctuaries Division, Silver Spring, MD.

Type of Zone: Limited Harvest

Legislated Title of Site: Marine Refuge

Location of Site

See Figure 10 for exact location

Monterey County
1) Pacific Grove Marine Refuge (PGMR)

Year Established

1952

Established By

City Ordinance, Pacific Grove City Council*

* A 1931 act of the California Legislature granted to the City of Pacific Grove all the right, title, interest, and estate of the lands from the mean high tide line to the 60 foot depth contour between the southeasterly corporate limit line and the westerly corporate limit line of the city. The City of Pacific Grove has authority to regulate disposition of substrate within its land holdings, including the PGMR.

Agencies Responsible

Pacific Grove City Manager
Pacific Grove Public Works Department
Pacific Grove Police Department
Pacific Grove City Council, Natural Resources Committee

Purpose

To protect certain kinds of marine life and to provide a marine garden for the City of Pacific Grove (Pacific Grove City Code, Chapter 14.04.010).

Attachment 3 (continued) – Regulations Pertaining to the Pacific Grove Marine Refuge (Brown 2001)

General Regulations

None

Site Specific Regulations

1) Unlawful Acts. Anyone taking specimens of marine plant life, or who willfully disturbs, injures of destroys marine animal habitats or who removes sand, gravel, or rocks therefrom shall be guilty of a misdemeanor (PG City Code, Chapter 14.04.020).+

2) Removal of Certain Material Permitted. Notwithstanding the provisions of Section 14.04.020, nonliving animals or portions thereof, detached plants, pebbles, flotsam and jetsam may be removed for noncommercial purposes and reduced to possession, but the quantity of nonliving animals and pebbles that may be taken shall not exceed the possession of one handful. The marine refuge shall not be subject to habitat destruction by the relocation and repositioning of large rocks. The city manager or his or her delegated authority may issue permits for scientific collecting of specific organisms or objects in specific quantities within the Marine Preserve of the city of Pacific Grove (PG City Code, Chapter 14.04.020). ^

+ The California Department of fish and Game (CDFG) has authority to regulate all living marine resources (animal and plants) within the sovereign waters of the State of California, including the PGMR. The City cannot restrict the take of marine plants unless such restriction is consistent with regulations imposed by the State. The State allows take of most marine plants within the area of the PGMR (see Pacific Grove Marine Gardens Fish Refuge regulations).

^ State regulations prohibit collection of shells or other parts of invertebrates (except sand dollars, sea urchins, and worms) within the PGMR (see Pacific Grove Marine Gardens Fish Refuge regulations)

Evaluation of Effectiveness

Enforcement of Regulations

Enforcement of the PGMR regulations is difficult to assess independently of the Pacific Grove Marine Gardens Fish Refuge and the Hopkins Marine Life Refuge, which have overlapping boundaries with the PGMR. For a summary of enforcement in the Hopkins Marine Life Refuge and the Pacific Grove Marine Gardens Fish Refuge see pages 40 and 67, respectively.

Attachment 3 (continued)– Regulations Pertaining to the Pacific Grove Marine Refuge (Brown 2001)

Achievement of Purpose

Evaluation of the PGMR is difficult because its boundaries overlap with those of the Pacific Grove Marine Gardens Fish Refuge and the Hopkins Marine Life Refuge. Please refer to the Hopkins Marine Life Refuge and the Pacific Grove Marine Gardens Fish Refuge evaluation sections on pages 40 and 67, respectively.

Overlapping Sites

- Monterey Bay National Marine Sanctuary
- Shark Attraction Prohibited
- Hopkins Marine Life Refuge
- Asilomar SB
- Pacific Grove Marine Gardens Fish Refuge
- Pacific Grove Marine Gardens Fish Refuge and Hopkins Marine Life Refuge ASBS

References

None

Attachment 4 – Regulations Pertaining to the Pacific Grove Marine Gardens Fish Refuge

Source: Brown, Jennifer. 2001. A Review of Marine Zones in the Monterey Bay National Marine Sanctuary. Marine Sanctuaries Conservation Series MSD-01-2. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Marine Sanctuaries Division, Silver Spring, MD.

Type of Zone: Limited Harvest

Legislated Title of Site: Fish Refuge

Location of Site
See Figure 10 for exact locations

Monterey County
1) Pacific Grove Marine Gardens Fish Refuge

Year Established

1963

Established By

State Legislature

Agencies Responsible

Fish and Game Commission
California Department of Fish and Game

Purpose

No legally mandated purpose accompanies the fish refuge designation.

Regulations

General Regulations

1) Except under a permit or specific authorization, it is unlawful to take or possess any species of fish or amphibian, or part thereof, in any fish refuge, or to use or have in possession in such refuge any contrivance designed to be used for catching fish (Fish and Game Code 10500(c)).

Attachment 4 (continued) – Regulations Pertaining to the Pacific Grove Marine Gardens Fish Refuge (Brown 2001)

Site Specific Regulations

1) In the Pacific Grove Marine Gardens Fish Refuge, fish, other than mollusks and crustaceans, may be taken under the authority of a sportfishing license as authorized by this code (Fish and Game Code 10660(a)).

2) Notwithstanding any other provision of this section, holders of scientific collectors' permits issued by the commission, or students working under their direction, may take marine life for scientific purposes in this refuge (Fish and Game Code 10660(b)).

3) In this refuge, sardines, mackerel, anchovies, squid, and herring may be taken by ring net, lampara net, or bait net as authorized by this code (Fish and Game Code 10660(c)).

Evaluation of Effectiveness

Enforcement of Regulations

Regulations are enforced primarily by California Department of Fish and Game wardens. Enforcement is intermittent and subject to availability of wardens. The City of Pacific Grove Police Department helps the CDFG wardens enforce fish and game regulations. Officers patrol the Pacific Grove coastline daily and, through their presence, act as a deterrent to poaching activity in the refuge. The are five levels of action that a police officer may take when a violation is observed (actions are listed in order of decreasing frequency): 1) issue a verbal warning; 2) issue a warning citation; 3) detain individual(s) for CDFG wardens; 4) issue a citation; or 5) make an arrest. Violation of the fish and game code is a misdemeanor offense (Captain Carl Miller, Pacific Grove Police Department, pers. comm.).

A local organization - The Coalition to Preserve and Protect Pacific Grove Tidepools - is attempting to increase the protection of plant and animal populations in the Pacific Grove Marine Gardens Fish Refuge.

Achievement of Purpose

Evaluation of this site is difficult because it lacks a legally mandated purpose. No research to date has examined the effectiveness of the fish refuge regulations to protect invertebrate and fish populations from over-exploitation.

Overlapping Sites

- Monterey Bay National Marine Sanctuary
- Shark Attraction Prohibited
- Pacific Grove Marine Reserve

Attachment 4 (continued) – Regulations Pertaining to the Pacific Grove Marine Gardens Fish Refuge (Brown 2001)

- Asilomar SB
- Pacific Grove Marine Gardens Fish Refuge and Hopkins Marine Life Refuge ASBS

References

McArdle, D. A. 1997. California Marine Protected Areas. Publication No. T-039. California Sea Grant Publication, San Diego, CA. 268 pp.

Attachment 5 – Pacific Grove City Ordinance 00-12

39

ORDINANCE NO. 00-12

ORDINANCE OF THE CITY COUNCIL OF THE CITY OF PACIFIC GROVE ADOPTING WITHOUT CHANGE A MARINE CONSERVATION INITIATIVE MEASURE THAT HAS QUALIFIED FOR THE BALLOT

WHEREAS, an initiative petition entitled "Pacific Grove Marine Gardens Fish Refuge Marine Conservation and Protection Initiative" has duly qualified pursuant to the City Charter and state elections law for consideration by the voters of the City of Pacific Grove at the regular municipal election to be held on November 7, 2000; and

WHEREAS, pursuant to Section 9215 of the California Elections Code this council may, as an alternative to placing the measure on the November ballot, adopt without change the ordinance petitioned for; and

WHEREAS, it is the decision of this council that the ordinance petitioned for shall be adopted without change, thereby obviating the election requirement;

NOW, THEREFORE, THE COUNCIL OF THE CITY OF PACIFIC GROVE DOES ORDAIN AS FOLLOWS:

SECTION 1. This council hereby adopts without change the aforedescribed initiative measure in the form submitted for petition signatures, as set out in Exhibit A, attached hereto and incorporated herein by this reference.

SECTION 2. The city clerk hereby is directed to send a certified copy of this ordinance to the California Department of Fish and Game and to the California Fish and Game Commission with the request that action be taken immediately regarding the objection filed pursuant to California Fish and Game Code Section 1002(h).

SECTION 3. This ordinance shall not be repealed or amended without a vote of the people of the City of Pacific Grove.

SECTION 4. This ordinance shall become effective immediately upon final passage and adoption.

PASSED AND ADOPTED BY THE COUNCIL OF THE CITY OF PACIFIC GROVE this 7th day of June, 2000, by the following vote:

AYES: Costello, Davis, Fisher, Honegger, Huitt, Koffman, Martine

NOES: None

ABSENT: None

APPROVED:

Sandra L Koffman

SANDRA L. KOFFMAN, Mayor

ATTEST:

Peter Woodruff

PETER WOODRUFF, City Clerk

APPROVED AS TO FORM:

G Thacher

GEORGE C. THACHER, City Attorney

Attachment 5 (continued) – Pacific Grove City Ordinance 00-12

40 Ordinance No. 00-12 Page 2 of 2

EXHIBIT A

Coalition to Preserve and Restore Pt. Pinos Tidepools

Within these areas, no risk of change is considered acceptable unless it is part of a natural process*

Proposed Ballot Initiative for the Citizens of Pacific Grove

Purpose: To Promote Marine Conservation and Broaden Protection within the intertidal areas of the Pacific Grove Marine Gardens Fish Refuge.

The People of the City of Pacific Grove do hereby ordain and adopt the following:

Whereas: We, the citizens of Pacific Grove, recognize the ecological value of the marine resources within the State established Pacific Grove Marine Gardens Fish Refuge which includes the Great Tidepools of Pt. Pinos. This Refuge borders the corporate city limit line (city limits) of Pacific Grove.

Whereas: The citizens further recognize that within this Refuge, there are tidelands of great biological, historical and archeological significance worthy of special protection. We endorse the newly adopted Pacific Grove Coastal Parks Plan that places special emphasis on protecting these intertidal resources to insure their preservation for future generations. It is not the intent of this measure to affect commercial fishing in the Pacific Grove Marine Gardens Fish Refuge.

Whereas: The citizens acknowledge oceanographic and climatic factors as well as vertebrate predation influencing the diversity and abundance of flora and fauna within these intertidal areas. More importantly, it is recognized there are deleterious effects on marine life from increasing human impact.

Therefore, We, the citizens of Pacific Grove, do hereby file with the State of California Department of Fish & Game and/or the State of California Fish and Game Commission an objection to the taking of invertebrates and other marine life from the ocean waters within the boundaries of the Pacific Grove Marine Gardens Fish Refuge as specified in Section 1002 (h) of the California Fish and Game Code.

In doing so, the citizens seek comprehensive protection of this Refuge where all extractive activities will be prohibited, including the taking of marine invertebrates by any means, in accordance with Fish & Game Regulations. Exceptions are made for the City Manager or his delegated authority, at his discretion and with written permission, to allow minimal scientific collecting under Pacific Grove Municipal Code (14.04.030) with the consent of the Department of Fish & Game.

The tidelands within this Refuge will continue to be open to the public, on site research and recreational fishing of selected species of fin fish by hook and line.

*Pacific Grove Coastal Parks Plan

Attachment 6 – City Regulations Pertaining to the Pacific Grove Marine Refuge

Chapter 14.04

MARINE REFUGE*

Sections:

14.04.010	Established.
14.04.020	Unlawful acts.
14.04.030	Removal of certain materials permitted.

* For provisions regarding intoxicated persons in marine refuge, see § 11.04.020 of this code.

For provisions regarding ocean rescue, see Chapter 4.10 of this code.

14.04.010 Established.

All the waterfront of the city, together with those certain submerged lands in the Bay of Monterey contiguous thereto, as set forth and particularly described in that certain Act of the Legislature of the State of California entitled, "An act granting to the City of Pacific Grove the title to the waterfront of said City together with certain submerged lands in the Bay of Monterey contiguous thereto," approved by the Governor June 9, 1931, are hereby established as a refuge for the protection of certain kinds of marine life hereinafter mentioned and as a marine garden of the city and reference is hereby made to said Act of the Legislature for a particular description of said waterfront and said submerged lands.
(Ord. 210 N.S. § 5-401(1), 1952).

14.04.020 Unlawful acts.

Anyone taking specimens of marine plant life, or who wilfully disturbs, injures or destroys marine animal habitats or who removes sand, gravel, or rocks therefrom shall be guilty of a misdemeanor.
(Ord. 1004 N.S. § 1, 1978: Ord. 210 N.S. § 5-401(2), 1952).

14.04.030 Removal of certain material permitted.

Notwithstanding the provisions of Section 14.04.020, nonliving animals or portions thereof, detached plants, pebbles, flotsam and jetsam may be removed for noncommercial purposes and reduced to possession, but the quantity of nonliving animals and pebbles that may be taken shall not exceed the possession of one handful. The marine refuge shall not be subject to habitat destruction by the relocation and repositioning of large rocks. The city manager or his or her delegated authority may issue permits for scientific collecting of specific organisms or objects in specific quantities within the Marine Preserve of the city of Pacific Grove.
(Ord. 349 N.S., 1960; Ord. 210 N.S. § 5-401(3)).

Chapter 14.08

PARKS*

Sections:

14.08.010	Unlawful acts within limits of park, golf course or beach.
14.08.015	Recreational trail as public park.
14.08.016	Recreational trail – Foot traffic prohibited on bicycle portion.
14.08.017	Monarch Grove Sanctuary as public park.
14.08.020	Bicycles prohibited.
14.08.030	Dogs prohibited in public parks – Exceptions.
14.08.040	Diving along the waterfront.

* For provisions regarding intoxicated persons in parks, see § 11.04.020 of this code.

14.08.010 Unlawful acts within limits of park, golf course or beach.

Within the limits of any public park, golf course, or beach in the city of Pacific Grove it is unlawful for any person to do any of the acts hereinafter specified:

(a) To cut, break, injure, deface, or disturb any tree, shrub, plant, rock, building, monument, bench, or other structure, apparatus or

Attachment 7 – Change in Scientific Collecting Policies Made in May 2003

State of California - The Resources Agency
DEPARTMENT OF FISH AND GAME
http://www.dfg.ca.gov
Marine Region
20 Lower Ragsdale Drive, Suite #100
Monterey, CA 93940
(831) 649-2870

GRAY DAVIS, *Governor*

May 21, 2003

Tenera Environmental Services
Attention: Mr. Scott Kimura
225 Prado Road, Suite D
San Luis Obispo, California 93401

Dear Mr. Kimura:

The California Department of Fish and Game (DFG) has revised its policy regarding scientific collecting, effective today, to increase protection for intertidal marine organisms along certain portions of Pacific Grove's shoreline, while allowing for some limited collecting in other areas.

Current state regulations within the Pacific Grove Marine Gardens Fish Refuge allow for scientific collecting under a permit that is evaluated on a case-by-case basis. Those regulations also allow the recreational harvest of invertebrates (other than mollusks and crustaceans) and finfish, and the commercial harvest of sardines, mackerel, anchovies, squid, and herring using ring nets, lampara nets, or bait nets.

Scientific collecting permits at the Refuge are issued by DFG under the authority of the Fish and Game Commission. The policy will be implemented through existing Fish and Game regulations and, unlike previous permits, will specifically apply to collecting within the refuge.

With this revision, DFG will continue to evaluate applications for scientific collecting permits on a case-by-case basis. Barring unusual circumstances, collecting in the refuge south of Point Pinos will not be allowed, but may be allowed to the north and east. This provides protection for the majority of tidepools within the refuge. Specifically, the two areas will be distinguished by a line extending from the southeast corner of the large green concrete box at Pt. Pinos to the highest point on the outer rocks of Pt. Pinos (map enclosed).

The Marine Life Protection Act (MLPA), which took effect in 1999, directed DFG to improve the design and management of marine protected areas like the refuge through a master planning process. As a result, seven regional working groups with broad stakeholder representation were formed, including one from the Monterey-Santa Cruz region.

Attachment 7 (continued) – Change in Scientific Collecting Policies Made in May 2003

Mr. Kimura
May 21, 2003
Page Two

DFG will implement this new policy until such time as the MLPA process makes a recommendation to the Fish and Game Commission concerning the status of the refuge.

Sincerely,

Fred Wendell

Fred Wendell
Nearshore Ecosytem Manager
Marine Region-Monterey

Enclosure

PR:et

Attachment 7 (continued) – Change in Scientific Collecting Policies Made in May 2003

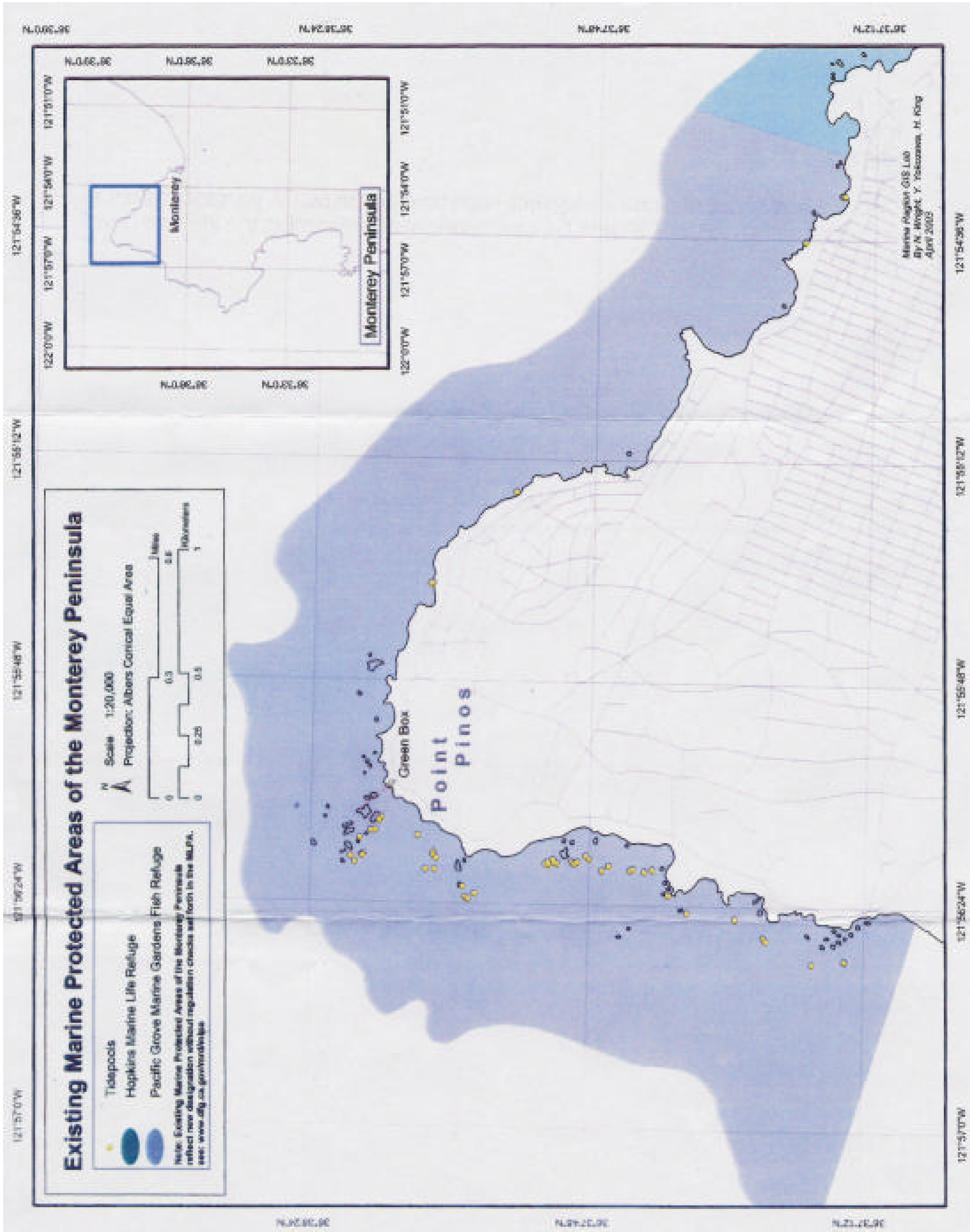

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Table 1. Visitor Census Surveys – Dates and Conditions

	Date	Day	Time Start	Time End	Tide During Survey (ft MLLW)	Sky[1]	Wind[2]	Sea[3]
1	Oct 2-01	Tu	17:02	18:55	2.0	4	1	1
2	Nov 14-01	W	15:30	17:50	-0.2	3	1	2
3	Nov 25-01	Su	13:30	15:05	1.9	2	1	1
4	Nov 30-01	F	14:30	15:35	0.1	1	2	1
5	Dec 6-01	Th	9:50	11:40	3.4	2	2	2
6	Dec 18-01	Tu	12:05	13:30	4.9	1	2	2
7	Jan 4-02	F	10:10	12:25	3.9	1	1	1
8	Feb 25-02	M	14:10	16:00	-1.1	1	2	2
9	Mar 21-02	Th	12:20	13:20	1.3	3	1	1
10	Mar 25-02	M	13:30	14:00	-0.8	1	1	1
11	Mar 28-02	Th	8:30	9:40	5.5	2	1	2
12	Apr 4-02	Th	13:00	14:00	1.3	3	1	1
13	Apr 11-02	Th	8:45	9:45	3.8	1	1	1
14	Apr 18-02	Th	12:00	13:00	0.9	1	1	2
15	Apr 25-02	Th	12:15	13:15	2.8	3	1	1
16	May 2-02	Th	12:00	13:00	0.5	3	1	1
17	May 9-02	Th	12:00	13:00	2.5	1	2	2
18	May 16-02	Th	12:00	13:00	2.0	2	1	1
19	May 23-02	Th	12:00	13:00	4.1	1	1	1
20	Jun 13-02	Th	12:00	13:00	3.1	3	1	1
21	Jun 27-02	Th	12:00	13:00	3.3	3	1	1
22	Jul 4-02	Th	9:00	10:00	2.8	2	1	?
23	Jul 10-02	W	9:00	10:00	2.2	4	1	1
24	Jul 18-02	Th	12:00	13:00	2.0	2	2	2
25	Aug 1-02	Th	12:00	13:00	2.9	3	1	1
26	Aug 8-02	Th	9:00	10:00	2.9	1	1	1
27	Aug 15-02	Th	12:15	13:10	3.4	3	1	1
28	Aug 22-02	Th	12:10	13:00	4.2	3	1	1
29	Aug 29-02	Th	12:00	12:50	4.0	3	1	1
30	Sep 5-02	Th	12:00	13:00	3.8	2	1	1
31	Sep 12-02	Th	12:00	13:00	4.5	3	1	1
32	Sep 19-02	Th	9:00	10:00	4.6	1	1	1
33	Oct 3-02	Th	12:30	13:15	2.9	1	1	1
34	Oct 10-02	Th	12:10	13:00	5.9	3	1	1
35	Oct 17-02	Th	12:10	13:00	3.3	1	1	1
36	Oct 24-02	Th	12:05	12:45	5.6	3	1	2
37	Oct 31-02	Th	12:05	12:45	2.5	1	1	2
38	Nov 7-02	Th	12:10	12:55	6.4	2	2	2
39	Nov 14-02	Th	12:10	12:55	2.2	1	1	2
40	Nov 21-02	Th	9:10	9:55	6.1	2	1	2
41	Dec 3-02	Tu	14:30	17:00	-0.9	2	1	1
42	Dec 5-02	Th	12:10	13:00	5.2	2	1	2
43	Dec 14-02	Sa	11:30	12:30	2.7	3	2	2
44	Dec 26-02	Th	9:05	9:55	3.0	3	1	1
45	Jan 2-03	Th	12:00	12:55	3.7	2	1	2
46	Jan 9-03	Th	12:05	12:50	3.5	3	1	1
47	Jan 16-03	Th	12:10	12:50	2.2	1	1	1

[1] Sky: 1=clear, 2=patchy clouds, 3=overcast, 4=foggy
[2] Wind: 1=none/mild, 2=strong/gusty
[3] Sea: 1=calm/moderate, 2=large waves/rough

Table 2. Total People in Cars

Segment	1	2	3	4	5,6,7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Oct 2-01	-	-	-	3	3	2	-	-	6	-	-	-	2	5	-	-	-	-	-	-	-	-	-	-	-
Nov 14-01	-	-	-	-	3	-	1	-	1	-	1	1	5	4	20	1	-	-	-	-	-	-	-	-	-
Nov 25-01	-	-	-	2	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec 6-01	-	-	-	-	-	-	-	4	-	-	2	-	-	3	-	-	-	2	-	-	-	1	-	-	3
Jan 4-02	2	-	1	3	-	2	6	-	-	-	2	-	-	12	6	-	-	2	-	-	-	-	-	-	-
Feb 25-02	1	-	2	2	3	4	-	-	-	-	1	-	-	2	5	-	1	-	2	-	-	-	-	12	6
Mar 21-02	2	-	-	-	9	1	1	-	6	-	14	5	-	-	3	-	-	4	2	-	-	-	2	4	4
Mar 28-02	1	2	-	-	2	-	2	-	1	2	1	6	6	2	4	4	-	2	1	2	-	2	3	2	5
Apr 4-02	7	2	2	-	24	2	2	2	7	4	5	5	4	2	7	6	4	2	-	-	-	4	2	4	21
Apr 11-02	-	-	-	-	9	1	-	1	1	1	1	4	-	-	-	-	-	-	-	2	-	-	-	1	12
Apr 18-02	8	-	3	-	11	3	-	6	-	6	1	5	7	4	9	-	7	-	-	3	-	-	6	-	8
Apr 25-02	1	-	-	-	8	4	5	-	2	-	3	2	5	-	6	5	-	-	-	-	-	2	-	-	13
May 2-02	2	-	1	-	11	2	2	4	-	-	5	4	4	-	5	6	5	2	2	-	-	2	2	1	10
May 9-02	1	2	-	6	12	3	-	-	2	-	3	8	10	6	4	2	1	2	2	1	-	1	7	2	12
May 16-02	3	-	1	5	14	5	2	4	3	3	2	2	7	2	2	5	1	-	-	2	-	-	2	3	5
May 23-02	1	1	1	2	6	-	-	1	5	-	1	7	1	2	3	1	1	2	3	4	1	5	3	2	3
Jun 13-02	1	-	-	-	3	2	1	-	3	-	2	10	-	2	6	-	7	3	1	-	-	-	-	-	-
Jun 27-02	2	1	-	-	6	3	4	7	-	-	-	9	6	6	4	-	7	5	1	1	-	-	2	2	23
Jul 4-02	1	-	1	1	8	1	1	-	1	2	-	2	-	-	1	1	-	2	2	-	-	2	-	-	3
Jul 10-02	-	-	-	-	2	-	-	-	1	-	1	-	2	1	-	1	-	2	1	-	-	-	-	6	8
Jul 18-02	1	-	-	-	7	2	1	5	1	1	1	2	5	2	6	1	4	2	2	1	1	-	-	10	7
Aug 1-02	1	-	-	-	2	11	1	1	6	-	2	2	3	4	2	-	3	2	-	-	-	1	1	2	5
Aug 8-02	-	-	2	-	4	-	-	1	-	-	-	1	-	-	-	-	1	1	-	-	-	-	-	1	5
Aug 15-02	-	2	2	2	4	-	1	10	1	-	2	6	3	4	4	3	3	1	-	-	-	-	2	4	10
Aug 22-02	1	1	-	1	4	3	-	6	1	2	2	12	2	10	10	2	6	2	6	-	2	-	-	2	10
Aug 29-02	2	3	3	7	9	2	2	2	6	-	3	13	8	2	3	12	2	-	4	2	-	18	-	7	25
Sep 5-02	-	-	-	-	9	2	-	3	-	-	-	9	2	3	8	-	3	2	2	-	-	5	-	1	6
Sep 12-02	5	-	-	-	4	2	3	-	-	-	3	4	5	3	2	2	13	4	-	2	1	-	1	4	6
Sep 19-02	1	-	1	1	3	1	-	2	-	-	-	2	1	1	-	-	-	-	-	-	-	5	2	-	5
Oct 3-02	-	-	2	3	7	-	-	-	-	8	4	2	3	3	3	2	2	1	-	1	-	-	1	5	6
Oct 10-02	2	-	1	3	6	2	-	7	-	-	-	5	3	2	3	1	8	2	-	-	-	2	5	1	3
Oct 17-02	9	2	1	6	7	2	1	5	-	-	6	8	4	2	2	2	4	1	2	2	-	3	4	3	4
Oct 24-02	2	-	-	2	8	2	3	-	3	-	-	8	5	-	3	3	2	-	-	2	-	1	1	2	7
Oct 31-02	5	-	-	-	4	2	2	3	-	1	3	4	6	2	8	4	4	3	2	3	-	1	2	2	8
Nov 7-02	3	-	-	8	-	1	5	5	32	28	13	16	13	3	10	3	3	7	2	-	3	3	2	4	7
Nov 14-02	2	1	-	2	5	-	1	-	1	-	7	-	5	4	8	5	5	2	2	3	-	1	-	3	4
Nov 21-02	1	-	-	-	8	1	-	2	-	-	-	1	1	-	-	-	3	-	-	-	-	-	1	1	15
Dec 3-02	-	-	-	4	8	-	-	-	-	-	2	3	-	-	4	2	1	-	1	-	-	-	-	-	-
Dec 5-02	1	-	-	-	8	1	1	-	1	-	7	6	1	5	2	6	1	-	-	-	-	-	2	3	14
Dec 14-02	3	-	-	1	6	1	2	6	4	1	5	4	3	4	6	2	5	7	-	-	-	1	1	2	11
Dec 26-02	-	-	1	-	3	2	-	-	-	-	3	-	-	2	5	-	2	-	-	-	-	4	-	1	4
Jan 2-03	2	1	-	2	8	2	-	-	1	1	9	7	3	2	1	5	3	3	-	-	-	1	-	7	10
Jan 9-03	1	-	-	5	4	2	-	3	-	-	2	4	3	2	3	2	3	2	-	-	-	3	4	2	9
Jan 16-03	5	1	1	-	3	2	3	-	-	1	5	4	6	2	4	8	2	2	-	-	-	-	2	2	8
TOTAL	80	19	26	71	265	84	53	90	96	61	124	193	144	115	182	97	117	74	40	31	8	68	60	108	325

Table 3. Total People on Cliff and Trails Above Intertidal Zone

Segment	1	2	3	4	5,6,7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Oct 2-01	4	2	9	7	8	4	11	2	1	-	2	7	1	-	-	-	-	-	-	-	2	2	1	2	1
Nov 14-01	5	3	5	2	20	5	2	2	2	-	-	2	2	1	-	-	1	-	1	-	-	-	-	-	-
Nov 25-01	3	2	5	2	14	8	7	2	3	-	6	-	3	6	12	2	7	3	5	2	-	2	4	5	9
Dec 6-01	5	4	4	6	23	6	8	4	3	-	6	4	2	7	4	-	2	3	-	2	-	2	3	-	4
Jan 4-02	6	8	23	16	19	6	4	-	-	-	-	2	-	1	6	-	-	3	-	-	-	2	6	4	2
Feb 25-02	6	10	12	12	5	6	2	-	4	3	3	3	-	20	-	-	3	-	-	5	-	3	3	7	3
Mar 21-02	3	8	-	-	38	2	2	-	2	-	3	1	2	-	2	-	-	-	-	-	-	-	2	20	15
Mar 28-02	6	10	6	3	10	8	-	6	6	6	2	-	2	2	-	3	1	-	-	-	2	3	-	-	-
Apr 4-02	23	6	-	-	6	-	2	2	1	-	-	-	1	-	6	-	1	-	-	-	-	3	-	7	6
Apr 11-02	17	3	6	5	11	6	1	4	-	1	-	1	1	-	-	-	-	-	-	1	3	4	5	1	6
Apr 18-02	7	4	7	-	31	5	8	4	3	-	6	4	2	2	1	-	-	-	-	-	-	2	3	2	4
Apr 25-02	8	4	3	-	39	8	9	3	4	-	2	7	1	-	2	-	-	-	-	-	3	2	4	5	4
May 2-02	8	5	11	-	27	10	8	-	-	-	3	1	2	-	12	-	3	-	0	-	-	2	-	2	2
May 9-02	12	12	5	8	24	3	2	4	5	1	-	5	-	1	-	-	-	-	-	-	-	-	1	1	2
May 16-02	10	5	7	2	6	2	4	10	-	-	2	2	-	2	-	3	-	-	-	1	5	2	2	2	2
May 23-02	4	5	10	3	10	5	2	2	8	2	-	1	-	-	2	-	-	-	-	5	2	3	2	1	2
Jun 13-02	2	4	3	-	27	4	2	-	4	-	2	2	-	1	2	-	-	-	-	-	-	-	-	2	4
Jun 27-02	3	6	4	-	28	6	2	4	4	2	5	2	-	3	4	-	-	2	2	2	5	-	-	2	7
Jul 4-02	10	7	6	8	57	8	2	2	4	8	-	2	-	-	-	-	-	2	2	1	1	3	3	3	10
Jul 10-02	7	4	6	5	8	6	7	1	1	1	2	18	1	1	-	-	2	-	-	-	-	1	3	4	4
Jul 18-02	12	10	12	3	38	16	4	3	3	-	7	15	-	5	2	2	2	-	-	1	2	-	22	4	4
Aug 1-02	8	12	10	6	30	-	-	8	3	5	3	5	-	2	2	-	-	-	1	1	1	10	2	-	-
Aug 8-02	9	10	12	3	16	10	2	1	4	2	2	4	3	3	2	2	1	-	-	-	2	5	3	4	2
Aug 15-02	13	6	12	6	22	2	4	4	3	-	2	-	7	4	2	2	-	-	-	-	-	-	-	4	4
Aug 22-02	8	6	13	9	25	8	-	7	4	3	2	-	2	4	2	1	3	1	2	7	2	5	3	2	2
Aug 29-02	9	5	7	5	66	6	13	5	3	-	-	9	3	2	3	2	-	-	-	-	3	11	-	2	12
Sep 5-02	-	-	3	6	31	7	-	8	4	2	-	4	-	2	-	-	2	3	-	2	2		4	3	5
Sep 12-02	10	7	4	6	20	5	4	2	-	-	1	1	1	4	3	-	-	3	1	2	2	2	3	3	-
Sep 19-02	12	15	4	7	15	3	3	4	1	3	-	1	1	6	14	1	-	-	2	-	-	3	2	6	10
Oct 3-02	5	4	3	10	18	4	3	1	4	3	2	1	6	3		2	1	-	2	2	1	1	2	3	3
Oct 10-02	9	6	3	5	22	7	4	1	2	2	3	4	-	3	-	-	-	-	1	1	2	2	-	-	-
Oct 17-02	15	7	4	9	30	7	5	-	3	2	1	2	-	-	60	12	7	3	3	2	2	2	1	5	5
Oct 24-02	6	3	4	2	19	13	8	7	8	1	2	-	4	4	8	1	7	-	-	-	-	2	1	3	7
Oct 31-02	11	5	4	2	23	6	1	7	3		2	1	1	3	2	2	-	1	-	-	-	3	2	1	3
Nov 7-02	12	8	7	5	5	7	10	11	11	14	6	4	1	3	2	3	1	2	2	-	2	1	1	2	1
Nov 14-02	4	5	3	3	32	7	1	2	3	2	1	2	-	4	-	-	3	3	-	-	2	5	2	1	4
Nov 21-02	10	5	3	6	14	8	7	3	1	4	-	-	-	2	-	-	1	2	1	4	1	6	6	16	5
Dec 3-02	8	6	5	10	25	5	4	5	3	2	3	5	3	2	7	7	2	4	2	2	1	3	2	2	1
Dec 5-02	5	4	5	3	12	6	3	3	5	-	2	-	8	1	-	2	2	2	2	1	-	4	3	8	1
Dec 14-02	11	9	13	7	21	3	5	2	1	2	6	5	3	-	4	-	-	-	-	-	-	1	-	3	5
Dec 26-02	2	1	8	5	11	2	1	-	1	-	-	-	-	-	1	2	-	1	2	1	-	1	1	3	3
Jan 2-03	13	11	6	3	32	8	5	7	3	2	8	14	-	2	2	3	2	2	2	2	-	2	2	-	-
Jan 9-03	11	5	6	5	11	3	-	1	-	1	1	2	3	1	1	-	2	2	2	-	-	4	1	2	4
Jan 16-03	7	12	8	5	32	6	-	1	1	-	2	1	1	-	2	2	-	2	2	2	3	8	1	3	2
TOTAL	359	274	291	210	981	257	172	145	129	74	100	144	67	107	172	54	56	44	37	49	51	117	106	150	170

Table 4. Total People on Rocks Above Intertidal Zone

Segment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Oct 2-01	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-
Nov 14-01	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-
Nov 25-01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec 6-01	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	4	-	-	2	3	-	-	-	-	-	-	-
Jan 4-02	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Feb 25-02	2	-	-	-	-	-	-	-	-	-	-	-	1	2	-	2	4	-	2	4	5	-	-	-	-	-	-
Mar 21-02	3	-	-	-	-	-	-	-	-	-	1	2	3	4	-	-	-	-	-	-	-	-	-	-	3	1	8
Mar 28-02	-	-	-	-	-	-	1	-	-	-	-	-	3	-	-	-	-	-	3	-	-	2	-	-	2	-	-
Apr 4-02	4	-	-	-	-	12	14	-	-	-	-	-	8	10	-	-	12	-	3	-	-	-	-	-	-	3	-
Apr 11-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Apr 18-02	4	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Apr 25-02	2	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
May 2-02	-	-	-	-	1	3	-	-	-	-	-	-	-	-	2	-	1	-	2	-	-	-	-	-	-	-	-
May 9-02	-	-	-	-	-	2	-	-	-	-	-	-	-	2	-	-	-	2	-	2	-	-	-	-	-	-	5
May 16-02	5	-	-	-	-	-	-	-	-	-	-	-	-	3	-	7	-	-	-	2	-	-	-	-	-	-	-
May 23-02	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	1	3	-	-	3	2
Jun 13-02	-	-	-	2	-	9	-	-	-	-	-	-	2	4	-	-	-	2	2	-	-	-	-	-	-	-	-
Jun 27-02	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jul 4-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-
Jul 10-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-
Jul 18-02	3	-	-	-	-	-	-	-	2	-	-	-	-	5	-	-	8	-	-	-	2	-	-	-	-	5	4
Aug 1-02	-	-	-	-	-	15	8	-	5	-	-	-	8	-	-	2	-	2	7	-	-	-	-	-	-	-	-
Aug 8-02	2	-	-	-	-	-	-	-	-	-	-	-	-	2	-	8	-	-	1	-	-	-	-	-	-	-	3
Aug 15-02	2	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2	2	9	7	-	-	-	-	-	-	7	8
Aug 22-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug 29-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	3	3	8	3	-	7	-	-	4
Sep 5-02	-	-	-	-	-	-	-	-	-	-	-	-	5	2	-	-	-	-	-	3	-	-	-	-	-	-	3
Sep 12-02	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	2	-	-	-	-	-	-	-
Sep 19-02	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct 3-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct 10-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct 17-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	12	-	-	-	-	-	-	-	-
Oct 24-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct 31-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	3
Nov 7-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nov 14-02	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-
Nov 21-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Dec 3-02	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	11	12	1	-	-	-	-	-	-	-	-
Dec 5-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec 14-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec 26-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jan 2-03	-	-	-	-	-	17	-	-	-	-	-	-	14	-	-	-	3	3	14	-	-	-	-	-	-	-	-
Jan 9-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	3	3	-	-
Jan 16-03	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	27	0	0	2	5	64	23	2	7	0	3	2	55	43	5	33	41	34	60	24	18	6	3	10	8	23	40

Table 5. Total People on Beach

Segment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Oct 2-01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nov 14-01	-	-	-	2	-	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nov 25-01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	4
Dec 6-01	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Jan 4-02	2	-	-	-	-	3	-	-	-	-	-	-	-	-	2	-	3	-	-	-	-	-	-	-	4	-	-
Feb 25-02	-	-	-	-	20	12	15	4	6	4	-	1	2	6	-	-	2	-	2	6	-	-	-	-	-	-	-
Mar 21-02	-	-	-	5	2	8	-	-	3	-	-	-	3	1	-	-	-	-	-	2	-	-	-	-	-	-	-
Mar 28-02	-	-	-	-	2	-	-	-	-	-	-	-	-	3	-	-	-	2	-	-	-	-	-	-	-	-	-
Apr 4-02	-	-	-	18	3	-	2	-	2	-	-	2	-	2	-	-	-	-	-	8	-	-	-	-	1	-	-
Apr 11-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Apr 18-02	-	-	-	-	11	11	-	3	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-
Apr 25-02	-	-	-	5	-	-	-	2	-	-	2	-	-	2	-	-	-	-	-	7	-	-	-	-	-	-	-
May 2-02	-	-	-	-	1	2	2	-	-	-	-	-	-	8	-	-	-	-	13	-	-	-	-	-	-	-	3
May 9-02	-	-	-	4	3	-	1	2	-	-	-	7	-	2	-	-	-	-	-	3	-	-	-	-	-	-	-
May 16-02	-	-	-	-	2	7	-	-	-	-	-	-	-	15	-	-	-	-	-	-	-	1	-	-	-	-	-
May 23-02	-	-	-	-	4	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Jun 13-02	-	-	-	10	-	10	-	-	-	-	-	2	-	2	-	-	-	-	-	-	-	4	-	-	-	-	-
Jun 27-02	-	-	-	6	8	-	-	5	2	-	-	-	-	6	-	-	-	-	-	6	-	-	-	-	8	-	-
Jul 4-02	-	-	-	-	-	-	-	-	2	-	-	-	-	2	-	-	-	-	-	-	-	4	-	-	-	-	-
Jul 10-02	-	-	-	-	6	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Jul 18-02	-	-	-	-	30	14	3	-	1	-	-	-	-	8	-	-	-	-	1	5	-	-	-	-	-	-	-
Aug 1-02	-	-	-	-	18	-	-	-	-	-	-	2	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug 8-02	-	-	-	8	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug 15-02	-	-	-	16	12	-	-	2	-	2	-	-	-	4	-	-	-	-	-	-	-	-	-	-	4	-	-
Aug 22-02	-	-	-	7	-	-	5	-	1	-	-	-	-	-	-	-	-	-	-	5	2	-	-	-	-	-	-
Aug 29-02	-	-	-	9	-	-	-	-	2	-	-	5	-	2	1	3	-	-	1	-	3	-	-	-	-	-	-
Sep 5-02	-	-	-	-	13	1	-	-	2	-	-	-	-	1	-	-	-	-	-	-	2	-	-	-	2	-	-
Sep 12-02	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	7	-	-	-	-	-	-	-	-	2	-
Sep 19-02	-	-	-	-	2	6	-	-	-	-	-	-	-	2	-	-	-	-	-	4	-	-	-	-	-	-	-
Oct 3-02	-	-	-	15	-	-	-	-	-	-	-	-	8	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Oct 10-02	-	-	-	-	1	3	-	-	-	-	-	3	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-
Oct 17-02	-	-	-	3	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct 24-02	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	1	4	-	-	-	-	-	-
Oct 31-02	-	-	-	-	4	8	-	-	-	-	-	2	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Nov 7-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-
Nov 14-02	-	-	-	2	-	3	-	-	1	-	-	-	-	1	-	-	-	-	5	-	-	-	-	-	-	-	-
Nov 21-02	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec 3-02	-	-	-	2	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec 5-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec 14-02	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	3	-	-	-	-	-	-	-	3	-	-
Dec 26-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	1	-	-	-	-	-	-	-
Jan 2-03	-	-	-	-	6	-	-	-	-	-	-	-	-	6	-	-	3	-	-	-	-	-	-	-	-	-	-
Jan 9-03	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	2	-	-	-	-	-	-	-
Jan 16-03	-	-	-	-	2	-	-	-	-	-	-	3	-	1	-	-	-	-	-	6	-	-	-	-	-	-	-
TOTAL	2	0	0	112	165	92	28	18	26	6	2	28	13	96	3	3	27	3	22	62	12	9	0	0	24	2	9

Table 6. Total People in Upper Rocky Intertidal Zone

Segment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Oct 2-01	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nov 14-01	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nov 25-01	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	4	-	1	-	3	2	-	-	-	-	-
Dec 6-01	-	-	-	-	10	-	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-	-	-	-	-	-	-
Jan 4-02	2	-	-	-	-	3	-	-	-	-	-	-	-	2	-	-	3	-	-	-	-	-	-	-	2	-	-
Feb 25-02	2	-	-	-	-	-	-	-	-	-	-	-	2	2	-	2	2	1	-	-	-	-	-	-	-	-	-
Mar 21-02	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mar 28-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Apr 4-02	7	-	-	-	-	11	-	-	-	-	-	2	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-
Apr 11-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Apr 18-02	7	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Apr 25-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May 2-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May 9-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May 16-02	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May 23-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jun 13-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jun 27-02	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
Jul 4-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2	-	-	-	-	-	-	-
Jul 10-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jul 18-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug 1-02	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug 8-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug 15-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug 22-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	6	-	-	-	-	-	-	8	-
Aug 29-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sep 5-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sep 12-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sep 19-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct 3-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct 10-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct 17-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct 24-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct 31-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nov 7-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nov 14-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nov 21-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec 3-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec 5-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec 14-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec 26-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jan 2-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jan 9-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jan 16-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	25	0	0	0	10	16	6	2	0	0	0	2	6	7	4	5	11	7	7	2	3	2	0	0	2	8	0

Table 7. Total People in Mid Rocky Intertidal Zone

Segment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Oct 2-01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nov 14-01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nov 25-01	-	2	-	-	-	6	-	-	-	-	-	-	-	4	3	4	6	2	6	3	2	-	-	-	-	-	-
Dec 6-01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jan 4-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Feb 25-02	3	-	-	-	-	-	-	-	-	-	-	-	1	4	-	3	18	7	6	2	-	2	-	-	-	-	-
Mar 21-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mar 28-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Apr 4-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Apr 11-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Apr 18-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Apr 25-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May 2-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May 9-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May 16-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May 23-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jun 13-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jun 27-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jul 4-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jul 10-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jul 18-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug 1-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug 8-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug 15-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug 22-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug 29-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sep 5-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sep 12-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sep 19-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct 3-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct 10-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct 17-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct 24-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct 31-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nov 7-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nov 14-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nov 21-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec 3-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec 5-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec 14-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec 26-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jan 2-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jan 9-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jan 16-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	3	2	0	0	0	6	0	0	0	0	0	0	1	8	3	7	24	9	12	5	2	2	0	0	0	0	0

Table 8. Total People in Low Rocky Intertidal Zone

Segment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Oct 2-01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nov 14-01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nov 25-01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec 6-01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jan 4-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Feb 25-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	4	3	-	-	-	-	-	-	-
Mar 21-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mar 28-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Apr 4-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Apr 11-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Apr 18-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Apr 25-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May 2-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May 9-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May 16-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May 23-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jun 13-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jun 27-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jul 4-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jul 10-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jul 18-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug 1-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug 8-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug 15-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug 22-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug 29-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sep 5-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sep 12-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sep 19-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct 3-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct 10-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct 17-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct 24-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct 31-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nov 7-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nov 14-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nov 21-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec 3-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec 5-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec 14-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec 26-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jan 2-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jan 9-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jan 16-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	4	3	0	0	0	0	0	0	0

Table 9. Total Fishers

Segment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Oct 2-01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nov 14-01	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nov 25-01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec 6-01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jan 4-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Feb 25-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mar 21-02	-	-	-	-	-	-	1	-	-	2	-	1	-	-	-	1	-	-	-	1	1	-	-	-	-	1	-
Mar 28-02	-	-	-	-	-	-	-	-	1	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Apr 4-02	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Apr 11-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Apr 18-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Apr 25-02	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	6	3	-	-	-	-	-	-	-	-	-	-
May 2-02	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	1	-	-	-	-	-	-	-	-	-	-	-
May 9-02	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May 16-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May 23-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
Jun 13-02	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-
Jun 27-02	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jul 4-02	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jul 10-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jul 18-02	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug 1-02	-	-	-	-	-	-	-	1	-	-	-	-	-	2	2	2	-	-	-	-	-	-	-	-	-	-	-
Aug 8-02	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug 15-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug 22-02	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug 29-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sep 5-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Sep 12-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sep 19-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct 3-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct 10-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-
Oct 17-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct 24-02	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct 31-02	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Nov 7-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nov 14-02	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nov 21-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Dec 3-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec 5-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec 14-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec 26-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jan 2-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jan 9-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jan 16-03	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	0	0	0	0	5	5	1	4	1	6	6	4	6	4	2	18	3	1	1	1	1	0	0	0	0	1	0

Table 10. Point Pinos Segment Counts

	Total People in CARS			Total People on Embankment, Trails			Total People on Rocks Above Intertidal Zone			Total People on Beach				Total People in Upper Rocky Intertdidal			Total People in Mid Rocky Intertidal			Total People in Low Rocky Intertidal		
Date	Mar25-02	Dec18-01	Nov30-01	Mar25-02	Dec18-01	Nov30-01	Mar25-02	Dec18-01	Nov30-01	Mar25-02	Dec18-01	Nov30-01		Mar25-02	Dec18-01	Nov30-01	Mar25-02	Dec18-01	Nov30-01	Mar25-02	Dec18-01	Nov30-01
Segment / Time	12:30-14:00	12:05-13:30	14:30-15:35	12:30-14:00	12:05-13:30	14:30-15:35	12:30-14:00	12:05-13:30	14:30-15:35	12:30-14:00	12:05-13:30	14:30-15:35		12:30-14:00	12:05-13:30	14:30-15:35	12:30-14:00	12:05-13:30	14:30-15:35	12:30-14:00	12:05-13:30	14:30-15:35
13	14	6	-	16	4	8	24	3	-	2	-	-	-	6	-	-	-	-	-	-	-	-
14	8	2	-	6	-	6	-	3	6	4	-	-	-	-	-	-	-	-	-	-	-	-
15	8	3	-	8	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	6	4	2	6	3	6	-	2	2	-	-	-	-	-	-	4	-	-	-	-	-	-
17	10	2	4	-	-	-	8	3	4	-	-	3	-	-	-	7	-	-	3	2	-	-
18	8	-	2	-	-	2	-	-	-	-	-	5	-	-	-	1	-	-	1	-	-	-
19	12	2	-	-	1	-	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-
20	-	3	1	10	3	4	-	4	2	-	4	-	-	-	-	2	-	-	-	-	-	-
21	-	1	1	4	2	2	-	2	4	-	-	-	-	-	-	6	-	-	2	-	-	-
22	-	-	-	2	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-

Table 11. Number of People in 'Active' Tidepool Behaviors

	Rocky Intertidal Zone			
	Up	Mid	Low	Total
Oct2-01	2	-	-	2
Nov14-01	6	-	-	6
Nov25-01	4	27	-	31
Nov30-01	10	6	-	16
Dec6-01	5	-	-	5
Feb25-02	4	45	15	64
Mar25-02	6	-	2	8
May16-02	3	-	-	3

Table 12. Field Interviews

Date:	11/25/01	11/30/01	12/18/01	12/18/01
Time:	14:15	14:45	12:20	12:35
Residence:	Hanford, CA	Palo Alto, CA	San Luis Obispo, CA	Salinas, CA
First visit?	No	No	No	No
Do you plan to come back?	Yes	Yes	Yes	Yes
How many days do you visit Point Pinos per year?	3	5	2	20
How long is each visit typically? (hours)	2	3	2	2
What day do you usually come?	wkends, hol./vac.	wkends, hol./vac.	wkends	all days of week
What time do you usually come?	lunch, afternoon	lunch, afternoon	lunch, afternoon	lunch, afternoon
What area do you spend most time?	beach, tidepools	shore cliff, tidepools	beach, tidepools	beach, tidepools
Why do you usually come? (see legend below)	A, B, D	A, B, D	A, B, C, D, E, G	A, B, D
How far out do you usually go?	mid-intertidal	mid-intertidal	low-intertidal	mid-intertidal
Does it matter if it is low tide?	No	Yes	Yes	No
What do you like best about Point Pinos? (see legend below)	1, 2, 3, 4, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	1, 2, 3, 4
Did you know this was a Marine Life Protected Area?	Yes	Yes	No	Yes
Have you seen the signs explaining tidepool etiquette?	No	Yes	No	No
Where else do you tidepool?	None	Fitzgerald Marine Reserve	Southern California, San Diego, Long Beach	Nowhere else
Comments:	Great place	Enjoy variety; close to San Francisco Bay Area	Glad to hear tidepools are being protected, and education about sea creatures	Love living close to coast

Why do you usually come?
A: Picnic
B: Photo/sightseeing
C. Kill time/relax
D. Tidepooling
E. Collecting
F. Dive/kayak
G. Bike/jog/walk
H. Fish

What do you like best about Point Pinos?
1. Ease of access
2. Scenic beauty
3. Diveristy of marine life
4. Clean environment
5. Proximity to other attractions

Table 12 (continued). Field Interviews

Date:	1/4/02	1/4/02	2/25/02	3/30/02
Time:	10:30	11:35	14:30	12:25
Residence:	Fresno, CA	Sacramento, CA	Pismo Beach, CA	Visalia, CA
First visit?	No	No	Yes	No
Do you plan to come back?	Yes	Yes	Yes	Yes
How many days do you visit Point Pinos per year?	5-6	3	1	3
How long is each visit typically? (hours)	2	4	2	2
What day do you usually come?	all days of week	wkends, hol./vac.	hol./vac.	wkends, wkdays
What time do you usually come?	morning, afternoon	morning, afternoon	afternoon	lunch
What area do you spend most time?	beach, tidepools	beach, tidepools	cliff, beach	cliff, beach, tidepools
Why do you usually come? (see legend below)	A, B, D	A, C, D	B, C	B, C
How far out do you usually go?	mid-intertidal	high and mid-intertidal	high-on beach	mid-intertidal
Does it matter if it is low tide?	Yes	No	No	No
What do you like best about Point Pinos? (see legend below)	1, 2, 3, 4	1, 2, 3, 4, 5	1, 2, 4	2, 3, 4
Did you know this was a Marine Life Protected Area?	Yes	No	No	Yes
Have you seen the signs explaining tidepool etiquette?	No	No	No	Yes
Where else do you tidepool?	Santa Cruz	No comment	L.A. to San Diego	Morro Bay, Pismo Beach
Comments:	Like the peninsula	No comment	Happy to see interpretive service (Bay Net)	Great area; family lives here; honeymoon in 1958

Why do you usually come?
A: Picnic
B: Photo/sightseeing
C. Kill time/relax
D. Tidepooling
E. Collecting
F. Dive/kayak
G. Bike/jog/walk
H. Fish

What do you like best about Point Pinos?
1. Ease of access
2. Scenic beauty
3. Diveristy of marine life
4. Clean environment
5. Proximity to other attractions

Table 12 (continued). Field Interviews

Date:	5/3/02	5/4/02	5/18/02	5/20/02
Time:	11:20	14:05	11:25	13:05
Residence:	San Jose, CA	Sacramento, CA	San Jose, CA	Salinas, CA
First visit?	No	No	Yes	No
Do you plan to come back?	Yes	Yes	Yes	Yes
How many days do you visit Point Pinos per year?	2-5	1-2	1	5-6
How long is each visit typically? (hours)	2	1-2	1-2	1-2
What day do you usually come?	wkends, hol./vac.	wkends, hol./vac.	wkends	all days of week
What time do you usually come?	morn., lunch, afternoon	lunch, afternoon	morning	lunch, afternoon, after work
What area do you spend most time?	beach, tidepools	beach, tidepools	cliff, beach	cliff, beach
Why do you usually come? (see legend below)	B, D	A, B, D, G	A, B	A, B, C , G
How far out do you usually go?	mid-intertial	mid-intertidal	high-on beach	high-on beach
Does it matter if it is low tide?	No	No	No	No
What do you like best about Point Pinos? (see legend below)	1, 2, 3, 4, 5	1, 2, 3, 4, 5	1, 2, 4, 5	1, 2, 3, 4,5
Did you know this was a Marine Life Protected Area?	Yes	Yes	No	Yes
Have you seen the signs explaining tidepool etiquette?	Yes	No	No	Yes
Where else do you tidepool?	Fitzgerald Marine Reserve	Pt. Lobos, Santa Cruz	No comment	Pt. Lobos, Lover's Pt.
Comments:	Great place for familiies	Appreciate Bay Net and support conservation of tidepools	Wonderful place	Glad to see we're taking care of the coast

Why do you usually come?
A: Picnic
B: Photo/sightseeing
C. Kill time/relax
D. Tidepooling
E. Collecting
F. Dive/kayak
G. Bike/jog/walk
H. Fish

What do you like best about Point Pinos?
1. Ease of access
2. Scenic beauty
3. Diveristy of marine life
4. Clean environment
5. Proximity to other attractions

Table 12 (continued). Field Interviews

Date:	5/20/02	6/4/02	6/4/02	7/2/02
Time:	13:28	12:05	13:15	10:45
Residence:	London, England	Greenfield, CA	Taipei, Taiwan	Salinas, CA
First visit?	Yes	No	Yes	No
Do you plan to come back?	Yes	Yes	Maybe	Yes
How many days do you visit Point Pinos per year?	1	2-3	1	8-10
How long is each visit typically? (hours)	2	1	2	2
What day do you usually come?	wkdays	wkends, hol./vac.	hol./vac.	wkends, hol./vac.
What time do you usually come?	afternoon	morn., lunch, afternoon	afternoon	morn., afternoon, after work
What area do you spend most time?	beach, tidepools	beach, tidepools	cliff, beach	beach, tidepools
Why do you usually come? (see legend below)	B, D, G	A, C, D, E , G	B	A, B, C, D, G
How far out do you usually go?	mid-intertidal	mid-intertidal	high-on beach	low-intertidal
Does it matter if it is low tide?	Yes	No	No	Yes
What do you like best about Point Pinos? (see legend below)	1, 2, 3, 4	1, 2, 3, 4, 5	1, 2, 4, 5	1, 2, 3, 4
Did you know this was a Marine Life Protected Area?	No	Yes	No	Yes
Have you seen the signs explaining tidepool etiquette?	No	No	No	Yes
Where else do you tidepool?	Nowhere else yet	Pt. Lobos	Nowhere else yet	Santa Cruz (Natural Bridges), Lovers Pt., So. Calif.
Comments:	Appreciate Bay Net volunteers	Love ocean marine life; cooler weather than Salinas Valley	Happy to see beauty and wildlife (deer, birds, etc)	Great place for kids and visiting friends and relatives; appreciate Bay Net

Why do you usually come?
A: Picnic
B: Photo/sightseeing
C. Kill time/relax
D. Tidepooling
E. Collecting
F. Dive/kayak
G. Bike/jog/walk
H. Fish

What do you like best about Point Pinos?
1. Ease of access
2. Scenic beauty
3. Diveristy of marine life
4. Clean environment
5. Proximity to other attractions

Table 12 (continued). Field Interviews

Date:	10/6/02	11/17/02
Time:	16:05	14:00
Residence:	Fresno, CA	Fresno, CA
First visit?	No	No
Do you plan to come back?	Yes	Yes
How many days do you visit Point Pinos per year?	2-3	3-4
How long is each visit typically? (hours)	2	2-3
What day do you usually come?	wkends	wkends, hol./vac.
What time do you usually come?	afternoon	lunch, afternoon
What area do you spend most time?	cliff, beach	beach, tidepools
Why do you usually come? (see legend below)	A, B	B, D
How far out do you usually go?	high-on beach	mid-intertidal
Does it matter if it is low tide?	No	Yes
What do you like best about Point Pinos? (see legend below)	1, 2, 3, 4, 5	1, 2, 3, 4, 5
Did you know this was a Marine Life Protected Area?	Yes	Yes
Have you seen the signs explaining tidepool etiquette?	No	Yes
Where else do you tidepool?	no comment	Pt. Lobos, Asilomar
Comments:	Glad to see Bay Net presence	Great for kids

Why do you usually come?
A: Picnic
B: Photo/sightseeing
C. Kill time/relax
D. Tidepooling
E. Collecting
F. Dive/kayak
G. Bike/jog/walk
H. Fish

What do you like best about Point Pinos?
1. Ease of access
2. Scenic beauty
3. Diveristy of marine life
4. Clean environment
5. Proximity to other attractions

Table 13. Fisher Interviews

Date:	11/14/01	12/6/01	3/19/01
Time:	16:55	10:20	17:20
Segment ID	13	8	10
Where from:	Santa Maria, CA	Seaside, CA	Marina, CA
What are you fishing for?	Have caught 3 rainbow surfperch	rockfish, cabezon, surfperch	anything
How many days do you usually fish here?	not asked	50+ visits per year	52
When do you usually fish?	not asked	morning, afternoon	all times of the day
How long do you usually fish?	not asked	4 hrs per visit	2+ hrs per visit
Where do you get bait?	store	store	store
What type of bait do you usually use?	mussels	fish, squid	anchovies

Attachment 1 – CDF&G, Asilomar, and Pacific Grove Police Enforcement Records

2000 Violations are for Marine Region and Region 3 Wardens Working Monterey County

Date	Violation	Location	Evidence
01/00	F&G - 10500(c) - take of invertebrates	Pacific Grove Fish Refuge	Starfish &crabs
01/00	F&G - 10500(c) - take of invertebrates	Pacific Grove Fish Refuge	(2) abalone (1)sea slug
01/00	F&G - 10500(c) - take of invertebrates T14 - 29.15(a) - take abalone F&G - 7145 - no fishing license	Pacific Grove Fish Refuge	(7) abalone
01/00	F&G - 10500(c) - take invertebrates F&G - 7145 - no fishing license	Pacific Grove Fish Refuge	(165) limpets
02/00	F&G - 10500(c) - take invertebrates	Pacific Grove Fish Refuge	(420) turban snails
03/00	F&G - 10500(c) - take invertebrates	Pacific Grove Fish Refuge	(280) turban snails
05/00	T14 - 29.05(a) - over limit invertebrates F&G - 7145 - no fishing license	Mill Creek	(698) limpets
05/00	T14 - 29.05(a) - over limit invertebrates F&G - 7145 - no fishing license	Mill Creek	(597) limpets
06/00	F&G - 10500(c) - take of invertebrates	Pacific Grove Fish Refuge	(81) turban snails
08/00	T14 - 29.05(b)(1) - take of invertebrates	Garrapata State Parks	(20) limpets
08/00	T14 - 29.05(b)(1) - take of invertebrates	Garrapata State Parks	(20) limpets
08/00	T14 - 29.05(b)(1)- take of invertebrates F&G - 7145 - no fishing license	Garrapata State Parks	(308) limpets 30#s mussels
11/00	F&G - 10500(f) - fishing closed area	Hopkins Marine Life Refuge	None
12/00	F&G - 5521 take abalone closed area F&G - 7145 no fishing license PC - 148	Rocky Point	(15) abalone (39) sea urchins
12/00	F&G - 5521 take abalone closed area F&G - 7145 no fishing license	Mill Creek	(2) abalone (10) mussels
12/00	T14 - 29.55 - over limit mussels	Sobranes Point	5#s

Attachment 1 (continued) – CDF&G, Asilomar, and Pacific Grove Police Enforcement Records

June 21, 1999

To Carl Miller
Pacific Grove Police Dept

From: Ranger Roxann Jacobus
Asilomar Park Ranger

Per your request, the number of Fish & Game violations within the PG Marine Refuge cited by Asilomar Rangers.

Year	F&G 7145	F&G 10500f	F&G 2000	F&G 2002	F&G 1052b
1991	19	26	0	0	0
1992	8	10	0	0	0
1993	7	12	1	1	0
1994	17	20	0	0	0
1995	17	19	0	0	0
1996	10	8	0	0	0
1997	9	8	0	0	1
1998	6	5	0	0	0
Total	**93**	**108**	**1**	**1**	**1**

Violation description
- F&G 7145 - No fishing license in possession
- F&G 10500f - Take and/or possess marine invertebrates inside the PG Marine Refuge
- F&G 2000 - Unlawful take of marine life
- F&G 2002 - Unlawful take of marine life
- F&G 1052b - Nonresident fishing with a resident license

Post-it™ Fax Note 7671	Date 6/21 # of pages ▶ 1
To Carl Miller	From Roxann Jacobus
Co./Dept PGPD	Co. Asilomar Rangers
Phone #	Phone # 372-4076
Fax # 373-4464	Fax # [illegible]

TOTAL P.01

Attachment 1 (continued) – CDF&G, Asilomar, and Pacific Grove Police Enforcement Records

Date 08/07/01

To: Carl Miller
From: Asilomar State Park Rangers
Re: F&G violations 1998-to present

1998 - 2 violations

May 1998 F&G 10500c -- Illegal take of mussels, turban snails in PG Marine Garden Refuge Asilomar State Beach

May 1998 F&G 10500c -- Illegal take of mussels, turban snails in PG Marine Garden Refuge Asilomar State Beach

1999 - no PG Marine Garden Refuge violations to report

2000 - no PG Marine Garden Refuge violations to report

2001 - 5 violations

April 2001 F&G 10500c - Illegal take of mussels in PG Marine Garden Refuge Asilomar State Beach

April 2001 F&G 10500c - Illegal take of mussels in PG Marine Garden Refuge Asilomar State Beach

May 2001 F&G 10500c - Illegal take of mussels in PG Marine Garden Refuge Asilomar State Beach

May 2001 F&G 10500c - Illegal take of mussels in PG Marine Garden Refuge Asilomar State Beach

May 2001 F&G 10500c - Illegal take of abalone and limpets in PG Marine Garden Refuge Asilomar State Beach

Attachment 1 (continued) – CDF&G, Asilomar, and Pacific Grove Police Enforcement Records

PACIFIC GROVE POLICE DEPARTMENT MEMORANDUM

DATE: July 30, 2001

TO: Capt. Carl Miller

FROM: Sylvia Newton

RE: Marine Refuge Violation

As discussed, Marine Refuge illegal take violation investigated by the Pacific Grove Police Department between 07/01/00 to 07/26/01 were:

Dates	Number Cited	Total Take	Disposition
07/01/00 to 12/31/00	3	70 turbin snails & 20 rock crabs	Returned to ocean
01/01/01 to 07/26/01	0	N/A	N/A

In addition to the above, the Pacific Grove Police Department responded to 33 separate incidents between 07/01/00 to 07/26/01 involving the Marine Refuge with the following results:

Verbal warnings –	6
GOA/UTL –	5
FI's –	2
Unfounded –	15
Followed-up for State Parks or Fish & Game –	5*

*1 citation was issued for State Parks. Total take and disposition for all contacts is unknown.

Please see me if you have any questions or concerns.

Attachment 1 (continued) – CDF&G, Asilomar, and Pacific Grove Police Enforcement Records

PACIFIC GROVE POLICE DEPARTMENT MEMORANDUM

November 1, 1999

TO: Coalition to Preserve & Restore Pt. Pinos Tidepools

FROM: Captain Carl Miller

SUBJECT: Marine Refuge Violations

As discussed, Marine Refuge illegal take violations investigated by the Pacific Grove Police Department since **07/04/97** were:

Dates	*Number cited*	*Total take*	*Disposition*
07/04/97 to 12/31/97	3	117 Mussels, 139 Limpets, 1 crab	Aquarium
01/01/98 to 12/31/98	3	104 Mussels, 884 Snails, 6 crabs,25 other	Aquarium
01/01/99 to 06/18/99	9	170 Mussels, 2,300 Snails, 3 other	Returned Ocean
06/19/99 to 07/31/99	4	50 Mussels, 60 Snails,	Returned to Ocean
08/01/99 to 08/31/99	1	1 crab	Returned to Ocean
09/01/99 to 09/30/99	0	3 warnings (unknown animals, but all returned to Ocean)	
10/01/99 to 10/31/99	0	2 warnings (unknown animals, but all returned to Ocean)	

Please call me if you have any questions or concerns.

Thank You,

Carl Miller
Captain

Attachment 1 (continued) – CDF&G, Asilomar, and Pacific Grove Police Enforcement Records

PACIFIC GROVE POLICE DEPARTMENT MEMORANDUM

DATE: November 26, 2002

TO: Capt. Carl Miller

FROM: Sylvia Newton, Records Supervisor

RE: Marine Refuge Violations

As discussed, Marine Refuge illegal take violations investigated by the Pacific Grove Police Department between 11/01/99-12/31/99, 01/01/00-06/30/00, 07/26/01-12/31/01 and 01/01/02-11/18/02 were:

Dates	Number Cited	Total Take	Disposition
11/01/99 – 12/31/99	0	0	
01/01/00 – 06/30/00	0	0	
07/26/01 – 12/31/01	0	0	
01/01/02 – 11/18/02	1	5 starfish	Returned to Ocean

In addition to the above, the Pacific Grove Police Department responded to 39 incidents during those dates with the following results:

Verbal or written warning –	12
GOA/UTL –	4
FI's –	2
Unfounded –	17
Followed-up for State Parks or Fish & Game –	4*

*Total take and disposition for contacts is unknown.

Please see me if you have any questions or concerns.

Attachment 2 - Bay Net Advisories

Date:	11/14/01	11/25/01	11/25/01	11/30/01	12/6/01	1/17/02
Time:	16:15	14:15	14:30	14:40	10:20	15:15
Were you able to talk with the person(s)?	Yes	Yes	Yes	Yes	Yes	Yes
No. people:	3	?	3	5	2	2
Segment ID of occurrence	7	13	16	16	19	6
Activity:	A	H: feeding gulls	A,B,F,G	A,B,C,D,F,G	A,B,C,D,F,G	A,B,D,F,G
Organisms collected and approximate number:	Pisaster-several mussels-dozen crab-1	N/A	Asterina-1 Pisater-1 urchins-1 shore crabs-3	Asterina-1 hermit crabs-5 shore crabs-2	urchins-2 hermit crabs-3 turban snails-5	sea stars-3 crabs-6 turban snails-3
Reason(s) for collecting animals:	6	N/A	5	5	5	5
Were the organisms/materials returned?	Yes	N/A	Yes	Yes	Yes	Yes
Reason(s) for collecting seaweeds:	N/A	N/A	5	5	5	N/A
Presence of collecting equipment:	Yes	N/A	Yes	buckets, dip nets	buckets	Yes
Did they know Pt. Pinos was a protected area?	No	N/A	No	No	No	No
Had they seen the tidepool etiquette signs?	No	N/A	No	No	No	No
Cooperative?	Yes	Yes	Yes	Yes	Yes	Yes
Notes:		Feeding french fries, chips to gulls and squirrels	Visiting from Arkansas. Saw Monterey Bay Aquarium. Wanted to take animals home.	From China. Looking for souvenirs	From so. Calif. Happy to see more tidepools than so. Calif.	From S. Carolina

Activity
A. Collecting animals
B. Collecting shells
C. Collecting algae
D. Collecting rocks
E. Collecting something, but couldn't tell
F. Turning rocks
G. Handling animals
H. Feeding animals

Reasons for collecting
1. Food
2. Bait
3. Aquaria
4. Scientific collecting
5. Show and tell
6. No reason
7. Did not talk with them

Attachment 2 (continued) - Bay Net Advisories

Date:	1/27/02	1/29/02	2/25/02	3/8/02	3/8/02	3/24/02
Time:	14:30	11:30	15:15	16:10	16:15	13:30
Were you able to talk with the person(s)?	Yes	Yes	Yes	Yes	Yes	Yes
No. people:	3	2	5	2	1	3
Segment ID of occurrence	17	5	16	6	?	17
Activity:	A,B,D,F,G	H: feeding gulls	A,B,C,D,F,G	B,F,G	B,F	A,F,G
Organisms collected and approximate number:	sea stars-1 crabs-5	N/A	Asterina-2 Pisaster-1 Leptasterias-1 shore crabs-3 hermit crabs-5	N/A	N/A	Asterina-5 rock crab-1 (approx. 10 in)
Reason(s) for collecting animals:	5	N/A	5	N/A	N/A	1,5
Were the organisms/materials returned?	Yes	N/A	Yes	N/A	N/A	Yes
Reason(s) for collecting seaweeds:	5	N/A	5	N/A	N/A	N/A
Presence of collecting equipment:	buckets, dip nets	N/A	buckets, dip nets	No	No	screw driver
Did they know Pt. Pinos was a protected area?	No	N/A	No	No	Yes	No
Had they seen the tidepool etiquette signs?	No	N/A	No	No	Yes	No
Cooperative?	Yes	Yes	Yes	Yes	No	Yes
Notes:	Couple with daughter from Fremont, CA	-	From San Jose with friends from Mexico, collecting for souvenirs	German tourists collecting for souvenirs	Claims she had been collecting for 20+ years. Signs don't say to not collect shells	Chinese (Taiwan) planning to eat crab, stars for display

Activity
A. Collecting animals
B. Collecting shells
C. Collecting algae
D. Collecting rocks
E. Collecting something, but couldn't tell
F. Turning rocks
G. Handling animals
H. Feeding animals

Reasons for collecting
1. Food
2. Bait
3. Aquaria
4. Scientific collecting
5. Show and tell
6. No reason
7. Did not talk with them

Bay Net Advisories: Page 2 of 6

Attachment 2 (continued) - Bay Net Advisories

Date:	4/21/02	4/21/02	5/3/02	5/3/02	5/4/02	5/18/02
Time:	?	?	11:30	11:45	13:10	11:00
Were you able to talk with the person(s)?	No	Yes	Ys	Yse	Yes	Yes
No. people:	5	1	3	1	6	3
Segment ID of occurrence	6	6	14	14	6	14
Activity:	A	A	A,B,C,D,F,G	B,C,D,F	H	A,B,C,D,F,G
Organisms collected and approximate number:	Pisaster-1 Asterina 3-5	Asterina-5	brittle stars-2 shore crabs-1 hermit crabs-2 turban snails 3	N/A	N/A	Asterina-1 shore crabs-2 hermit crabs-3 turban snails-10
Reason(s) for collecting animals:	5	5	5	?	N/A	5
Were the organisms/materials returned?	Yes	Yes	Ys	Yes	N/A	Yes
Reason(s) for collecting seaweeds:	N/A	N/A	5	5	N/A	5
Presence of collecting equipment:	?	No	plastic bags, tray	plastic cup	N/A	plastic cups
Did they know Pt. Pinos was a protected area?	Did not interview	No	No	Yes	N/A	No
Had they seen the tidepool etiquette signs?	Did not interview	No	No	No	N/A	No
Cooperative?	Did not interview	No	Yes	Yes	Yes	Yes
Notes:	They were cited by the P.G. Police	Ignored request to return animals until I pointed to P.G. officer citing other family	From San Jose and first time to Point Pinos	Thought collecting animals was prohibited	From San Jose. Feeding chips and bread to gulls. Asked what's best to feed them	From Sacramento; been coming for many years

Activity
A. Collecting animals
B. Collecting shells
C. Collecting algae
D. Collecting rocks
E. Collecting something, but couldn't tell
F. Turning rocks
G. Handling animals
H. Feeding animals

Reasons for collecting
1. Food
2. Bait
3. Aquaria
4. Scientific collecting
5. Show and tell
6. No reason
7. Did not talk with them

Attachment 2 (continued) - Bay Net Advisories

Date:	5/20/02	6/4/02	6/15/02	7/2/02	7/2/02	7/12/02
Time:	12:10	12:30	10:15	10:35	11:05	4:30
Were you able to talk with the person(s)?	Yes	Yes	Yes	Yes	Yes	Yes
No. people:	2	4	3	5	2	2
Segment ID of occurrence	16	17	14	6	6	19
Activity:	H	A,B,C,D,F,G	B,C,D,F,G	B,C,D,F,G	A,B,C,F,G	A
Organisms collected and approximate number:	N/A	Asterina-3 Pisaster-1 urchins-1 Mimulus-1 shore crabs-1 hermit crabs-3 turban snails-5 tidepool sculpin	N/A	N//a	Asterina-1 hermit crabs-1 shore crabs-2 turban snails-3	None yet
Reason(s) for collecting animals:	N/A	5	N/A	5	5	1
Were the organisms/materials returned?	N/A	Yes	N/A	Yes	Yes	N/A
Reason(s) for collecting seaweeds:	N/A	5	Yes	5	5	N/A
Presence of collecting equipment:	N/A	plastic bags	plastic bags	buckets	buckets, dip nets	knife=8 in blade
Did they know Pt. Pinos was a protected area?	N/A	Yes	Yes	Yes	No	Yes
Had they seen the tidepool etiquette signs?	N/A	No	?	No	No	No
Cooperative?	Yes	?	?	Yes	Yes	Yes
Notes:	Feeding entire loaf of bread to gulls	Intended to release animals before leaving. Said that even relocating can be disturbing.	Thought it was OK to collect non-living shells and algae	Did not collect live animals. Thought shells and plants were OK.	From Fresno visiting first time to Lover's Pt.	During biol. sampling. Still dark. Man & wife (Bakersfield) to collect crabs, but thought meant abalone. Holding knife. Asked what we were hunting.

Activity
A. Collecting animals
B. Collecting shells
C. Collecting algae
D. Collecting rocks
E. Collecting something, but couldn't tell
F. Turning rocks
G. Handling animals
H. Feeding animals

Reasons for collecting
1. Food
2. Bait
3. Aquaria
4. Scientific collecting
5. Show and tell
6. No reason
7. Did not talk with them

Bay Net Advisories: Page 4 of 6

Attachment 2 (continued) - Bay Net Advisories

Date:	8/10/02	8/12/02	9/2/02	9/11/02	10/6/02	10/6/02
Time:	10:20	11:10	13:05	14:30	15:00	15:30
Were you able to talk with the person(s)?	Yes	Yes	Yes	Yes	No	Yes
No. people:	2	2	3	5	8	5
Segment ID of occurrence	6	20	6	13	20	13
Activity:	A,B,C,F,G	A,B,C,D,F,G	A,B,C,F,G	H	E,F,G	A,B,C,D,F,G
Organisms collected and approximate number:	Asterina-2 urchins-1 shore crab-2 hermit crab-3 turban snails-1 tidepool sculpin-1	seastar-1 urchin-2 porcelain crab-2 hermit crab-3 turban snail-5	hermit crabs-8 shore crabs-1	N/A	couldn't see	Asterina-5 urchins-2 rock crab-1 (8 in) turban snails-50+
Reason(s) for collecting animals:	5	5	5	N/A	no interview	1,5
Were the organisms/materials returned?	Yes	Yes	Yes	N/A	not certain	Yes
Reason(s) for collecting seaweeds:	5	5	5	N/A	no interview	5
Presence of collecting equipment:	buckets, dip nets	Yes	Yes	N/A	plastic bags	buckets
Did they know Pt. Pinos was a protected area?	Yes	No	No	N/A	no interview	No
Had they seen the tidepool etiquette signs?	No	No	No	N/A	no interview	No
Cooperative?	Yes	No	Yes	Yes	no interview	Yes
Notes:	From San Jose. Just looking and planned to return all animals.	From Sacramento. Complained of poor/non-existent signage. Doing this for years (2-3 times/yr).	Couple with daughter from Stockton; said they would have returned animals	Family from Salinas feeding french fries and crackers to gulls and squirrels	Mix of adults and kids in low-interitdal.	Extened family from China gathering food. Bat stars for souvenirs.

Activity
A. Collecting animals
B. Collecting shells
C. Collecting algae
D. Collecting rocks
E. Collecting something, but couldn't tell
F. Turning rocks
G. Handling animals
H. Feeding animals

Reasons for collecting
1. Food
2. Bait
3. Aquaria
4. Scientific collecting
5. Show and tell
6. No reason
7. Did not talk with them

Attachment 2 (continued) - Bay Net Advisories

Date:	11/2/02	11/5/02	11/17/02
Time:	13:20	15:15	14:30
Were you able to talk with the person(s)?	Yes	Yes	Yes
No. people:	3	4	?
Segment ID of occurrence	13	17	17
Activity:	B,C,F,G	B,C,D,F,G	B,C,D,F,G
Organisms collected and approximate number:	N/A	N/A	N/A
Reason(s) for collecting animals:	N/A	?	?
Were the organisms/materials returned?	N/A	?	?
Reason(s) for collecting seaweeds:	5	5	5
Presence of collecting equipment:	No	buckets	buckets
Did they know Pt. Pinos was a protected area?	No	No	Yes
Had they seen the tidepool etiquette signs?	No	No	Yes
Cooperative?	Yes	Yes	Yes
Notes:	Family from San Jose with son collecting for school	Parents and 2 kids from Gilroy	Thought OK to collect plants and non-living materials. From Fresno. Visit 2-3 times/year.

Activity
A. Collecting animals
B. Collecting shells
C. Collecting algae
D. Collecting rocks
E. Collecting something, but couldn't tell
F. Turning rocks
G. Handling animals
H. Feeding animals

Reasons for collecting
1. Food
2. Bait
3. Aquaria
4. Scientific collecting
5. Show and tell
6. No reason
7. Did not talk with them

Attachment 3 - Tidepool Coalition Letter

-----Original Message-----

From: LWillo1124@aol.com [mailto:LWillo1124@aol.com]
Sent: Thursday, January 16, 2003 6:15 PM
To: skimura@tenera.com
Subject: Re: Point Pinos visitor use records

Scott

I am sending you a sample of the Coalition's low tide monitoring activities. As you know it is usually only once a day, so obviously doesn't in anyway give an accurate assessment of what is going on in the tidepools on a daily basis. I only went thru 7/3l/03. I haven't transferred subsequent observations from the log book to the computer, but it gives you an idea of the types of things going on Zone's 1 thru 4 go from the Great Tidepool to Acropolis Blvd. and are parallel to the convenient auto pullouts on Ocean View Blvd. where people can park and get out of their cars. This is only documentation of once a day casual observations of tidepool activities and is intended only to confirm that these tidepools are in constant use and there needs to be better management, protection and monitoring if we are going to preserve anything for the future.

Attachment 4 – Tidepool Coalition Monitoring

Tidepool Coalition Monitoring Activities at Low Tides and Periods of High Human Use

2/20/02 Tuesday: Aprox. 5:00 pm, low tide (-0.3 ft). Out-of-town school bus observed parked in pullout area across from the foghorn. Approx. 50 students. Teachers standing on the beach while students scampered all over the tidepool areas collecting bat stars on paper plates and moving seastars from lower zones to upper zones. One student had 6 bat stars on her plate. The group had been to the aquarium prior to visiting the refuge Teachers were advised of city ordinance and proper tidepool etiquette and given Coalition Handouts. Captain Carl Miller, Coastal Protection Coordinator, was advised of the incident.

3/26/ 2002 Tuesday: Coalition volunteer checked tidepools at 2:00 pm. Talked with CDF&G Lt. Tim Olivas who was also monitoring the refuge.

4/17/02 Wednesday: Coalition volunteer checked tidepools at 8:30 am. No contacts made.

4/l8/02 Thursday: Coalition volunteer checked refuge. Very windy day. No contacts made.

4/19/02 Friday: Coalition volunteer checked refuge. Bus from Visalia was parked and about 50 students were in the tidepools. They were doing minimal collecting. Teachers were advised of it being a "no take" refuge, which they did not know. They were on their way to the aquarium.

4/20/02 Saturday: San Jose University students in the tidepools. Estimated to be about 60-70 students in 4 groups at 10:30 in the morning. On their way to aquarium in the afternoon. Made contact with marine biology department and gave out literature.

4/21/02 Sunday: Monitored tidepools at 1:30 pm. Probably close to 100 people in the tidepools and on the beach. One poke pole fisherman was seen taking a large live 2 ft monkeyface eel.

4/24/02 Wednesday: Monitored tidepools at 3:30 pm. Approx 14 visitors seen on the rocks and in tidepools. Tide 0.0 but still a lot of rocks exposed. No contacts made. State Ranger Roxann was patrolling the P.G. Pt. Pinos area checking buckets of fishermen.

4/26/02 Friday: 3:00 pm. Cold and overcast - windy as well - rough surf

Zone I	Nobody at Pt. Pinos Tidepools
Zone II	2 people on the rocks
Zone III	2 people on rocks
Zone IV	8 people on rocks and beach

Attachment 4 (continued) – Tidepool Coalition Monitoring

4/27/02 Saturday: 5:45 pm. Sunny with intermittent clouds - windy

Zone 1	Great Tidepool area - 2 visitors
Zone II	Noted 8 visitors on the rocks and in tidepools
Zone III	16 visitors in the tidepools
Zone IV	30 people in the tidepools and climbing on the rocks.

4/28/02 Sunday: 5:15. Sunny and windy

Zone I	Great Tidepool - 3 people in tidepools and scrambling around the rocks.
Zone II	2 people on the beach
Zone III	6 people on the rocks
Zone IV	6 people on the rocks

4/29/02 Monday: 5:15. Sunny, clear and little wind

Zone I	Nobody in the tidepools or on beach
Zone II	Nobody in the tidepools or on beach
Zone III	Nobody in the tidepools
Zone IV	2 people on the rocks and 2 people in tidepools

4/30//02 Tuesday: 6:15. Windy and drizzly - cold

Zone I	1 person in the tidepools area
Zone II	No visitors in tidepools
Zone III	No visitors in tidepools
Zone IV	No visitors in tidepools

5/l/02 Wednesday: Cold, cloudy and overcast day; -0.9 tide

Zone I	No visitors to tidepools
Zone II	No visitors in tidepools
Zone III	No visitors in tidepools

5/l/02 Wednesday (continued):

Zone IV	No visitors in tidepools

5/2/02 Thursday: Overcast and cold day at low tide period. 10:45 a.m.

Zone I	No visitors to tidepools
Zone II	15 high school students and teacher from Salinas in tidepools - not collecting; studying shells and painting watercolor seascapes. Teacher was very perceptive to conservation needs of our marine environment. Gave him tidepool literature for class use.
Zone III	No one in the tidepools
Zone IV	4 fishermen on rocks - 5 people in tidepools

Attachment 4 (continued) – Tidepool Coalition Monitoring

5/3/02 Friday: Low tide at 11:15; Overcast, cold and windy

Zone I	1 man on the beach
Zone II	1 man in tidepools; 2 on the beach
Zone III	3 adults and one child on beach and in tidepools they said they had noticed an increase in animals over past few years. From Pacific Grove. Gave them tidepool coalition literature.

5/4/02 Saturday: 12:45 pm. Clear, warm and low tide period

Zone I	2 men with white buckets way out in the lower tidal area - called dispatch, but by the time officer arrived the two men had left. Unable to see what they had in their buckets, but they were heavy!!! Talked with Officer Sinclair and he wrote it in his log "we need a cell phone".
Zone II	2 people on rocks and 3 on beach
Zone III	5 people in tidepools
Zone IV	4 people on rocks and in tidepools

Sunday 5/5/02: 12:05 pm. Sunny, clear and cool with some breeze

Zone I	4 kids in tidepols and 5 adults - 1 poke pole fisherman with white bucket
Zone II	2 people in tidepools
Zone III	8 people in the tidepools + 2 kayakers and 2 fishermen
Zone IV	l7 people on beach and rocks

Tuesday: 2:30 pm. Sunny, clear and windy

Zone I	No one in great tidepool
Zone II	No one in tidepools or on rock
Zone III	42 kids + teachers and aides in tidepools running all over. From out of town. Had come from the aquarium - said there was no instruction on tidepool etiquette – Gave teacher Coalition information and asked her to share with her associates. One student brought a large starfish up for display to other students. Advised regarding need to leave animals in place and unmolested. Obvious need for tidepool docents.

5/8/02 Wednesday: Clear - windy and sunny

Zone I	Nobody in tidepools

5/8/02 Wednesday (continued):

Zone II	20 people on rocks and in tidepools
Zone III	3 people on rocks 2 people tidepooling 2 people on beach
Zone IV	5 people on the rocks (2 way out) 1 child on the beach

Attachment 4 (continued) – Tidepool Coalition Monitoring

5/26/02 Sunday: Weekend and Memorial Day Holiday. Time 11:45 am. Overcast and cool; mid-tide

Zone I	25 people
Zone II	13
Zone III	18
Zone IV	20

5/31/02 Friday: Low tide 9:17 am. Surf up with high waves - overcast

Zone I	2 carloads of young men (about 9 altogether) said they were studying crabs – students. In the lower zones of the Great Tidepool and became somewhat "spooked" when asked what they were doing. When asked what kind of crabs, one said blue crabs and another said hermit crabs. They left rather abruptly when they had their pictures taken.
Zone II	0
Zone III	l poke pole fisherman working the tidepools
Zone IV	4 people on the beach

6/1/02 Wednesday: Overcast, low tide at 10:45

Zone I	2 on beach. Jim remarked on the amount of damage done with overturned rocks and trampling
Zone II	4 on the rocks
Zone III	2 tidepoolers 3 on the beach
Zone IV	6 on rocks 2 on the beach

6/3/02: Overcast and warm - seas calm and mild

Zone I	0
Zone II	6
Zone III	0
Zone IV	1

The Coalition only monitors at periods of (minus) tides when tidepool animals are most vulnerable.

6/11/02 Tuesday: 7:30 am. Low tide, beautiful day

Zone I	0
Zone II	0
Zone III	Tenera group - spoke with Scott Kimura - he said one of his markers was missing and thought that it might have been pulled off the rocks by someone - 4 people in his party
Zone IV	0

Attachment 4 (continued) – Tidepool Coalition Monitoring

6/11/02 Tuesday (continued):

Zone I	3 people
Zone II	7 people
Zone III	6 people
Zone IV	6 people on rocks and beach

6/12/02: Overcast; low tide at ll:30 am.

Zone I	2 people observed
Zone II	0
Zone III	9 parent advised about child taking life in plastic container
Zone IV	11

6/14/02 Friday: Overcast – chilly, low tide -l.0, Assemblyman Fred Keeley's Aide, Gary Shallcross came to observe the Pt. Pinos tidepools with Coalition representatives

Zone I	1 poke pole fisherman
Zone II	2 people on beach
Zone III	3 aquarium vans with young people (summer interns?). David K. was leading group- many had hip boots on - were going tidepooling; no collecting they said. Gave them packet of tidepool information
Zone IV	5 people

6/15/02 Saturday: Minus tide - sunny and clear

Zone I	0
Zone II	0
Zone III	l sport fisherman
Zone IV	2 collecting in large plastic bags - plant life and ? Called P.G. police who gave me dispatch. 3 P.G. police cars arrived. Officer Wishart, Officer White, and one female officer. Officer Wishart wanted to go talk to people, but called CDF&G who arrived and assumed responsibility. When the suspects put the material in the car, CDF&G intervened. Eventually Warden Ewald arrived on scene - they had 50 lbs. of marine algae and 80 turban snails.

10:30

Zone I	0
Zone II	0
Zone III	12
Zone IV	4

6/16/02 Sunday: Sunny, low tide

Zone I	0

Attachment 4 (continued) – Tidepool Coalition Monitoring

Zone II 0

Zone III 20 people on rocks - 2 poke pole fishermen, 1 skiff fisherman

Zone IV 12 people swarming over the rocks. Jim Willoughby talked to 2 young people out in the brown and green algae on exposed rocks area - said they were biology students from a junior college. Not collecting; Jim gave jumpstart to a man with dead battery. Successful.

6/18/02 Tuesday: Low tide, warm and overcast

Zone I 0

Zone II 9 people on a picnic

Zone III 6 people

Zone IV 2 kids, each with a bucket, (from Bay area); collecting turban snails. We talked about tidepool etiquette and they put them back. Mom didn't say anything.

6/20/02 Thursday: Overcast and cold; low tide monitored at 1:54

Zone I 2 kids on beach - none in great tidepools

Zone II 0

Zone III 2 fishermen, 5 in tidepools and on rocks - 1 with camera 3 way out on the monument; 4 on beach

Zone IV 9 people on the rocks

6/28/02 Friday: Minus tide, cool and overcast, 10:00 am.

Zone I 0
Zone II 0
Zone III 2 on rocks
Zone IV

6/29/02 Saturday: 10:00 am. Minus tide, overcast and warm

Zone I l sports fisherman in Great Tidepool for 3 hours poke pole fishing - took 10 large (several huge) monkeyface eels from the area - l immature rockfish. 1 youngster also poke pole fishing - had 3 eels in his bucket; 3 tidepoolers, 2 fishermen on rocks

Zone II 5 tidepoolers - one with a bat star and one with a mussel - given a Police Department letter and advised to return where they found them.

Zone III 2 fishermen, 3 tidepoolers

Zone IV 5 tidepoolers - no buckets

Attachment 4 (continued) – Tidepool Coalition Monitoring

6/30/02 Sunday: Minus tide

Zone I	2 boys poke pole fishing; said they could take 25 a day; had 10 so far; 6 people on beach on/in tidepools.
Zone II	0
Zone III	6
Zone IV	l on beach, 4 in tidepools

5/8/02 Wednesday: Time 11:45 am. mid-tide

Zone I	0
Zone II	2
Zone III	13 including 2 kids with collecting bucket and plastic cup
Zone IV	5

7/16/02 Tuesday: 9:50 am. low tide, overcast

Zone I	3 boys on rocks nobody in great tidepool
Zone II	0; Sea Otter Observers on shore - Gave tidepool information
Zone III	0
Zone IV	5 on beach, 5 in tidepools - all with papers from local school

7/17/02 Wednesday: Overcast

Zone I	3 people on rocks, 1 with tripod and camera 2 (father and son who had a bucket) not collecting - gave father a paper from Pacific Grove police chief regarding protection of refuge. Very receptive and friendly tourists from Paradise, CA.
Zone II	2 middle school kids jumping around from rock to rock – had a plastic bottle for collecting - gave them Pacific Grove police letter
Zone III	0
Zone IV	4

7/18/02 Thursday: MLPA meeting all day.

7/19/02 Friday: Overcast and cool. 0.3 tide at 1:49; lots of visitor traffic

Zone I	14 people in tidepools including 3 others from Oakland collecting shells. Explained protection within refuge. Very cooperative and friendly
Zone II	0
Zone III	4 people - 2 fishermen and 2 people watching the fishermen
Zone IV	15 people just enjoying the beach and the tide starting to come in while they stood on the rocks no buckets.

Attachment 4 (continued) – Tidepool Coalition Monitoring

7/22/02 Monday: 3:45 pm. Sunny day with fog starting to come in

Zone I	12 people on beach on rocks
Zone II	3 visitors on rocks
Zone III	11 people on beach
Zone IV	14 people on beach and on rocks

7/24/02 Wednesday: Low tide at 5:44 am. Observations at 8:50 am.

Zone I	No one in great tidepool area. Father and son in adjacent rocky tidepool area just observing
Zone II	2 men on rocks fishing; 4 youngsters and l adult with plastic bags - said they were from Stockton - gave them copy of Chief Miller's welcoming statement
Zone II	0
Zone IV	2 men on rocks - turned out to be Scott Kimura and his colleague. Observer living across the street wanted to know what was going on - advised him it was an on-going study. Says he sees a lot of activity in the tidepools as he lives on Ocean View Blvd. Gave him a copy of police chief's letter for his information.

7/24/02: 2nd Monitoring at 11:00 am.

Zone I	l person on rocks
Zone II	8 people on beach
Zone III	0
Zone IV	5 people on beach

7/25/02 Thursday: Sunny and clear;low tide at 6 pm. 9:15 am. observation

Zone I	7 people on beach, 2 poke pole fishermen with big white bucket - they had sports fishing license - hadn't caught anything - gave them Chief Miller's letter.
Zone II	2 adults and 2 youngsters on rocks
Zone III	3 adults on rocks and l on beach
Zone IV	l adult and 2 little kids on rocks

7/26/02 Friday: Overcast - low tide 11 am.

Zone I	8 on rocks - none in tidepools
Zone II	0
Zone III	0
Zone IV	5 people in tidepools and 9 on rocks (Christian youth group)

Attachment 4 (continued) – Tidepool Coalition Monitoring

2nd observation that day at 3:40 pm.

Zone I	11 people on rocks and 5 on beach and l otter in the great tidepool area, 5 people on the beach
Zone II	0

7/27/02 Saturday: Overcast at 8:30

Zone I	l man putting on hip boots - assume he was a sports fisherman
Zone II	0
Zone III	1 recreational fishermen; Stanford people with white buckets conducting a study - not collecting - Professor doing grid work with students. Other professors present and observing. Also a photo session going on with 7 people on the rocks - busy area.
Zone IV	4 people on rocks

7/28/02 Sunday: High tide at 12:45

Zone I	6 on rocks and l dog
Zone II	6 people on rocks
Zone III	13 visitors and 2 sports fishermen
Zone IV	10 people on rocks

7/29/02 Monday: Overcast 9:00 am. Low 0.3 ft tide

Zone I	0
Zone II	0
Zone III	4 people on rocks - 2 serious tidepoolers from Colorado, but no buckets and no bags - just enjoying the life in the tidepools
Zone IV	0

7/30/02 Tuesday: 9:00 am. Clear and cool

Zone I	0
Zone II	0
Zone III	3 tidepoolers
Zone IV	0

7/31/02 Wednesday: Overcast and cool - low tide

Zone I	0
Zone II	l fisherman -
Zone III	0
Zone IV	0

Literature Search for Baseline Studies

Purpose

A literature search was completed to determine whether any historical baseline studies had been completed at Point Pinos in which sampling could be resumed for comparison purposes.

Methods

The literature search was completed mainly using internet library search methods of books, technical reports, scientific papers, theses, student papers, and dissertations using the key search words ‘Point Pinos’, Pt. Pinos’, ‘Pinos’, and ‘Great Tidepool’. Dr. Joseph Wible (head librarian and assistant director, Hopkins Marine Station) provided invaluable assistance and direction in the literature search. Ms. Joan Parker (head librarian, Moss Landing Marine Laboratories) also provided invaluable assistance. The library catalogs and indexes that were searched included:

- MELVYL catalog: University of California library holdings
- GLADIS catalog: U.C. Berkeley research
- WORLDCAT: union catalog for library catalogs
- Hopkins Marine Station local index
- Moss Landing Marine Laboratories local index
- Local history index at the Pacific Grove Library (includes research completed at Hopkins by Carleton College and Bodega Bay Marine Laboratories)

As papers, books, articles, theses, student papers, and dissertations were found using the key word searches they were further screened for meeting four criteria:

- The study was of the intertidal zone versus the subtidal zone.
- The study provided a sufficient amount of data on an array of organisms to characterize the area’s biological diversity in terms of historical levels of species composition and abundance.
- The sampling stations and methods were sufficiently described so that the observations could be repeated in the same fashion as in the first study. An ideal paradigm would be the study completed at Hopkins Marine Station by Barry et al. (1995) and Sagarin et al. (1999), in which sampling in 1930 (Hewatt transect study) was repeated in 1991-93 using the same sampling methods at the same transect for comparisons purposes.

- The study was completed at both Point Pinos and in areas of similar habitat but with low/no visitor use and with suitable replication in each area.

Long-time, local resident senior scientists were also contacted for baseline studies that might have been completed and that match the above criteria (see Appendix B).

Results

The library search accessed millions of books, contents of books, individual papers, and articles. Furthermore, three bibliography documents of studies completed in the Monterey Bay area and intertidal studies completed in central California were found and hand viewed, page by page, for studies completed at Point Pinos based on titles and annotated descriptions of the references. Collectively, the three bibliography documents contained approximately 4,000 references of studies on marine ecology in California:

- Kinnetics Laboratories, Inc. 1987. Annotated bibliography: rocky intertidal communities of central and northern California. OCS study, MMS 86-0052. United States, Minerals Management Service.
- Baron, D. 1971. Monterey Bay bibliography. Moss Landing Marine Laboratories, Moss Landing, California. 285 pp.
- Baron, D. 1972. Monterey Bay bibliography supplement number one. Moss Landing Marine Laboratories, Moss Landing, California. 92 pp.

All of the studies found in the internet library search method and in the hand check method of the three bibliography documents above were considered as not being relevant to base the present study, due to having one or more of the following characteristics:

- Focus on taxonomy, behavior, or physiology rather than on species composition and abundance of the general marine community
- No quantitative data to base comparisons
- Locations of the sampling sites not accurately described
- Species studied not necessarily affected by collectors
- Studies were not near Point Pinos

As the literature search progressed we felt that studies pertaining to resource planning and permitting might also provide useful information on baseline conditions, as biological characterization studies are often needed for planning and facilities development projects. Furthermore, these types of documents may provide appropriate references not revealed by other literature search methods. We found three reports for Point Pinos in this manner.

City of Pacific Grove. 1998. Pacific Grove Coastal Parks Plan. Local Coastal Program Land Use Plan, Major Amendment No. 1-97. August 1998.

This document was reviewed, but provided only an overview of biological characteristics. No specific biological information was given. Rather, the Pacific Grove shoreline was characterized as being rich and diverse. The Coastal Parks Plan seeks to maximize protection of the diverse shoreline, and the Plan discusses programs and methods to protect the shores while allowing for visitor use.

Dommes, S.F. 1947. In the matter of application to the City of Pacific Grove for permit to construct and operate a new sewage disposal system comprising intercepting sewers and force mains, sewage lift stations, primary sewage treatment consisting of plain sedimentation, separate sludge digestion and discharge of clarified and chlorinated effluent into the Pacific Ocean off Point Pinos. State of California, Dept. of Public Health, Bureau of Sanitary Engineering.

This document could not be located through the library search process or in the Pacific Grove Public Works Department archives.

Engineering-Science, Inc. 1970. Point Pinos outfall feasibility study. Submitted to the City of Pacific Grove, California.

This document pertains mainly to water quality and oceanographic studies completed in 1969-70 at the Point Pinos sewage outfall. The studies were done to evaluate the discharge constituents with respect to water quality criteria. The biological studies associated with this study were zooplankton surveys and sediment core (sand) analyses for infauna. No results were provided for the rocky shore marine community, and therefore the findings contained in this report are not relevant to the Point Pinos visitor use study.

California State Water Resources Control Board. 1979. Pacific Grove Marine Garden Fish Refuge and Hopkins Marine Life Refuge. Water quality monitoring report 79-11. Surveillance and monitoring section. Monterey County, State Water Resources Control Board, Sacramento, California.

The California State Water Resources Control Board completed biological surveys in 1977 in the reach between Point Pinos and Hopkins Marine Station for consideration of the area as an Area of Special Biological Significance (ASBS). The results are mainly from subtidal transect studies. However, intertidal observations were also completed in the same reach, and the qualitative descriptions are presented based on the shore walk observations. The locations of the five intertidal sites observed in the shore walks were sufficiently detailed that they were re-visited and sampled in a similar qualitative manner in the present study.

Several other references pertaining to baseline studies of regional interest are described below. The studies were excluded from resumed sampling in the present program, primarily due to site considerations and the types of data collected. Explanations are included.

Pearse (MBNMS web site, Ecosystem Observations 1998)

This article summarizes the results of studies on recovery at the Point Pinos and Soquel (Santa Cruz) sewer outfalls after the outfalls were taken off-line in the mid-1970s. The studies were conducted mainly at the terminus locations of the sewer outfalls in the low intertidal zone that is typically characterized by surfgrass (*Phyllospadix* spp.). During discharge conditions, the areas were depauperate of foliose algae and invertebrates, and the areas were characterized as being covered with diatoms, low-growing coralline algae, stunted *Prionitis lanceolata* (red algae), and deformed *Laminaria setchellii* (oar kelp). Changes following the termination of outfall operations were similar at both sites with increases in the abundance of surfgrass and increases in algal and invertebrate diversity. This study was not incorporated into the present study, since the baseline conditions would be the patterns of recovery following the termination of sewer outfall discharges.

The MBNS Long-Term Intertidal Monitoring and Experiential Training for Students (LiMPETS)

The monitoring of a rocky outcrop near the northwest end of the Point Pinos headland is being conducted as part of a long-term monitoring program under the direction of Dr. John Pearse. High school students perform the work, in which the presence/absence of species along transects perpendicular to shore is the primary database. The location of the outcrop site is not within an area that receives an appreciable amount of visitor traffic, as it is relatively far removed from shoreline access points and is not readily visible from the shore (personal observation). Furthermore, it is a relatively difficult site to access due to the amount of intertidal zone one has to traverse, which consists of a slippery boulder field. While this site may be attractive to poachers, it was considered as not being a representative site where collecting by the casual visitor or scientific community may occur.

Nybakken, J. 1978. Abundance, diversity, and temporal variability in a California nudibranch assemblage. Mar. Biol. 45: 129-146.

This was a study of nudibranch composition and abundance from 1970 through 1973 at an Asilomar site. No complimentary studies were completed at Point Pinos. A few classroom follow-up surveys were completed at the Asilomar site to provide one-time results for course exercise assignments. Consequently, the follow-up surveys were not designed or intended for comparing the results to the earlier work. Any re-analysis of the follow-up surveys for this purpose would have to account for sampling differences. Mainly, the area of study and sampling teams differed between the early and follow-up surveys. The size of the search area was larger in the follow up surveys, and the observers in the follow-up surveys had less training and experience than those in the earlier surveys (J. Nybakken, pers. com.). This study was not incorporated into the present study due to location considerations and the Nybakken study having been a species-assemblage specific study.

Clowes, S.W. and B.S. Coleman. 2000. A quantitative analysis of human activity at Point Pinos rocky intertidal. Student paper, Biology 175 H. Hopkins Marine Station, Stanford University. – and

Clowes, S.W. 2002. Temporal changes in algal communities at Point Pinos rocky intertidal as potential indicators of human and natural disturbance. M.S. Thesis. Hopkins Marine Station, Stanford University.

Students, staff, and research associates at Hopkins Marine Station have completed numerous studies in the region. The two studies cited above were recently completed, and were found to pertain most directly to the sampling design chosen for the present study. Clowes and Coleman (2000) completed initial observations on where people tended to be most and least concentrated at Point Pinos upon which they established and sampled stations in corresponding areas of ‘high’ and ‘low’ visitor use. Their study design was targeted at the algal assemblages to assess trampling effects. Much of the study findings, however, were inconclusive with regards to trampling effects, due to a discovered but uncertain influence of sand scour in the area (Clowes 2002). A possible limitation of the study was that all of their sampling was completed at Point Pinos. It is possible that visitor densities in her areas of ‘low’ visitor use were still sufficiently high to elicit biological responses similar to those in her areas of ‘high’ visitor use. Thus, visitor effects in the ‘high’ use areas may have not been distinguishable from the ‘low’ use areas because visitor densities were not sufficiently different.

Discussion

The chosen sampling design of the present visitor use impact study was developed due to the absence of previous studies by which sampling could be resumed for comparison purposes (see *Section 3.0 – Biological Descriptions*). The study would be best accomplished in a sampling design in which data collections were made before the impact in both control and impact areas with continued sampling after the impact (before-after-control-impact study design). However, no such baseline studies were found in the literature and from interviews with senior scientists from local academic institutions. While numerous biological studies have been completed at Point Pinos, none were found that provided comprehensive quantitative data on species composition and abundance at both Point Pinos and at appropriate reference stations. Furthermore, none were found that were completed before tourism and visitor use became a concern at Point Pinos. The closest example of such a study comes from a transect survey completed at Hopkins Marine Station in 1931-33 by W.G. Hewatt. The transect markers were relocated, and the transect was re-sampled in 1993-96 by Barry et al. (1995) and Sagarin et al. (1999). However, the sampling was not replicated in 'high' and 'low/no' visitor use areas.

The work in 2000 by Clowes and Coleman (2000) and Clowes (2002) was most relevant to the present study. Their observations and counts of people in segments along the Point Pinos shoreline were used to establish our visitor use sites (see *Section 2.0 – Visitor Descriptions* and *Section 3.0 - Biological Descriptions*). Our sampling sites in areas of low/no visitor use were away from Point Pinos in adjoining coastal areas. Counts of people were made in the present study, in the same manner as Clowes and Coleman (2000), to substantiate the visitor numbers in segments along the Point Pinos coast. In addition, counts were made in adjoining coastline regions to associate the lower numbers of visitors at our reference stations. The reference stations in our study were located away from Point Pinos to provide for a greater difference in the degree of visitor use between 'impact' and 'reference' stations compared to the study of Clowes and Coleman (2000) and Clowes (2002).

Although no studies were found in which the sampling sites could be re-located and sampled for comparisons, it is not concluded that no such studies exist, as they were searched in library catalogs and indexes using key words present in the project titles. It is possible that studies exist, which the key words do not appear in the project titles. However, resident senior scientists in the local area did not recall any previous studies that were of sufficient quantitative rigor and sampling replication to have been appropriate to re-establish sampling for the present project (see *Appendix I* for interview list).

Some of the very old studies in the literature search and interviews did furnish information on species composition and relative abundance, but lacked accurate descriptions of the sampling locations and the manner in which the data were collected. Consequently, we felt that a significant amount of time, effort, and project expense would be incurred attempting to duplicate any prior efforts without the assurance that the efforts would be worthwhile.

One exception of an appropriate comparison study was a study completed by the California State Water Resources Control Board (1979). The results of the study consisted of qualitative descriptions of the biota in 1977 at five intertidal sites between Hopkins Marine Station and Point Pinos. The site locations were sufficiently described to enable the sites to be re-located and sampled in the present study for comparison purposes (see *Section 3.5 – 1977-2002 Site Comparion*). However, the repeated observations did not form the basis of the present study because the initial and follow-up observations were subjective. The comparisons provide a qualitative interpretation on the similarity and differences between 1977 and 2000 in the composition and abundance of conspicuous species at Point Pinos relative to other sites that were located nearby with less visitor use.

In conclusion, the present quantitative study design was implemented due to the lack of previous baseline studies by which sampling could be resumed. The present study now establishes a new quantitative baseline by which future results may be further evaluated.

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Table 1. Invertebrate and Fish Taxa Sampled in the Point Pinos Quantitative Studies

Scientific Name	Common Name/Description
Porifera	
encrusting sponge	sponge
Haliclona spp.	purple sponge
Cnidaria	
Aglaophenia latirostris	ostrich-plume hydroid
Anthopleura elegantissima	aggregating anemone
Anthopleura sola	anemone
Anthopleura xanthogrammica	green anemone
Corynactis californica	strawberry anemone
Epiactis prolifera	proliferating anemone
Hydroida	hydrod
Urticina coriacea	anemone
Urticina crassicornis	anemone
Urticina spp.	anemone
Platyhelminthes	
Notoplana spp.	flatworm
Nemertea	
Amphiporus imparviensis	unsegmented worm
Nermertea	unsegmented worm
Paranemertes peregrina	unsegmented worm
Annelida	
Cirratulidae/Terebellidae	tube worm
Dodecaceria spp.	tube worm
Nereididae	segmented worm
Phragmatopoma californica	sand tube worm
Pista spp.	tube worm
Salmacina tribranchiata	tube worm
Serpula vermicularis	tube worm
Serpulidae	tube worm
Spirobranchus spinosus	tube worm
Spirorbidae	tube worm
Sipuncula	
Golfingia procera	peanut worm
Themistes pyroides	peanut worm
Arthropoda	
Balanus spp.	barnacle
Cancer antennarius	rock crab
Cancer productus (juv)	red crab
Cancer spp. (juv)	Cancer crab (juvenile)
Chthamalus fissus	barnacle
Cirolana harfordi	isopod
Crangon spp.	shrimp
Grapsidae	crab
Haplogaster cavicauda	harry arm crab
Hemigrapsus nudus	purple shore crab
Idotea wozneskii	isopod
Isopoda	isopod
Lophopanopeus loeucomanus	black-clawed crab
Pachygrapsus crassipes	lined shore crab
Pagurus spp.	hermit crab
Petrolisthes spp.	porcelain snail
Pugettia producta	kelp crab
Tetraclita rubescens	barnacle
Mollusca	
Acanthinucella spp.	unicorn snail
Acmaea mitra	white-cap limpet
Alia spp. (carinata)	dove snail
Amphissa spp. (verisicolor)	wrinkled dove snail
Barleeia spp.	snail
Bittium spp.	threaded bittium snail
Calliostoma ligatum	blue top snail
Crepidula spp.	slipper shell
Cryptochiton stelleri	chiton
Cyanoplax dentiens	chiton
Cyanoplax hartwedgii	chiton
Cyanoplax spp.	chiton
Mollusca (continued)	
Dendronotus subramosus	nudibranch
Doriopsilla albopunctata	salted dorid nudibranch
Epilucina spp. (californica)	clam
Epitonium tinctum	tinted wentletrap
Fissurella volcano	key hole limpet
Haliotis cracherodii	black abalone
Haliotis rufescens	red abalone
Hermissenda crassicornis	nudibranch
Homalopoma spp.	snail
Irusella lamellifera	rock venus clam
Ishnochitonidae	chiton
Lacuna spp.	chink snail
Lepidozona spp.	chiton
Lithopoma gibberosa	red top snail
Littorina keenae	eroded periwinkle snail
Littorina scutulata	checkered periwinkle snail
Lottia asmi	black limpet
Lottia digitalis	ribbed limpet
Lottia gigantea	owl limpet
Lottia limatula	file limpet
Lottia ochracea	limpet
Lottia pelta	shield limpet
Lottia scabra	rough limpet
Lottiidae	limpet
Mitra idae	Ida's mitre snail
Mopalia lignosa	chiton
Mopalia muscosa	mossy chiton
Mytilus spp. (calif./gallo.)	mussel
Notoacmaea incessa	seaweed limpet
Nucella emarginata	emarginate dogwinkle snail
Nuttalina californica	chiton
Ocenebra circumtexta	circled rock snail
Ocenebra interfossa	sculptured rock snail
Ocenebra lurida	lurid rock snail
Octopus spp.	octopus
Onchidella borealis	leather limpet
Pholadidae	boring clam
Pollicipes polymerus	leaf barnacle
Serpulorbis squamigerus	scaled worm snail
Stenoplax heathiana	chiton
Tectura scutum	plate limpet
Tegula brunnea	brown turban snail
Tegula funebralis	black turban snail
Tonicella lineata	lined chiton
Ectoprocta (Bryozoa	
encrustiing bryozoan	moss bryozoan
Echinodermata	
Amphiodia urtica	brittle star
Amphipholis squamata	brittle star
Asterina miniata	bat star
Leptasterias spp. (hexactis)	six-armed star
Ophionereis annulata	brittle star
Ophioplocus esmarki	brittle star
Pisaster giganteus	giant spined sea star
Pisaster ochraceus	ochre sea star
Pisaster spp. (juv)	sea star (juvenile)
Pisaster/Henricia spp. (juv.)	sea star (juvenile)
Pycnopodia helianthoides	sunflower star
Strongylocentrotus purpuratus	purple sea urchin
Urochordata	
Tunicata	tunicate
Chordata	
Artedius spp.	sculpin
Cebidichthys violaceus	monkeyface eel
Cottidae	sculpin
Oligocottus spp.	sculpin
Sebastes melanops (YOY)	black rockfish

Table 2. Plant Taxa Sampled in the Point Pinos Quantitative Studies

Scientific Name	Common Name/Description
Chrysophyta	diatoms
Chlorophyta	
Acrosiphonia spp.	filamentous algae
Bryopsis corticulans	filamentous algae
Bryopsis hypnoides	filamentous algae
Cladophora spp.	pin cushion
Ulva/Enteromorpha spp.	sea lettuce
Phaeophyta	
Colpomenia spp.	saccate algae
Egregia menziesii	feather boa kelp
Fucus gardneri	rockweed
Hesperophycus californicus	rockweed
Pelvetiopsis limitata	rockweed
Silvetia compressa	rockweed
Rhodophyta	
Bossiella spp.	articulated coralline algae
Calliarthron spp.	articulated coralline algae
Callithamnion pikeanum	filamentous red algae
Callithamnion/Pleonosporium spp.	filamentous red algae
Ceramium spp.	filamentous red algae
Chondracanthus canaliculatus	branched algae
Chondracanthus exasperata/corymbifera	foliose algae
Chondracanthus spinosus	foliose algae
Corallina officinalis	articulated coralline
Corallina vancouveriensis	articulated coralline
coralline crust	crustose coralline
Cryptopleura violacea	foliose algae
Cryptosiphonia woodii	branched algae
Endocladia muricata	nail brush seaweed, turf algae
Gastroclonium subarticulatum	hollow branch seaweed
Gelidium coulteri	branched algae
Gelidium pusillum	branched algae
Halosaccion glandiforme	saccate red algae
Halymenia/Schizymenia spp.	foliose algae
juv. articulated coralline algae	articulated coralline algae
Mastocarpus jardinii	foliose algae
Mastocarpus papillatus	foliose algae
Mazzaella affinis	foliose algae
Mazzaella flaccida	iridescent seaweed
Mazzaella leptorhynchos	fluffy algae
Mazzaella phyllocarpa	foliose algae
Mazzaella splendens	foliose algae
Melobesia mediocris	crustose coralline
Microcladia borealis	branched algae
Microcladia coulteri	branched algae
non-coralline crust	non-coralline crust
Osmundea pacifica	branched algae
Osmundea spectabilis	branched algae
Porphyra spp.	foliose algae
Prionitis australis	branched algae
Prionitis lanceolata	branched algae
Pterosiphonia dendroidea	filamentous algae
Rhodymenia spp.	foliose algae
Sarcodiotheca gaudichaudii	branched algae
Smithora naiadum	foliose algae
Tracheophyta	
Phyllospadix spp.	surfgrass

Table 1. Algal Cover in Tidepools at Hopkins

Site Name	Hopkins	Hopkins	Hopkins	Hopkins	Hopkins
Tidepool Number	1	2	3	4	5
Estimated Surface Area Size (m2)	0.40	0.50	0.40	0.75	0.30
Bossiella spp.	-	-	-	-	-
Calliarthron spp.	-	-	-	-	0.01
Chondracanthus canaliculatus	-	-	-	-	-
Chrysophyta (unid)	-	-	-	-	-
Cladophora spp.	-	-	-	0.01	0.01
Corallina vancouveriensis	-	-	-	15.00	0.01
coralline crust	15.00	25.00	46.00	30.00	50.00
Cryptopleura violacea	-	-	-	-	-
Cryptosiphonia woodii	-	-	-	-	-
Fucus gardneri	-	-	-	-	-
Gelidium coulteri	1.00	3.00	-	-	0.01
Gelidium pusillum	-	-	0.01	-	-
juv. articulated coralline algae	-	-	-	-	-
Mastocarpus papillatus	0.01	-	1.00	1.00	0.01
Mazzaella affinis	-	-	-	-	-
Mazzaella flaccida	-	-	-	-	-
Mazzaella heterocarpa	-	-	-	-	-
Mazzaella leptorhynchos	-	-	-	0.01	0.01
non-coralline crust	68.00	45.00	5.00	20.00	10.00
Osmundea spectabilis	-	-	-	-	-
Phyllospadix spp.	-	-	-	-	-
Prionitis lanceolata	1.00	7.00	8.00	5.00	10.00
Prionitis lyallii	-	-	-	-	-
Silvetia compressa	-	-	-	-	-
Bare Rock	10.00	5.00	40.00	15.00	15.00
Bare Boulder	-	-	-	-	-
Bare Cobble	5.00	-	-	-	2.00
Sand	5.00	3.00	-	15.00	-

Table 2. Algal Cover in Tidepools at Restless Seas

Site Name	Restless Sea	Restless Sea	Restless Sea	Restless Sea	Restless Sea
Tidepool Number	1	2	3	4	5
Estimated Surface Area Size (m2)	0.75	0.80	0.50	0.25	1.00
Bossiella spp.	-	-	-	-	-
Calliarthron spp.	-	-	1.00	-	-
Chondracanthus canaliculatus	-	-	0.01	-	-
Chrysophyta (unid)	-	-	-	-	-
Cladophora spp.	0.01	-	0.01	0.01	0.01
Corallina vancouveriensis	0.01	-	1.00	0.01	0.01
coralline crust	5.00	0.01	5.00	5.00	5.00
Cryptopleura violacea	-	-	-	-	-
Cryptosiphonia woodii	-	-	-	-	0.01
Fucus gardneri	-	-	-	-	-
Gelidium coulteri	0.01	-	0.01	-	2.00
Gelidium pusillum	-	-	-	-	-
juv. articulated coralline algae	-	-	-	-	-
Mastocarpus papillatus	-	10.00	-	0.01	0.00
Mazzaella affinis	-	-	0.01	-	0.01
Mazzaella flaccida	-	2.00	1.00	-	-
Mazzaella heterocarpa	-	-	-	-	-
Mazzaella leptorhynchos	1.00	15.00	15.00	-	15.00
non-coralline crust	25.00	5.00	3.00	5.00	25.00
Osmundea spectabilis	-	-	-	-	-
Phyllospadix spp.	-	-	-	-	-
Prionitis lanceolata	50.00	0.01	20.00	-	60.00
Prionitis lyallii	0.01	-	-	-	-
Silvetia compressa	-	-	-	-	-
Bare Rock	20.00	40.00	15.00	90.00	2.00
Bare Boulder	-	-	20.00	-	-
Bare Cobble	5.00	20.00	15.00	-	-
Sand	15.00	10.00	5.00	-	40.00

Table 3. Algal Cover in Tidepools at Seawall

Site Name	Sea Wall	Sea Wall	Sea Wall	Sea Wall	Sea Wall
Tidepool Number	1	2	3	4	5
Estimated Surface Area Size (m2)	1.75	2.50	0.40	0.50	0.35
Bossiella spp.	-	-	-	10.00	-
Calliarthron spp.	2.00	5.00	5.00	25.00	10.00
Chondracanthus canaliculatus	0.01	-	-	-	-
Chrysophyta (unid)	-	-	-	-	-
Cladophora spp.	-	-	0.00	-	0.01
Corallina vancouveriensis	-	-	-	-	20.00
coralline crust	6.00	15.00	8.00	15.00	30.00
Cryptopleura violacea	-	0.01	-	-	-
Cryptosiphonia woodii	-	-	-	-	-
Fucus gardneri	-	-	-	-	-
Gelidium coulteri	-	-	0.01	0.01	-
Gelidium pusillum	-	-	-	-	-
juv. articulated coralline algae	-	-	-	-	-
Mastocarpus papillatus	2.00	-	-	-	-
Mazzaella affinis	1.00	-	-	-	-
Mazzaella flaccida	-	-	-	-	-
Mazzaella heterocarpa	-	-	-	-	-
Mazzaella leptorhynchos	10.00	4.00	3.00	-	-
non-coralline crust	15.00	10.00	5.00	0.00	20.00
Osmundea spectabilis	-	-	-	-	-
Phyllospadix spp.	-	1.00	-	-	-
Prionitis lanceolata	40.00	20.00	15.00	20.00	15.00
Prionitis lyallii	-	-	-	-	-
Silvetia compressa	-	-	-	-	-
Bare Rock	0.01	2.00	5.00	-	1.00
Bare Boulder	-	-	-	-	-
Bare Cobble	0.01	5.00	50.00	10.00	-
Sand	25.00	40.00	10.00	20.00	-

Table 4. Algal Cover in Tidepools at Asilomar

Site Name	Asilomar	Asilomar	Asilomar	Asilomar	Asilomar
Tidepool Number	1	2	3	4	5
Estimated Surface Area Size (m2)	0.75	0.80	0.50	1.00	0.75
Bossiella spp.	-	3.00	-	-	-
Calliarthron spp.	12.00	-	-	-	-
Chondracanthus canaliculatus	-	-	-	-	-
Chrysophyta (unid)	-	-	-	-	-
Cladophora spp.	2.00	2.00	0.01	3.00	0.01
Corallina vancouveriensis	5.00	-	0.01	30.00	-
coralline crust	-	1.00	0.01	10.00	0.01
Cryptopleura violacea	-	-	-	-	-
Cryptosiphonia woodii	-	-	-	-	-
Fucus gardneri	-	-	-	-	-
Gelidium coulteri	0.01	0.01	-	1.00	-
Gelidium pusillum	-	0.01	-	-	-
juv. articulated coralline algae	-	-	-	-	-
Mastocarpus papillatus	1.00	5.00	1.00	-	0.01
Mazzaella affinis	-	-	-	-	-
Mazzaella flaccida	-	-	-	-	-
Mazzaella heterocarpa	-	-	-	-	-
Mazzaella leptorhynchos	-	2.00	0.01	-	-
non-coralline crust	10.00	18.00	5.00	2.00	0.01
Osmundea spectabilis	-	-	-	-	-
Phyllospadix spp.	20.00	-	-	-	-
Prionitis lanceolata	-	-	-	5.00	-
Prionitis lyallii	-	-	-	-	-
Silvetia compressa	-	-	-	-	-
Bare Rock	10.00	5.00	70.00	15.00	50.00
Bare Boulder	-	-	-	-	-
Bare Cobble	30.00	45.00	7.00	2.00	-
Sand	20.00	20.00	0.00	12.00	2.00

Table 5. Algal Cover in Tidepools at PP Lot 4-Center

Site Name	PP Lot 4-C	PP Lot 4-C	PP Lot 4-C	PP Lot 4-C	PP Lot 4-C
Tidepool Number	1	2	3	4	5
Estimated Surface Area Size (m2)	3.00	1.00	2.00	0.75	1.75
Bossiella spp.	-	-	-	-	-
Calliarthron spp.	8.00	0.01	-	-	-
Chondracanthus canaliculatus	-	-	-	-	-
Chrysophyta (unid)	-	-	-	-	-
Cladophora spp.	-	-	0.01	-	-
Corallina vancouveriensis	-	-	40.00	-	-
coralline crust	5.00	8.00	5.00	0.01	1.00
Cryptopleura violacea	-	-	-	-	-
Cryptosiphonia woodii	-	-	-	-	-
Fucus gardneri	-	-	-	-	-
Gelidium coulteri	0.01	-	-	-	-
Gelidium pusillum	-	-	-	-	-
juv. articulated coralline algae	0.01	2.00	-	0.01	0.01
Mastocarpus papillatus	2.00	5.00	3.00	1.00	15.00
Mazzaella affinis	-	-	-	-	-
Mazzaella flaccida	0.01	-	-	-	-
Mazzaella heterocarpa	-	-	0.01	-	-
Mazzaella leptorhynchos	0.00	15.00	3.00	-	5.00
non-coralline crust	10.00	2.00	5.00	10.00	4.00
Osmundea spectabilis	0.01	-	-	-	-
Phyllospadix spp.	2.00	-	-	-	-
Prionitis lanceolata	15.00	-	-	5.00	-
Prionitis lyallii	-	0.01	2.00	0.01	-
Silvetia compressa	-	-	-	-	-
Bare Rock	25.00	60.00	25.00	40.00	10.00
Bare Boulder	-	-	-	-	-
Bare Cobble	25.00	5.00	5.00	50.00	55.00
Sand	50.00	15.00	2.00	2.00	10.00

Table 6. Algal Cover in Tidepools at PP Lot 2

Site Name	PP Lot 2	PP Lot 2	PP Lot 2	PP Lot 2	PP Lot 2
Tidepool Number	1	2	3	4	5
Estimated Surface Area Size (m2)	2.00	0.50	1.25	0.50	1.25
Bossiella spp.	-	-	-	-	-
Calliarthron spp.	-	-	-	-	-
Chondracanthus canaliculatus	-	-	-	-	-
Chrysophyta (unid)	-	-	-	-	-
Cladophora spp.	-	-	3.00	0.01	-
Corallina vancouveriensis	-	-	15.00	0.01	-
coralline crust	12.00	20.00	10.00	40.00	8.00
Cryptopleura violacea	-	-	-	-	-
Cryptosiphonia woodii	-	-	-	-	-
Fucus gardneri	-	-	-	-	-
Gelidium coulteri	-	-	0.01	-	3.00
Gelidium pusillum	-	0.01	-	0.01	0.01
juv. articulated coralline algae	0.01	-	-	-	0.01
Mastocarpus papillatus	3.00	2.00	5.00	2.00	18.00
Mazzaella affinis	-	-	-	-	-
Mazzaella flaccida	-	-	-	-	-
Mazzaella heterocarpa	-	-	-	-	-
Mazzaella leptorhynchos	-	10.00	2.00	5.00	1.00
non-coralline crust	25.00	20.00	30.00	10.00	5.00
Osmundea spectabilis	-	-	-	-	-
Phyllospadix spp.	-	-	-	-	-
Prionitis lanceolata	2.00	-	6.00	5.00	1.00
Prionitis lyallii	-	-	3.00	-	-
Silvetia compressa	-	-	-	-	-
Bare Rock	20.00	50.00	25.00	50.00	60.00
Bare Boulder	-	-	-	-	-
Bare Cobble	25.00	5.00	1.00	2.00	5.00
Sand	15.00	5.00	6.00	2.00	0.00

Table 7. Algal Cover in Tidepools at Lot 5-North

Site Name	PP Lot 5-North	PP Lot 5-North	PP Lot 5-North	PP Lot 5-North	PP Lot 5-North
Tidepool Number	1	2	3	4	5
Estimated Surface Area Size (m2)	1.50	1.60	0.30	0.50	0.80
Bossiella spp.	-	-	-	-	-
Calliarthron spp.	2.00	-	-	-	-
Chondracanthus canaliculatus	-	-	0.00	1.00	-
Chrysophyta (unid)	-	-	-	92.00	-
Cladophora spp.	-	0.01	0.01	0.01	-
Corallina vancouveriensis	15.00	20.00	40.00	0.01	-
coralline crust	5.00	10.00	15.00	0.01	5.00
Cryptopleura violacea	-	-	-	-	-
Cryptosiphonia woodii	-	-	-	-	-
Fucus gardneri	-	-	1.00	-	-
Gelidium coulteri	-	-	-	-	-
Gelidium pusillum	-	-	-	-	-
juv. articulated coralline algae	-	-	-	-	-
Mastocarpus papillatus	0.01	0.01	0.01	-	6.00
Mazzaella affinis	-	-	1.00	-	-
Mazzaella flaccida	-	-	-	-	-
Mazzaella heterocarpa	-	-	-	-	-
Mazzaella leptorhynchos	-	0.01	-	-	-
non-coralline crust	25.00	10.00	1.00	0.01	1.00
Osmundea spectabilis	-	-	-	-	-
Phyllospadix spp.	-	-	-	-	-
Prionitis lanceolata	20.00	15.00	17.00	5.00	2.00
Prionitis lyallii	-	-	-	-	-
Silvetia compressa	-	-	2.00	-	-
Bare Rock	15.00	20.00	25.00	5.00	85.00
Bare Boulder	-	-	-	-	-
Bare Cobble	5.00	30.00	-	-	2.00
Sand	30.00	8.00	0.00	3.00	2.00

Table 8. Invertebrate and Fish Abundance in Tidepools at Hopkins

Site Name	Hopkins	Hopkins	Hopkins	Hopkins	Hopkins
Tidepool Number	1	2	3	4	5
No./ 0.25 m2					
Acanthinucella spp.	-	-	2.50	-	-
Alia carinata	-	-	-	-	-
Amphipholis squamata	-	-	-	-	-
Amphissa spp.	-	-	-	-	-
Amphissa versicolor	-	-	-	0.33	-
Barleeia spp.	-	-	-	-	-
Bittium spp.	-	-	-	-	-
Calliostoma ligatum	-	-	-	-	0.83
Cancer productus (juv)	-	-	-	-	-
Cirolana harfordi	-	-	-	-	-
Cirratulidae/Terebellidae	-	-	-	1.67	-
Corynactis californica	-	-	-	-	-
Crepidula spp.	-	-	-	5.00	0.83
Cyanoplax spp.	-	-	-	-	-
Dendronotus subramosus	-	-	-	-	-
Epilucina californica	-	-	-	-	-
Golfingia procera	-	-	-	0.33	0.83
Hemigrapsus nudus	-	-	-	-	-
Lepidozona spp.	-	-	-	-	-
Leptasterias spp.	-	0.50	-	-	-
Littorina keenae	-	-	1.25	-	-
Littorina scutulata	-	-	6.25	3.33	-
Lottia asmi	-	-	-	-	-
Lottia limatula	1.88	-	3.13	1.00	-
Lottia ochracea	-	-	-	-	-
Lottia pelta	-	-	-	-	-
Lottia scabra	-	-	-	-	-
Lottidae	1.88	-	-	4.00	0.83
Mopalia lignosa	-	-	-	-	-
Mopalia muscosa	-	-	0.63	0.67	0.83
Nuttalina californica	-	-	-	1.67	2.50
Ocenebra circumtexta	-	-	-	0.67	0.83
Ocenebra lurida	-	-	-	-	-
Ophiothrix spiculata	-	-	-	-	-
Pachygrapsus crassipes	0.63	0.50	-	-	1.67
Pagurus spp.	53.13	35.00	12.50	20.00	16.67
Petrolisthes spp.	-	-	-	-	-
Pugettia producta	-	-	-	0.33	-
Strongylocentrotus purpuratus	-	8.00	-	3.33	3.33
Tectura scutum	1.25	-	-	-	-
Tegula brunnea	-	-	-	-	-
Tegula funebralis	43.75	27.50	34.38	150.00	75.00
Tonicella lineata	-	-	-	-	-
Urticina coriacea	-	-	-	-	-
Percent Cover					
Anthopleura elegantissima/sola	-	10.00	-	10.00	20.00
Anthopleura xanthogrammica	-	-	-	-	-
colonial/social tunicates	-	-	-	-	-
encrusting sponge	-	0.01	-	1.00	-
Hydroida (unid)	-	-	-	0.01	-
Mytilus californianus	-	-	21.00	-	-
Phragmatopoma californica	-	-	-	0.01	0.01
Salmacina tribranchiata	2.00	0.01	0.01	-	-
Serpula vermicularis	-	-	-	-	-
Serpulidae	-	-	-	-	-
Serpulorbis squamigerus	-	-	-	-	-
Spirorbidae	-	-	-	0.01	0.01
Fishes (No./ 0.25 m2)					
Artedius spp.	-	-	-	-	-
Cebidichthys violaceus	-	-	-	-	-
Cottidae	-	1.00	-	1.33	0.83
Oligocottus spp.	-	-	-	-	-
Sebastes melanops (YOY)	-	-	-	-	-
			-		

Table 9. Invertebrate and Fish Abundance in Tidepools at Restless Sea

Site Name	Restless Sea	Restless Sea	Restless Sea	Restless Sea	Restless Sea
Tidepool Number	1	2	3	4	5
No./ 0.25 m2					
Acanthinucella spp.	-	-	-	1.00	-
Alia carinata	-	-	-	-	-
Amphipholis squamata	-	-	-	-	-
Amphissa spp.	-	-	-	-	-
Amphissa versicolor	-	-	-	-	-
Barleeia spp.	-	9.38	-	-	-
Bittium spp.	-	-	-	-	-
Calliostoma ligatum	-	-	-	-	-
Cancer productus (juv)	-	-	-	-	-
Cirolana harfordi	-	1.56	-	-	-
Cirratulidae/Terebellidae	-	-	-	1.00	-
Corynactis californica	-	-	-	-	-
Crepidula spp.	3.33	1.56	0.50	-	1.25
Cyanoplax spp.	-	-	-	1.00	-
Dendronotus subramosus	-	-	-	-	-
Epilucina californica	-	-	-	-	0.25
Golfingia procera	-	-	-	-	-
Hemigrapsus nudus	-	0.31	-	-	-
Lepidozona spp.	-	-	-	-	-
Leptasterias spp.	-	0.31	0.50	-	-
Littorina keenae	-	-	-	-	-
Littorina scutulata	-	-	-	1.00	-
Lottia asmi	-	-	-	1.00	-
Lottia limatula	-	-	-	20.00	-
Lottia ochracea	-	-	-	-	-
Lottia pelta	0.67	-	-	-	-
Lottia scabra	-	-	-	11.00	-
Lottidae	-	-	-	3.00	-
Mopalia lignosa	0.33	-	-	-	-
Mopalia muscosa	0.33	-	-	3.00	0.25
Nuttalina californica	-	-	-	1.00	-
Ocenebra circumtexta	-	-	-	-	-
Ocenebra lurida	-	-	-	-	-
Ophiothrix spiculata	-	-	-	-	-
Pachygrapsus crassipes	-	-	-	5.00	-
Pagurus spp.	183.33	187.50	250.00	5.00	375.00
Petrolisthes spp.	-	3.13	-	-	-
Pugettia producta	-	-	-	-	0.25
Strongylocentrotus purpuratus	8.00	0.63	0.50	1.00	-
Tectura scutum	1.67	0.31	0.50	-	-
Tegula brunnea	-	-	-	-	-
Tegula funebralis	15.00	25.00	10.00	125.00	20.00
Tonicella lineata	-	-	-	-	-
Urticina coriacea	0.33	-	-	-	-
Percent Cover					
Anthopleura elegantissima/sola	15.00	0.01	3.01	0.01	1.00
Anthopleura xanthogrammica	-	-	-	-	-
colonial/social tunicates	-	-	0.01	-	-
encrusting sponge	-	-	-	-	-
Hydroida (unid)	-	-	-	-	-
Mytilus californianus	-	-	-	-	-
Phragmatopoma californica	-	-	-	-	-
Salmacina tribranchiata	-	-	-	-	-
Serpula vermicularis	-	-	-	-	-
Serpulidae	-	-	-	-	-
Serpulorbis squamigerus	-	-	-	-	-
Spirorbidae	-	0.01	0.01	0.01	-
Fishes (No./ 0.25 m2)					
Artedius spp.	-	-	-	-	-
Cebidichthys violaceus	-	-	-	-	-
Cottidae	1.33	0.63	0.50	3.00	1.50
Oligocottus spp.	-	-	-	-	-
Sebastes melanops (YOY)	-	-	-	-	-

Table 10. Invertebrate and Fish Abundance in Tidepools at Sea Wall

Site Name	Sea Wall	Sea Wall	Sea Wall	Sea Wall	Sea Wall
Tidepool Number	1	2	3	4	5
No./ 0.25 m2					
Acanthinucella spp.	-	-	-	-	-
Alia carinata	-	0.50	-	-	-
Amphipholis squamata	-	-	-	-	-
Amphissa spp.	-	-	-	-	-
Amphissa versicolor	-	-	-	-	-
Barleeia spp.	-	-	-	-	-
Bittium spp.	-	-	-	-	-
Calliostoma ligatum	-	-	-	-	-
Cancer productus (juv)	-	-	-	-	-
Cirolana harfordi	-	-	1.88	-	-
Cirratulidae/Terebellidae	-	-	-	-	-
Corynactis californica	-	-	-	-	-
Crepidula spp.	0.29	1.50	-	-	-
Cyanoplax spp.	-	-	-	-	1.43
Dendronotus subramosus	-	-	-	-	-
Epilucina californica	-	-	-	-	-
Golfingia procera	-	-	-	-	0.71
Hemigrapsus nudus	-	-	-	-	-
Lepidozona spp.	-	-	-	-	-
Leptasterias spp.	-	0.30	2.50	-	4.29
Littorina keenae	-	-	-	-	-
Littorina scutulata	-	-	-	-	-
Lottia asmi	-	0.10	1.25	-	-
Lottia limatula	-	-	-	-	-
Lottia ochracea	-	-	-	-	-
Lottia pelta	-	-	-	-	-
Lottia scabra	-	-	-	-	-
Lottidae	-	-	-	-	-
Mopalia lignosa	-	-	-	-	-
Mopalia muscosa	-	0.10	-	-	-
Nuttalina californica	-	-	-	-	4.29
Ocenebra circumtexta	-	-	-	-	-
Ocenebra lurida	-	-	-	-	-
Ophiothrix spiculata	-	-	-	-	-
Pachygrapsus crassipes	-	-	-	0.50	0.71
Pagurus spp.	214.29	75.00	37.50	37.50	7.14
Petrolisthes spp.	-	-	-	-	-
Pugettia producta	0.29	-	-	-	-
Strongylocentrotus purpuratus	-	-	3.13	17.50	12.14
Tectura scutum	-	-	-	-	-
Tegula brunnea	-	-	-	-	0.71
Tegula funebralis	2.86	40.00	81.25	7.50	53.57
Tonicella lineata	-	0.10	-	-	-
Urticina coriacea	-	-	-	-	-
Percent Cover					
Anthopleura elegantissima/sola	-	-	0.01	1.00	16.00
Anthopleura xanthogrammica	-	-	1.00	1.00	-
colonial/social tunicates	-	0.01	0.01	-	-
encrusting sponge	-	-	0.01	0.01	-
Hydroida (unid)	-	-	-	-	-
Mytilus californianus	-	-	-	-	1.00
Phragmatopoma californica	-	-	-	-	0.01
Salmacina tribranchiata	-	-	-	-	-
Serpula vermicularis	-	-	-	-	-
Serpulidae	-	-	-	-	-
Serpulorbis squamigerus	-	-	-	-	-
Spirorbidae	-	0.01	0.01	-	0.01
Fishes (No./ 0.25 m2)					
Artedius spp.	-	0.10	-	-	-
Cebidichthys violaceus	-	-	-	-	-
Cottidae	-	-	0.63	-	2.14
Oligocottus spp.	-	-	-	-	-
Sebastes melanops (YOY)	-	-	-	-	-

Table 11. Invertebrate and Fish Abundance in Tidepools at Asilomar

Site Name	Asilomar	Asilomar	Asilomar	Asilomar	Asilomar
Tidepool Number	1	2	3	4	5
No./ 0.25 m2					
Acanthinucella spp.	-	0.31	1.00	1.00	1.00
Alia carinata	-	-	-	-	-
Amphipholis squamata	0.67	-	-	-	-
Amphissa spp.	-	-	-	-	-
Amphissa versicolor	-	-	-	-	-
Barleeia spp.	-	-	-	-	-
Bittium spp.	-	-	-	-	-
Calliostoma ligatum	-	-	-	-	-
Cancer productus (juv)	-	-	-	-	-
Cirolana harfordi	0.67	3.13	-	-	-
Cirratulidae/Terebellidae	-	-	1.00	-	-
Corynactis californica	-	-	-	-	-
Crepidula spp.	3.33	-	0.50	-	-
Cyanoplax spp.	-	-	1.00	-	0.67
Dendronotus subramosus	-	-	-	-	-
Epilucina californica	-	-	-	-	-
Golfingia procera	-	-	-	-	-
Hemigrapsus nudus	-	-	-	-	-
Lepidozona spp.	-	-	-	-	-
Leptasterias spp.	0.33	0.63	-	-	-
Littorina keenae	-	-	-	-	-
Littorina scutulata	-	-	-	-	8.33
Lottia asmi	1.67	-	0.50	-	-
Lottia limatula	1.00	1.56	3.00	0.50	2.33
Lottia ochracea	-	-	-	-	-
Lottia pelta	-	-	0.50	-	0.67
Lottia scabra	-	-	5.00	-	13.00
Lottidae	-	-	-	-	2.33
Mopalia lignosa	-	-	-	-	-
Mopalia muscosa	-	0.63	-	0.25	-
Nuttalina californica	-	-	-	-	-
Ocenebra circumtexta	-	-	-	-	-
Ocenebra lurida	-	-	-	-	-
Ophiothrix spiculata	-	0.31	-	-	-
Pachygrapsus crassipes	-	-	0.50	0.25	-
Pagurus spp.	13.33	14.06	52.50	8.75	6.33
Petrolisthes spp.	-	-	-	-	-
Pugettia producta	0.67	-	-	-	-
Strongylocentrotus purpuratus	4.00	1.56	-	3.75	-
Tectura scutum	-	-	5.00	-	0.67
Tegula brunnea	-	-	-	-	-
Tegula funebralis	110.00	54.69	37.50	35.00	48.33
Tonicella lineata	-	-	-	-	-
Urticina coriacea	-	-	-	-	-
Percent Cover					
Anthopleura elegantissima/sola	0.01	1.00	20.00	20.00	50.00
Anthopleura xanthogrammica	-	-	-	-	-
colonial/social tunicates	0.01	-	-	-	-
encrusting sponge	-	-	-	-	-
Hydroida (unid)	-	-	-	-	-
Mytilus californianus	-	-	-	-	-
Phragmatopoma californica	-	-	-	-	-
Salmacina tribranchiata	-	-	-	0.01	-
Serpula vermicularis	-	-	-	-	-
Serpulidae	-	-	-	-	-
Serpulorbis squamigerus	-	-	-	-	-
Spirorbidae	0.01	-	-	-	-
Fishes (No./ 0.25 m2)					
Artedius spp.	-	-	-	-	-
Cebidichthys violaceus	0.67	1.25	-	-	-
Cottidae	0.67	0.63	-	0.50	0.33
Oligocottus spp.	-	-	-	-	-
Sebastes melanops (YOY)	-	-	-	-	-

Table 12. Invertebrate and Fish Abundance in Tidepools at PP Lot 4-Center

Site Name	PP Lot 4-C	PP Lot 4-C	PP Lot 4-C	PP Lot 4-C	PP Lot 4-C
Tidepool Number	1	2	3	4	5
No./ 0.25 m2					
Acanthinucella spp.	-	0.75	1.25	0.33	0.29
Alia carinata	-	-	-	-	-
Amphipholis squamata	-	-	-	-	-
Amphissa spp.	0.42	-	-	-	-
Amphissa versicolor	-	-	-	-	-
Barleeia spp.	-	-	-	-	-
Bittium spp.	-	-	-	-	0.43
Calliostoma ligatum	-	-	-	-	-
Cancer productus (juv)	-	-	-	-	-
Cirolana harfordi	-	-	-	-	-
Cirratulidae/Terebellidae	-	-	-	-	-
Corynactis californica	2.08	-	-	-	-
Crepidula spp.	1.25	-	1.88	7.33	1.43
Cyanoplax spp.	-	2.25	1.00	-	0.14
Dendronotus subramosus	0.08	-	-	-	-
Epilucina californica	-	-	-	-	-
Golfingia procera	-	-	-	-	-
Hemigrapsus nudus	-	0.25	0.13	-	-
Lepidozona spp.	-	0.50	-	-	-
Leptasterias spp.	0.50	-	0.13	-	-
Littorina keenae	-	-	-	-	-
Littorina scutulata	-	0.25	-	-	-
Lottia asmi	0.83	-	1.25	-	0.43
Lottia limatula	-	0.75	1.25	-	0.29
Lottia ochracea	-	-	-	-	-
Lottia pelta	-	-	-	-	-
Lottia scabra	-	-	-	-	-
Lottidae	0.08	-	50.00	-	-
Mopalia lignosa	-	-	-	-	-
Mopalia muscosa	-	0.25	0.25	-	0.14
Nuttalina californica	-	-	-	-	-
Ocenebra circumtexta	-	-	-	-	-
Ocenebra lurida	0.08	-	-	-	-
Ophiothrix spiculata	-	-	-	-	-
Pachygrapsus crassipes	-	-	0.25	0.33	-
Pagurus spp.	9.17	20.00	16.25	36.67	27.14
Petrolisthes spp.	-	-	0.25	-	-
Pugettia producta	0.08	-	-	0.33	-
Strongylocentrotus purpuratus	0.25	-	-	-	-
Tectura scutum	-	-	0.63	0.33	1.71
Tegula brunnea	-	-	-	-	-
Tegula funebralis	54.17	68.75	81.25	80.00	37.14
Tonicella lineata	-	-	-	-	-
Urticina coriacea	-	-	-	-	-
Percent Cover					
Anthopleura elegantissima/sola	0.01	6.00	10.00	8.00	0.01
Anthopleura xanthogrammica	-	-	-	-	-
colonial/social tunicates	-	-	-	-	-
encrusting sponge	-	-	-	-	-
Hydroida (unid)	-	-	-	-	-
Mytilus californianus	-	-	-	-	-
Phragmatopoma californica	10.00	-	-	-	-
Salmacina tribranchiata	-	-	-	-	-
Serpula vermicularis	-	1.00	10.00	-	-
Serpulidae	10.00	-	-	-	-
Serpulorbis squamigerus	5.00	-	-	-	-
Spirorbidae	0.01	-	0.01	-	0.01
Fishes (No./ 0.25 m2)					
Artedius spp.	0.25	-	-	-	-
Cebidichthys violaceus	-	-	0.13	-	-
Cottidae	0.08	1.00	0.63	0.33	0.43
Oligocottus spp.	0.08	-	-	-	-
Sebastes melanops (YOY)	1.17	-	0.13	-	-

Table 13. Invertebrate and Fish Abundance in Tidepools at PP Lot 2

Site Name	PP Lot 2	PP Lot 2	PP Lot 2	PP Lot 2	PP Lot 2
Tidepool Number	1	2	3	4	5
No./ 0.25 m2					
Acanthinucella spp.	0.13	1.50	0.80	1.50	0.60
Alia carinata	-	-	-	-	-
Amphipholis squamata	-	-	-	-	-
Amphissa spp.	-	-	-	-	-
Amphissa versicolor	-	-	-	-	-
Barleeia spp.	-	-	-	-	-
Bittium spp.	-	-	-	-	-
Calliostoma ligatum	-	-	-	-	-
Cancer productus (juv)	0.13	-	-	-	-
Cirolana harfordi	-	-	-	-	-
Cirratulidae/Terebellidae	-	-	-	-	-
Corynactis californica	-	-	-	-	-
Crepidula spp.	-	-	-	-	-
Cyanoplax spp.	-	-	0.20	-	0.20
Dendronotus subramosus	-	-	-	-	-
Epilucina californica	-	-	-	-	-
Golfingia procera	-	-	-	-	-
Hemigrapsus nudus	-	-	-	-	-
Lepidozona spp.	-	-	-	-	-
Leptasterias spp.	0.38	-	-	-	-
Littorina keenae	-	-	-	-	-
Littorina scutulata	-	-	-	1.00	1.00
Lottia asmi	-	-	1.00	-	-
Lottia limatula	1.50	3.50	0.60	0.50	0.60
Lottia ochracea	-	-	-	-	-
Lottia pelta	-	-	-	-	-
Lottia scabra	-	-	-	0.50	3.00
Lottidae	-	-	-	2.00	-
Mopalia lignosa	-	-	-	-	-
Mopalia muscosa	1.13	0.50	0.40	0.50	0.40
Nuttalina californica	-	-	0.20	-	-
Ocenebra circumtexta	-	-	-	-	-
Ocenebra lurida	-	-	-	-	-
Ophiothrix spiculata	-	-	-	-	-
Pachygrapsus crassipes	0.13	1.00	0.20	0.50	-
Pagurus spp.	10.00	10.00	14.00	3.50	17.00
Petrolisthes spp.	-	-	-	-	-
Pugettia producta	-	-	-	-	-
Strongylocentrotus purpuratus	0.75	0.50	-	1.50	-
Tectura scutum	-	1.00	-	0.50	2.00
Tegula brunnea	-	-	-	-	-
Tegula funebralis	81.25	70.00	50.00	150.00	43.00
Tonicella lineata	-	-	-	-	-
Urticina coriacea	-	-	-	-	-
Percent Cover					
Anthopleura elegantissima/sola	-	-	18.00	2.00	-
Anthopleura xanthogrammica	-	-	-	-	-
colonial/social tunicates	-	-	-	-	-
encrusting sponge	-	-	-	-	-
Hydroida (unid)	-	-	-	-	-
Mytilus californianus	-	-	-	-	-
Phragmatopoma californica	-	-	-	-	-
Salmacina tribranchiata	-	-	-	-	-
Serpula vermicularis	-	-	2.00	-	-
Serpulidae	-	-	-	1.00	-
Serpulorbis squamigerus	-	-	-	-	-
Spirorbidae	0.01	0.01	-	0.01	-
Fishes (No./ 0.25 m2)					
Artedius spp.	0.13	-	0.00	-	-
Cebidichthys violaceus	0.25	-	0.00	-	-
Cottidae	0.25	-	0.60	-	0.60
Oligocottus spp.	-	-	-	0.50	-
Sebastes melanops (YOY)	-	-	-	0.00	-

Table 14. Invertebrate and Fish Abundance in Tidepools at PP Lot 4-North

Site Name	PP Lot 5-North	PP Lot 5-North	PP Lot 5-North	PP Lot 5-North	PP Lot 5-North
Tidepool Number	1	2	3	4	5
No./ 0.25 m2					
Acanthinucella spp.	-	0.16	2.50	-	1.88
Alia carinata	-	-	-	-	-
Amphipholis squamata	-	-	-	-	-
Amphissa spp.	-	-	-	-	-
Amphissa versicolor	0.33	-	-	-	-
Barleeia spp.	-	-	-	-	-
Bittium spp.	-	-	-	-	0.63
Calliostoma ligatum	-	-	-	-	-
Cancer productus (juv)	-	-	-	-	-
Cirolana harfordi	-	-	-	-	-
Cirratulidae/Terebellidae	-	-	-	-	-
Corynactis californica	-	-	-	-	-
Crepidula spp.	-	2.34	-	-	-
Cyanoplax spp.	-	-	-	-	1.88
Dendronotus subramosus	-	-	-	-	-
Epilucina californica	-	-	-	-	-
Golfingia procera	-	-	-	-	-
Hemigrapsus nudus	0.17	-	-	-	0.63
Lepidozona spp.	-	-	-	-	-
Leptasterias spp.	1.67	-	-	-	-
Littorina keenae	-	-	-	-	-
Littorina scutulata	-	-	-	-	-
Lottia asmi	0.83	-	-	-	-
Lottia limatula	-	-	-	3.50	0.31
Lottia ochracea	-	0.94	-	-	-
Lottia pelta	-	-	-	-	-
Lottia scabra	-	-	-	2.00	10.94
Lottidae	-	-	-	0.50	3.13
Mopalia lignosa	-	-	-	-	-
Mopalia muscosa	-	0.16	0.83	-	-
Nuttalina californica	-	-	-	-	-
Ocenebra circumtexta	-	-	0.83	-	-
Ocenebra lurida	-	-	-	-	-
Ophiothrix spiculata	0.17	-	-	-	-
Pachygrapsus crassipes	0.17	0.31	-	0.50	-
Pagurus spp.	25.00	23.44	10.00	2.00	12.50
Petrolisthes spp.	-	-	-	-	-
Pugettia producta	-	-	-	-	-
Strongylocentrotus purpuratus	-	-	-	-	-
Tectura scutum	-	0.47	-	-	-
Tegula brunnea	-	-	-	-	-
Tegula funebralis	50.00	62.50	20.83	0.50	39.06
Tonicella lineata	-	-	-	-	-
Urticina coriacea	-	-	-	-	-
Percent Cover					
Anthopleura elegantissima/sola	-	-	-	-	-
Anthopleura xanthogrammica	-	-	-	-	-
colonial/social tunicates	-	-	-	-	-
encrusting sponge	-	-	-	-	-
Hydroida (unid)	-	-	-	-	-
Mytilus californianus	-	-	-	-	-
Phragmatopoma californica	-	-	-	-	-
Salmacina tribranchiata	-	-	-	-	-
Serpula vermicularis	-	-	-	-	-
Serpulidae	-	-	-	-	-
Serpulorbis squamigerus	-	-	-	-	-
Spirorbidae	0.01	0.01	0.01	0.01	-
Fishes (No./ 0.25 m2)					
Artedius spp.	-	-	-	-	-
Cebidichthys violaceus	-	-	-	-	0.31
Cottidae	0.67	0.31	-	-	0.31
Oligocottus spp.	-	-	-	-	-
Sebastes melanops (YOY)	-	-	-	-	-

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Table 1. Algal and Substrate Mean Percent Cover in Perimeter Tidepool Quadrats at Hopkins

Site Name	Hopkins	Hopkins	Hopkins	Hopkins	Hopkins
Tidepool Number	1	2	3	4	5
Bossiella spp.	-	-	-	-	-
Callithamnion pikeanum	-	-	-	-	-
Chondracanthus canaliculatus	-	-	-	-	-
Chrysophyta (unid)	-	-	-	-	-
Cladophora spp.	0.34	0.67	0.01	0.01	0.01
Corallina vancouveriensis	-	0.33	<0.01	-	<0.01
coralline crust	2.67	4.34	4.67	0.67	2.00
Cryptosiphonia woodii	-	-	-	-	-
Endocladia muricata	45.00	58.33	4.00	25.67	36.67
Fucus gardneri	-	-	-	-	-
Gelidium coulteri	-	-	-	-	-
Gelidium pusillum	<0.01	0.67	6.00	2.00	2.33
Hesperophycus californicus	-	-	-	-	-
articulated coralline algae (juv.)	-	-	-	-	-
Mastocarpus jardinii	1.00	9.00	-	0.33	-
Mastocarpus papillatus	33.33	11.67	23.33	28.33	25.00
Mazzaella affinis	-	-	-	-	0.01
Mazzaella flaccida	-	-	-	-	-
Mazzaella leptorhynchos	-	-	-	-	-
Microcladia borealis	-	-	-	-	-
non-coralline crust	2.67	2.67	4.33	6.00	4.67
Pelvetiopsis limitata	-	-	-	-	-
Porphyra spp.	<0.01	1.00	-	-	-
Prionitis lanceolata	-	-	-	-	-
Silvetia compressa	-	-	-	-	-
Upright algal cover	79.68	81.67	33.35	56.34	64.02
Mean No. Species / 0.25 m^2	5.67	6.67	5.33	5.33	7.33
Bare Rock	20.00	17.33	60.00	40.00	45.00
Bare Cobble	-	-	0.33	-	-
Sand	0.33	-	0.33	-	-

Table 2. Algal and Substrate Mean Percent Cover in Perimeter Tidepool Quadrats at Restless Sea

Site Name	Restless Sea	Restless Sea	Restless Sea	Restless Sea	Restless Sea
Tidepool Number	1	2	3	4	5
Bossiella spp.	-	-	-	-	-
Callithamnion pikeanum	<0.01	-	-	-	-
Chondracanthus canaliculatus	-	<0.01	-	-	<0.01
Chrysophyta (unid)	-	-	-	-	-
Cladophora spp.	0.67	0.01	0.34	2.34	0.67
Corallina vancouveriensis	5.33	<0.01	<0.01	-	2.00
coralline crust	11.00	0.01	0.67	0.34	1.00
Cryptosiphonia woodii	-	-	-	-	-
Endocladia muricata	16.67	20.67	21.67	3.00	15.00
Fucus gardneri	-	-	4.00	-	3.67
Gelidium coulteri	0.01	3.34	-	-	2.00
Gelidium pusillum	0.01	0.67	0.33	-	0.01
Hesperophycus californicus	1.67	-	6.67	3.00	-
articulated coralline algae (juv.)	-	-	-	-	-
Mastocarpus jardinii	5.00	1.67	1.67	-	3.33
Mastocarpus papillatus	20.33	21.67	10.67	1.00	11.67
Mazzaella affinis	<0.01	5.00	<0.01	-	0.01
Mazzaella flaccida	0.34	8.34	<0.01	-	<0.01
Mazzaella leptorhynchos	-	4.67	-	-	-
Microcladia borealis	-	-	-	-	-
non-coralline crust	7.00	9.67	11.67	0.01	21.67
Pelvetiopsis limitata	-	-	-	1.67	-
Porphyra spp.	1.67	-	-	0.01	-
Prionitis lanceolata	-	-	-	-	-
Silvetia compressa	29.33	<0.01	7.33	1.00	58.33
Upright algal cover	81.03	66.03	52.69	12.02	96.70
Mean No. Species / 0.25 m^2	11.33	9.67	8.67	8.00	11.33
Bare Rock	19.00	22.67	56.67	94.67	20.33
Bare Cobble	-	-	-	-	-
Sand	0.33	6.00	-	-	6.00

Table 3. Algal and Substrate Mean Percent Cover in Perimeter Tidepool Quadrats at Sea Wall

Site Name	Sea Wall	Sea Wall	Sea Wall	Sea Wall	Sea Wall
Tidepool Number	1	2	3	4	5
Bossiella spp.	-	-	-	<0.01	-
Callithamnion pikeanum	-	-	-	-	-
Chondracanthus canaliculatus	10.67	-	-	<0.01	-
Chrysophyta (unid)	-	-	-	-	-
Cladophora spp.	0.34	0.01	0.01	0.34	1.00
Corallina vancouveriensis	-	-	-	9.00	8.34
coralline crust	<0.01	0.01	0.67	14.33	11.67
Cryptosiphonia woodii	-	-	-	-	-
Endocladia muricata	-	1.00	20.00	18.33	23.33
Fucus gardneri	-	-	-	1.67	-
Gelidium coulteri	8.33	3.67	0.00	7.33	-
Gelidium pusillum	4.00	11.67	1.67	1.00	<0.01
Hesperophycus californicus	-	-	-	-	-
articulated coralline algae (juv.)	-	-	-	-	-
Mastocarpus jardinii	-	-	-	4.33	5.67
Mastocarpus papillatus	45.00	25.00	26.67	15.00	14.00
Mazzaella affinis	11.67	1.33	6.00	2.33	0.33
Mazzaella flaccida	-	-	-	8.33	0.33
Mazzaella leptorhynchos	0.34	1.00	-	-	-
Microcladia borealis	-	-	-	0.00	-
non-coralline crust	3.00	11.67	8.67	15.00	16.67
Pelvetiopsis limitata	-	-	-	-	-
Porphyra spp.	-	-	-	-	-
Prionitis lanceolata	-	-	-	-	-
Silvetia compressa	-	-	1.67	-	0.33
Upright algal cover	80.34	43.67	56.01	67.68	53.34
Mean No. Species / 0.25 m^2	7.33	7.00	6.33	10.67	8.00
Bare Rock	20.00	17.33	60.00	40.00	45.00
Bare Cobble	-	-	0.33	-	-
Sand	0.33	-	0.33	-	-

Table 4. Algal and Substrate Mean Percent Cover in Perimeter Tidepool Quadrats at Asilomar

Site Name	Asilomar	Asilomar	Asilomar	Asilomar	Asilomar
Tidepool Number	1	2	3	4	5
Bossiella spp.	-	-	-	-	-
Callithamnion pikeanum	-	-	-	-	-
Chondracanthus canaliculatus	1.67	0.33	-	-	-
Chrysophyta (unid)	-	-	-	-	-
Cladophora spp.	6.33	8.33	4.33	1.67	0.67
Corallina vancouveriensis	-	<0.01	<0.01	<0.01	<0.01
coralline crust	2.00	2.67	9.67	3.00	<0.01
Cryptosiphonia woodii	-	0.00	-	-	-
Endocladia muricata	6.33	7.00	3.67	9.33	0.67
Fucus gardneri	8.34	-	-	<0.01	-
Gelidium coulteri	1.00	0.34	-	<0.01	-
Gelidium pusillum	14.33	12.00	1.67	0.67	-
Hesperophycus californicus	-	-	7.00	<0.01	10.00
articulated coralline algae (juv.)	-	-	-	-	-
Mastocarpus jardinii	-	-	-	-	-
Mastocarpus papillatus	26.67	33.33	15.00	45.00	16.67
Mazzaella affinis	8.34	6.67	-	-	-
Mazzaella flaccida	-	-	-	-	-
Mazzaella leptorhynchos	-	0.01	-	-	-
Microcladia borealis	-	-	-	-	-
non-coralline crust	23.33	10.67	5.67	3.67	1.67
Pelvetiopsis limitata	-	-	-	-	-
Porphyra spp.	-	-	-	0.01	<0.01
Prionitis lanceolata	-	-	-	-	-
Silvetia compressa	13.33	3.00	15.67	20.00	-
Upright algal cover	86.34	71.02	47.34	76.69	28.02
Mean No. Species / 0.25 m^2	9.33	9.33	7.33	9.00	5.67
Bare Rock	15.00	26.67	61.67	30.00	81.67
Bare Cobble	-	0.67	-	-	-
Sand	2.67	3.67	-	0.67	-

Table 5. Algal and Substrate Mean Percent Cover in Perimeter Tidepool Quadrats at PP Lot 4-Center

Site Name	PP Lot 4-C	PP Lot 4-C	PP Lot 4-C	PP Lot 4-C	PP Lot 4-C
Tidepool Number	1	2	3	4	5
Bossiella spp.	-	-	-	-	-
Callithamnion pikeanum	-	-	-	-	-
Chondracanthus canaliculatus	-	-	-	-	-
Chrysophyta (unid)	-	-	-	-	-
Cladophora spp.	0.01	<0.01	0.01	0.01	<0.01
Corallina vancouveriensis	-	-	<0.01	-	-
coralline crust	0.67	0.01	1.34	<0.01	0.01
Cryptosiphonia woodii	1.67	-	-	-	-
Endocladia muricata	-	-	11.33	<0.01	-
Fucus gardneri	-	-	0.00	-	-
Gelidium coulteri	12.34	-	-	-	-
Gelidium pusillum	1.67	0.01	<0.01	0.01	-
Hesperophycus californicus	-	-	-	-	-
articulated coralline algae (juv.)	0.01	0.34	-	-	-
Mastocarpus jardinii	-	-	-	-	-
Mastocarpus papillatus	38.33	19.00	15.00	5.67	7.33
Mazzaella affinis	1.67	-	-	-	<0.01
Mazzaella flaccida	0.34	-	-	-	-
Mazzaella leptorhynchos	-	-	-	0.33	-
Microcladia borealis	-	-	-	-	-
non-coralline crust	3.34	1.00	5.01	9.00	3.00
Pelvetiopsis limitata	-	-	-	-	-
Porphyra spp.	0.67	5.00	0.67	-	-
Prionitis lanceolata	-	-	-	<0.01	-
Silvetia compressa	-	2.67	1.67	-	-
Upright algal cover	56.70	27.02	28.69	6.03	7.34
Mean No. Species / 0.25 m^2	10.00	5.33	7.00	5.33	3.33
Bare Rock	28.33	71.67	65.00	80.00	78.67
Bare Cobble	2.00	-	-	<0.01	4.67
Sand	12.33	0.67	-	-	1.67

Table 6. Algal and Substrate Mean Percent Cover in Perimeter Tidepool Quadrats at PP Lot 2

Site Name	PP Lot 2	PP Lot 2	PP Lot 2	PP Lot 2	PP Lot 2
Tidepool Number	1	2	3	4	5
Bossiella spp.	-	-	-	-	-
Callithamnion pikeanum	-	-	-	-	-
Chondracanthus canaliculatus	-	-	-	-	-
Chrysophyta (unid)	-	-	-	-	-
Cladophora spp.	0.01	0.34	16.67	5.01	0.01
Corallina vancouveriensis	-	-	-	-	-
coralline crust	0.01	0.01	0.01	2.00	3.00
Cryptosiphonia woodii	-	-	-	-	-
Endocladia muricata	0.33	0.01	0.33	1.67	0.33
Fucus gardneri	-	-	-	-	-
Gelidium coulteri	0.00	-	-	-	-
Gelidium pusillum	14.33	2.00	11.33	1.67	4.67
Hesperophycus californicus	-	-	-	-	-
articulated coralline algae (juv.)	-	-	-	-	-
Mastocarpus jardinii	-	-	-	-	-
Mastocarpus papillatus	20.67	33.33	50.00	55.00	55.00
Mazzaella affinis	-	<0.01	1.67	1.33	-
Mazzaella flaccida	-	-	-	-	-
Mazzaella leptorhynchos	-	0.00	-	-	-
Microcladia borealis	-	-	-	-	-
non-coralline crust	7.33	4.34	1.33	1.33	1.67
Pelvetiopsis limitata	-	-	-	-	-
Porphyra spp.	-	-	-	-	-
Prionitis lanceolata	-	-	-	-	-
Silvetia compressa	-	-	-	-	-
Upright algal cover	35.34	35.69	80.00	64.68	60.01
Mean No. Species / 0.25 m^2	5.33	6.33	5.67	5.67	5.33
Bare Rock	51.67	71.67	20.00	50.00	35.00
Bare Cobble	1.00	2.33	-	-	-
Sand	5.33	0.67	2.00	-	1.34

Table 7. Algal and Substrate Mean Percent Cover in Perimeter Tidepool Quadrats at PP Lot 5-North

Site Name	PP Lot 5-N	PP Lot 5-N	PP Lot 5-N	PP Lot 5-N	PP Lot 5-N
Tidepool Number	1	2	3	4	5
Bossiella spp.	-	-	-	-	-
Callithamnion pikeanum	-	-	-	-	-
Chondracanthus canaliculatus	0.33	-	-	-	-
Chrysophyta (unid)	-	-	-	93.33	-
Cladophora spp.	0.34	0.01	0.34	0.00	-
Corallina vancouveriensis	1.67	-	4.00	-	-
coralline crust	4.01	<0.01	6.33	0.01	-
Cryptosiphonia woodii	-	-	-	-	-
Endocladia muricata	-	-	1.33	-	-
Fucus gardneri	13.33	-	4.00	-	-
Gelidium coulteri	5.00	-	1.67	-	-
Gelidium pusillum	15.67	2.00	6.00	<0.01	-
Hesperophycus californicus	-	-	-	-	-
articulated coralline algae (juv.)	-	-	-	-	-
Mastocarpus jardinii	1.00	-	-	-	-
Mastocarpus papillatus	9.33	13.33	16.67	0.01	0.34
Mazzaella affinis	-	-	<0.01	-	-
Mazzaella flaccida	-	-	-	-	-
Mazzaella leptorhynchos	-	-	-	-	-
Microcladia borealis	-	-	-	-	-
non-coralline crust	5.33	3.67	21.67	0.01	1.33
Pelvetiopsis limitata	-	-	-	-	-
Porphyra spp.	-	-	0.33	-	-
Prionitis lanceolata	0.01	-	-	-	-
Silvetia compressa	15.00	<0.01	66.67	-	-
Upright algal cover	61.68	15.35	101.01	93.35	0.34
Mean No. Species / 0.25 m^2	8.33	4.67	9.33	4.33	1.67
Bare Rock	51.67	81.67	24.00	6.67	98.33
Bare Cobble	-	-	-	-	-
Sand	5.00	-	-	-	0.33

Table 8. Invertebrate Abundance in Perimeter Tidepool Quadrats at Hopkins

Site Name	Hopkins	Hopkins	Hopkins	Hopkins	Hopkins
Tidepool Number	1	2	3	4	5
Mean No. / 0.25 m^2					
Acanthinucella spp.	-	0.33	-	3.00	1.67
Bittium spp.	-	-	-	-	-
Cirratulidae/Terebellidae	-	-	-	-	-
Crepidula spp.	-	1.67	-	1.33	0.67
Cyanoplax spp.	0.67	-	-	0.33	-
Fissurella volcano	-	-	-	-	-
Hemigrapsus nudus	-	-	-	-	-
Ishnochitonidae (juv)	-	-	-	-	-
Leptasterias spp.	-	-	-	-	-
Littorina planaxis	3.33	-	30.00	-	-
Littorina scutulata	25.33	7.00	55.33	23.33	3.00
Lottia asmi	0.33	0.33	-	0.33	1.33
Lottia digitalis	2.00	2.00	-	-	-
Lottia limatula	0.33	0.67	1.33	1.33	1.33
Lottia pelta	0.33	-	-	-	-
Lottidae	-	-	-	-	0.33
Macclintockia scabra	6.33	3.33	-	19.00	5.67
Mopalia muscosa	-	0.33	-	-	-
Nucella emarginata	-	3.00	-	-	-
Nuttalina californica	0.67	2.00	-	0.67	1.67
Ocenebra circumtexta	0.33	-	-	0.67	-
Pachygrapsus crassipes	0.67	0.33	0.33	-	0.67
Pagurus spp.	0.67	-	4.67	2.00	0.67
Paranemertes peregrina	-	-	-	-	-
Petrolisthes spp.	-	-	-	-	-
Phragmatopoma californica	-	-	-	-	<0.01
Pollicipes polymerus	-	-	-	-	-
Pugettia producta	-	-	-	-	-
Strongylocentrotus purpuratus	-	1.33	-	-	-
Tectura scutum	-	-	0.33	1.33	-
Tegula funebralis	13.67	17.67	7.33	42.33	88.33
Mean Percent Cover					
Anthopleura sola/elegantissima	0.67	0.67	-	-	0.34
Anthopleura xanthogrammica	-	-	-	-	-
Salmacina tribranchiata	0.00	-	-	-	-
Serpulorbis squamigerus	-	-	-	-	-
Spirorbidae	-	-	-	-	-
Balanus spp.	0.67	5.00	-	-	-
Chthamalus fissus	0.01	1.67	2.67	0.01	<0.01
Mytilus californianus	1.67	5.00	0.67	-	-
Haliclona spp.	-	-	-	-	-
Tetraclita rubescens	-	4.00	-	-	-
colonial/social tunicates	-	-	-	-	-
Mean No. Species / 0.25 m^2	10.00	8.33	6.67	8.33	9.33

Table 9. Invertebrate Abundance in Perimeter Tidepool Quadrats at Restless Sea

Site Name	Restless Sea	Restless Sea	Restless Sea	Restless Sea	Restless Sea
Tidepool Number	1	2	3	4	5
Mean No. / 0.25 m^2					
Acanthinucella spp.	-	-	-	-	0.33
Bittium spp.	0.33	-	-	-	0.33
Cirratulidae/Terebellidae	-	-	-	-	-
Crepidula spp.	-	0.33	0.33	0.67	2.00
Cyanoplax spp.	-	-	2.67	-	0.33
Fissurella volcano	0.33	-	-	-	-
Hemigrapsus nudus	-	0.67	-	-	-
Ishnochitonidae (juv)	-	-	-	-	-
Leptasterias spp.	-	-	-	-	0.33
Littorina planaxis	-	-	-	-	-
Littorina scutulata	6.67	2.00	9.33	44.00	1.67
Lottia asmi	-	-	-	0.33	0.67
Lottia digitalis	-	-	1.00	2.00	-
Lottia limatula	0.33	0.33	1.00	-	0.33
Lottia pelta	0.67	0.67	2.00	-	0.67
Lottidae	-	-	0.33	-	-
Maclintockia scabra	6.67	-	1.00	17.67	0.67
Mopalia muscosa	-	-	-	-	0.33
Nucella emarginata	-	-	-	-	-
Nuttalina californica	-	-	-	-	-
Ocenebra circumtexta	-	-	-	-	-
Pachygrapsus crassipes	0.67	0.33	0.33	-	-
Pagurus spp.	4.67	14.33	1.67	-	3.00
Paranemertes peregrina	-	-	-	-	-
Petrolisthes spp.	-	-	-	-	-
Phragmatopoma californica	-	-	-	-	-
Pollicipes polymerus	-	-	-	-	-
Pugettia producta	-	-	-	-	-
Strongylocentrotus purpuratus	-	-	-	-	-
Tectura scutum	-	0.33	-	-	-
Tegula funebralis	28.00	8.00	10.67	6.67	14.33
Mean Percent Cover					
Anthopleura sola/elegantissima	0.67	1.67	0.67	<0.01	0.67
Anthopleura xanthogrammica	-	0.67	-	-	-
Salmacina tribranchiata	-	-	-	-	-
Serpulorbis squamigerus	-	-	-	-	-
Spirorbidae	-	-	-	-	-
Balanus spp.	-	-	-	-	-
Chthamalus fissus	0.01	-	<0.01	0.01	-
Mytilus californianus	0.67	-	-	-	-
Haliclona spp.	-	<0.01	-	-	<0.01
Tetraclita rubescens	-	-	<0.01	-	-
colonial/social tunicates	-	-	-	-	-
Mean No. Species / 0.25 m^2	7.67	6.00	7.67	5.33	8.33

Table 10. Invertebrate Abundance in Perimeter Tidepool Quadrats at Sea Wall

Site Name	Sea Wall	Sea Wall	Sea Wall	Sea Wall	Sea Wall
Tidepool Number	1	2	3	4	5
Mean No. / 0.25 m^2					
Acanthinucella spp.	-	-	-	-	-
Bittium spp.	-	-	-	-	-
Cirratulidae/Terebellidae	-	-	-	-	-
Crepidula spp.	1.00	2.33	2.67	-	1.33
Cyanoplax spp.	-	-	-	-	0.33
Fissurella volcano	-	-	-	-	-
Hemigrapsus nudus	-	-	-	-	-
Ishnochitonidae (juv)	-	-	-	-	-
Leptasterias spp.	-	-	-	0.33	1.33
Littorina planaxis	-	-	-	-	-
Littorina scutulata	-	-	-	-	0.33
Lottia asmi	0.67	1.00	-	1.67	1.00
Lottia digitalis	-	-	-	-	-
Lottia limatula	0.33	-	1.33	-	0.67
Lottia pelta	-	-	-	0.33	0.33
Lottidae	-	-	-	-	-
Macclintockia scabra	-	-	-	5.00	-
Mopalia muscosa	0.67	-	-	-	-
Nucella emarginata	-	-	-	-	-
Nuttalina californica	-	-	0.33	2.33	4.00
Ocenebra circumtexta	-	-	-	0.67	-
Pachygrapsus crassipes	-	0.33	-	0.33	0.33
Pagurus spp.	3.33	3.00	0.67	5.67	2.67
Paranemertes peregrina	-	-	-	0.67	-
Petrolisthes spp.	-	-	-	-	-
Phragmatopoma californica	-	-	-	0.00	-
Pollicipes polymerus	-	-	-	5.00	-
Pugettia producta	-	-	-	-	-
Strongylocentrotus purpuratus	-	-	-	-	-
Tectura scutum	-	-	1.33	-	-
Tegula funebralis	15.00	24.00	37.33	93.33	59.67
Mean Percent Cover					
Anthopleura sola/elegantissima	-	0.67	0.33	2.33	4.33
Anthopleura xanthogrammica	-	-	-	-	-
Salmacina tribranchiata	-	-	-	0.00	-
Serpulorbis squamigerus	-	-	-	0.67	-
Spirorbidae	-	-	-	<0.01	<0.01
Balanus spp.	-	-	-	-	-
Chthamalus fissus	-	-	-	<0.01	0.67
Mytilus californianus	-	-	-	1.33	0.01
Haliclona spp.	-	-	-	-	-
Tetraclita rubescens	-	-	-	4.00	0.01
colonial/social tunicates	-	-	-	<0.01	-
Mean No. Species / 0.25 m^2	4.00	4.67	3.67	10.00	10.67

Table 11. Invertebrate Abundance in Perimeter Tidepool Quadrats at Asilomar

Site Name	Asilomar	Asilomar	Asilomar	Asilomar	Asilomar
Tidepool Number	1	2	3	4	5
Mean No. / 0.25 m^2					
Acanthinucella spp.	-	0.33	-	1.67	-
Bittium spp.	-	-	-	-	-
Cirratulidae/Terebellidae	-	-	0.33	-	1.00
Crepidula spp.	0.67	2.33	-	-	-
Cyanoplax spp.	0.33	-	-	0.33	0.33
Fissurella volcano	-	-	-	-	-
Hemigrapsus nudus	-	-	-	-	-
Ishnochitonidae (juv)	-	-	-	-	-
Leptasterias spp.	-	0.33	-	-	-
Littorina planaxis	-	-	-	-	-
Littorina scutulata	-	-	21.00	1.33	48.67
Lottia asmi	-	3.00	1.33	0.67	-
Lottia digitalis	-	-	-	0.67	-
Lottia limatula	-	0.33	2.33	0.67	0.33
Lottia pelta	-	-	3.67	0.33	0.33
Lottidae	-	-	0.33	-	-
Macclintockia scabra	-	-	2.00	11.00	3.67
Mopalia muscosa	-	0.33	-	-	-
Nucella emarginata	-	-	-	-	-
Nuttalina californica	-	-	-	-	-
Ocenebra circumtexta	-	-	-	-	-
Pachygrapsus crassipes	1.00	0.33	-	0.33	0.67
Pagurus spp.	5.67	7.33	6.00	0.67	1.00
Paranemertes peregrina	-	-	-	0.33	-
Petrolisthes spp.	-	-	-	-	-
Phragmatopoma californica	-	-	-	-	-
Pollicipes polymerus	-	-	-	-	-
Pugettia producta	0.33	-	-	-	-
Strongylocentrotus purpuratus	-	-	-	-	-
Tectura scutum	-	1.33	-	-	-
Tegula funebralis	76.67	88.33	56.00	46.00	3.67
Mean Percent Cover					
Anthopleura sola/elegantissima	3.67	1.00	4.00	3.34	0.00
Anthopleura xanthogrammica	-	-	-	-	-
Salmacina tribranchiata	-	-	-	-	-
Serpulorbis squamigerus	-	-	-	-	-
Spirorbidae	-	-	-	-	-
Balanus spp.	-	-	-	-	-
Chthamalus fissus	-	-	0.01	0.01	0.01
Mytilus californianus	-	-	-	-	-
Haliclona spp.	-	-	-	-	-
Tetraclita rubescens	-	-	-	-	-
colonial/social tunicates	-	-	-	-	-
Mean No. Species / 0.25 m^2	4.67	6.00	8.67	8.00	6.33

Table 12. Invertebrate Abundance in Perimeter Tidepool Quadrats at PP Lot 4-Center

Site Name	PP Lot 4-C	PP Lot 4-C	PP Lot 4-C	PP Lot 4-C	PP Lot 4-C
Tidepool Number	1	2	3	4	5
Mean No. / 0.25 m^2					
Acanthinucella spp.	-	-	-	-	-
Bittium spp.	0.33	-	-	-	-
Cirratulidae/Terebellidae	-	-	-	-	-
Crepidula spp.	3.67	0.67	-	0.67	0.67
Cyanoplax spp.	-	-	0.67	-	-
Fissurella volcano	-	-	-	-	-
Hemigrapsus nudus	-	-	-	-	-
Ishnochitonidae (juv)	-	-	-	-	-
Leptasterias spp.	-	-	0.33	-	-
Littorina planaxis	-	-	-	-	-
Littorina scutulata	-	6.67	0.33	0.67	-
Lottia asmi	-	-	0.33	-	0.33
Lottia digitalis	-	1.33	22.33	1.33	2.33
Lottia limatula	-	-	2.00	0.33	0.67
Lottia pelta	-	-	-	-	-
Lottidae	-	0.67	-	-	1.00
Macclintockia scabra	-	1.33	9.67	-	3.00
Mopalia muscosa	1.00	-	-	-	-
Nucella emarginata	-	-	-	-	-
Nuttalina californica	-	-	-	-	-
Ocenebra circumtexta	-	-	-	-	-
Pachygrapsus crassipes	-	-	-	-	-
Pagurus spp.	8.33	2.00	1.00	1.33	6.00
Paranemertes peregrina	0.33	-	-	-	-
Petrolisthes spp.	-	-	-	-	-
Phragmatopoma californica	-	-	-	-	-
Pollicipes polymerus	-	-	-	-	-
Pugettia producta	-	-	-	-	-
Strongylocentrotus purpuratus	-	-	-	-	-
Tectura scutum	-	-	-	0.67	-
Tegula funebralis	108.33	14.67	15.00	33.67	28.00
Mean Percent Cover					
Anthopleura sola/elegantissima	0.67	0.33	2.00	5.00	4.67
Anthopleura xanthogrammica	-	-	-	-	-
Salmacina tribranchiata	-	-	-	-	-
Serpulorbis squamigerus	-	-	-	-	-
Spirorbidae	-	-	-	-	-
Balanus spp.	-	-	-	-	-
Chthamalus fissus	-	-	0.33	-	0.00
Mytilus californianus	-	-	-	-	-
Haliclona spp.	-	-	-	-	-
Tetraclita rubescens	-	-	-	-	-
colonial/social tunicates	-	-	-	-	-
Mean No. Species / 0.25 m^2	4.67	4.67	6.00	4.67	6.33

Table 13. Invertebrate Abundance in Perimeter Tidepool Quadrats at PP Lot 2

Site Name	PP Lot 2	PP Lot 2	PP Lot 2	PP Lot 2	PP Lot 2
Tidepool Number	1	2	3	4	5
Mean No. / 0.25 m^2					
Acanthinucella spp.	-	-	0.33	-	0.67
Bittium spp.	-	-	-	-	-
Cirratulidae/Terebellidae	-	-	-	-	-
Crepidula spp.	1.67	-	1.33	-	-
Cyanoplax spp.	-	-	0.33	-	-
Fissurella volcano	-	-	-	-	-
Hemigrapsus nudus	-	-	-	-	-
Ishnochitonidae (juv)	-	-	-	-	-
Leptasterias spp.	-	-	-	-	-
Littorina planaxis	-	-	-	-	-
Littorina scutulata	-	19.00	4.67	3.00	14.00
Lottia asmi	0.34	0.33	-	0.67	1.00
Lottia digitalis	-	-	0.33	-	-
Lottia limatula	0.67	-	-	-	-
Lottia pelta	-	-	-	-	-
Lottidae	0.67	-	-	-	0.33
Macclintockia scabra	2.33	7.00	1.67	0.67	0.33
Mopalia muscosa	-	-	-	-	-
Nucella emarginata	-	-	-	-	-
Nuttalina californica	-	-	-	-	-
Ocenebra circumtexta	0.33	-	-	-	-
Pachygrapsus crassipes	0.33	0.33	-	0.67	0.33
Pagurus spp.	3.33	2.67	4.00	1.67	7.67
Paranemertes peregrina	-	-	-	-	-
Petrolisthes spp.	0.33	-	-	-	-
Phragmatopoma californica	-	-	-	-	-
Pollicipes polymerus	-	-	-	-	-
Pugettia producta	-	-	-	-	-
Strongylocentrotus purpuratus	-	-	-	-	-
Tectura scutum	-	-	-	-	-
Tegula funebralis	153.33	40.67	93.33	70.67	70.67
Mean Percent Cover					
Anthopleura sola/elegantissima	-	-	1.67	0.67	-
Anthopleura xanthogrammica	-	-	-	-	-
Salmacina tribranchiata	-	-	-	-	-
Serpulorbis squamigerus	-	-	-	-	-
Spirorbidae	-	-	-	-	0.00
Balanus spp.	-	-	-	-	-
Chthamalus fissus	-	0.01	-	0.01	-
Mytilus californianus	-	-	-	-	-
Haliclona spp.	-	-	-	-	-
Tetraclita rubescens	-	-	-	-	-
colonial/social tunicates	-	-	-	-	-
Mean No. Species / 0.25 m^2	6.00	4.67	5.67	4.67	6.00

Table 14. Invertebrate Abundance in Perimeter Tidepool Quadrats at PP Lot 5-North

Site Name	PP Lot 5-N	PP Lot 5-N	PP Lot 5-N	PP Lot 5-N	PP Lot 5-N
Tidepool Number	1	2	3	4	5
Mean No. / 0.25 m^2					
Acanthinucella spp.	0.33	-	0.67	-	0.33
Bittium spp.	0.67	-	-	-	-
Cirratulidae/Terebellidae	-	-	-	-	-
Crepidula spp.	0.67	-	-	-	-
Cyanoplax spp.	-	-	-	-	-
Fissurella volcano	-	-	-	-	-
Hemigrapsus nudus	0.33	-	-	-	-
Ishnochitonidae (juv)	-	-	0.33	-	-
Leptasterias spp.	0.67	-	0.33	0.33	-
Littorina planaxis	-	-	-	-	-
Littorina scutulata	3.33	-	5.33	-	3.33
Lottia asmi	0.67	-	-	-	-
Lottia digitalis	-	-	-	-	7.67
Lottia limatula	-	0.33	1.00	0.33	0.33
Lottia pelta	-	-	-	-	-
Lottidae	-	-	-	-	-
Macclintockia scabra	-	5.33	2.33	19.67	2.00
Mopalia muscosa	-	-	-	-	-
Nucella emarginata	-	-	-	-	-
Nuttalina californica	-	-	-	-	-
Ocenebra circumtexta	-	-	-	-	-
Pachygrapsus crassipes	1.00	-	0.33	1.00	0.33
Pagurus spp.	11.33	0.33	1.00	-	-
Paranemertes peregrina	-	-	-	-	-
Petrolisthes spp.	-	-	-	-	-
Phragmatopoma californica	-	-	-	-	-
Pollicipes polymerus	-	-	-	-	-
Pugettia producta	0.33	-	-	-	-
Strongylocentrotus purpuratus	-	-	-	-	-
Tectura scutum	0.33	-	-	-	-
Tegula funebralis	51.67	8.33	35.67	-	2.00
Mean Percent Cover					
Anthopleura sola/elegantissima	-	-	-	-	-
Anthopleura xanthogrammica	-	-	-	-	-
Salmacina tribranchiata	-	-	-	-	-
Serpulorbis squamigerus	-	-	-	-	-
Spirorbidae	-	-	<0.01	-	-
Balanus spp.	-	-	-	-	-
Chthamalus fissus	-	<0.01	<0.01	0.01	0.01
Mytilus californianus	-	-	<0.01	-	-
Haliclona spp.	-	-	-	-	-
Tetraclita rubescens	-	-	<0.01	-	-
colonial/social tunicates	-	-	-	-	-
Mean No. Species / 0.25 m^2	6.33	2.67	6.33	3.00	5.33

Table 1. Algal and Substrate Mean Percent Cover in Lower Band Transects

	PP Lot 4-C	PP Lot 4-E	PP Lot 5-N	PP Lot 2	PP Lot 1	Asilomar	Sea Wall	Restless Sea	Hopkins	Segment 10
Acrosiphonia spp.	-	<0.01	<0.01	0.10	0.00	<0.01	-	-	0.05	0.15
articulated coralline algae (juv.)	0.10	0.25	<0.01	0.25	0.15	-	<0.01	0.50	0.30	0.50
Bryopsis corticulans	-	-	-	-	-	-	-	-	-	<0.01
Bryopsis hypnoides	-	-	-	-	-	-	-	-	<0.01	-
Calliarthron/Bossiella spp.	-	-	-	0.05	0.30	-	-	-	0.05	0.30
Callithamnion/Pleonosporium spp.	-	-	-	-	-	-	-	-	0.10	-
Ceramium spp.	-	-	-	-	-	-	-	1.90	-	-
Chondracanthus canaliculatus	2.55	10.10	20.85	1.75	9.25	1.60	1.30	22.50	28.45	11.50
Chondracanthus exasp./corymb.	-	-	-	0.40	0.50	-	-	-	-	0.25
Chondracanthus spinosus	-	-	-	-	0.50	-	-	0.05	5.10	1.95
Chrysophyta	-	-	-	0.05	-	-	-	-	-	-
Cladophora spp.	0.01	0.50	0.00	0.05	<0.01	1.31	0.05	0.05	0.11	1.00
Colpomenia spp.	-	<0.01	0.75	-	-	-	-	0.50	-	<0.01
Corallina officinalis	-	-	-	0.05	-	0.10	-	-	-	-
Corallina vancouveriensis	<0.01	<0.01	0.45	<0.01	0.25	0.10	0.10	0.60	4.35	0.35
coralline crust	5.25	5.95	13.05	12.25	3.75	10.10	8.25	11.00	9.45	3.70
Cryptopleura violacea	1.65	1.20	1.85	3.20	0.60	0.65	2.70	2.75	7.50	8.90
Cryptosiphonia woodii	0.25	-	-	0.10	-	1.40	-	-	-	<0.01
Egregia menziesii	-	1.45	3.45	3.00	1.45	0.20	-	9.95	4.95	0.35
Endocladia muricata	-	0.25	1.25	1.35	0.65	0.40	4.05	-	0.25	1.00
Gastroclonium subarticulatum	17.15	7.00	6.75	19.35	4.05	9.35	4.30	7.05	5.75	7.80
Gelidium coulteri	7.30	6.20	2.35	4.70	14.55	10.50	4.90	2.45	11.60	4.60
Gelidium pusillum	0.05	<0.01	0.50	0.30	-	0.65	0.16	0.10	<0.01	-
Halymenia/Schizymenia spp.	-	-	-	<0.01	-	-	-	-	-	-
Mastocarpus jardinii	0.50	0.25	2.80	0.60	0.60	1.45	6.10	2.40	-	2.00
Mastocarpus papillatus	10.65	10.75	7.70	9.60	17.00	24.15	9.85	4.70	6.75	6.45
Mazzaella affinis	13.40	19.55	13.40	15.10	16.25	25.55	20.70	16.15	17.85	25.10
Mazzaella flaccida	14.75	19.40	56.90	26.75	11.25	12.35	42.35	37.10	30.20	15.35
Mazzaella leptorhynchos	14.55	15.50	0.20	8.05	22.00	8.90	9.55	0.75	2.50	22.55
Mazzaella lilacina	-	0.15	0.10	1.25	-	-	-	-	0.15	-
Mazzaella phyllocarpa	1.15	0.75	0.15	8.10	5.00	1.05	1.55	0.20	<0.01	-
Microcladia coulteri	-	-	-	0.05	-	-	-	-	-	-
non-coralline crust	19.30	13.40	13.05	11.25	9.45	8.15	24.00	10.40	12.00	7.61
Osmundea pacifica	-	0.05	-	-	-	-	-	-	-	3.50
Osmundea spectabilis	0.20	-	-	1.55	0.85	0.35	-	0.15	0.10	0.85
Phyllospadix spp.	3.70	4.90	0.25	4.35	0.95	0.30	0.10	0.30	0.20	1.70
Porphyra spp.	-	0.15	0.35	-	-	<0.01	-	0.25	-	<0.01
Prionitis australis	-	-	-	-	-	-	-	-	-	0.10
Prionitis lanceolata	1.20	0.05	0.35	1.80	0.80	0.65	<0.01	0.75	0.10	3.40
Pterosiphonia dendroidea	-	-	-	0.05	-	-	<0.01	0.05	0.75	-
Rhodymenia spp.	-	-	-	0.65	<0.01	-	-	-	-	0.00
Sarcodiotheca gaudichaudii	-	0.10	-	1.50	0.55	0.05	-	0.40	0.15	0.85
Silvetia compressa	-	-	0.15	0.65	-	0.25	-	2.45	-	-
Ulva/Enteromopha spp.	-	-	0.65	1.70	-	0.00	-	5.65	-	-
Total Upright Cover	94.42	104.57	134.27	128.67	111.27	111.32	116.03	130.71	136.77	124.38
Total Taxa	10.60	10.95	10.75	13.90	11.60	11.80	11.45	11.60	12.75	13.50
Bedrock	52.25	43.25	70.65	68.25	39.10	85.25	67.75	83.25	89.30	97.35
Boulder	23.35	50.50	21.50	30.50	55.50	8.25	27.25	13.15	10.00	-
Cobble	23.65	3.75	4.40	0.50	4.35	5.25	3.85	0.25	-	-
sand/gravel	0.75	5.25	3.45	0.50	1.05	1.25	1.15	3.35	0.70	2.65
Uncolonized rocks	20.65	10.20	5.50	7.60	16.55	11.10	9.25	4.40	1.85	6.60

Table 2. Algal and Substrate Cover in Upper Band Transects

	PP Lot 4-C	PP Lot 4-E	PP Lot 5-N	PP Lot 2	PP Lot 1	Asilomar	Sea Wall	Restless Sea	Hopkins	Segment 10
Acrosiphonia spp.	-	-	0.05	-	-	-	-	-	-	-
articulated coralline algae (juv.)	-	0.05	-	0.05	-	-	0.25	1.05	0.20	0.15
Calliarthron/Bossiella spp.	-	-	<0.01	-	-	-	-	<0.01	-	-
Callithamnion pikeanum	-	-	-	-	-	-	-	<0.01	0.10	-
Chondracanthus canaliculatus	<0.01	<0.01	0.05	-	-	-	0.10	<0.01	-	0.15
Cladophora spp.	0.55	0.26	1.10	-	0.31	3.45	0.26	1.75	3.15	0.71
Corallina vancouveriensis	0.30	<0.01	0.55	<0.01	<0.01	0.65	0.15	4.20	0.80	1.00
coralline crust	3.06	9.10	5.45	2.45	1.30	7.60	7.25	4.60	7.90	3.25
Cryptopleura violacea	-	-	0.10	-	-	-	-	0.25	-	0.25
Cryptosiphonia woodii	-	<0.01	-	-	-	-	-	0.05	-	-
Endocladia muricata	10.00	3.60	3.60	6.40	4.00	2.95	2.65	13.35	39.80	28.45
Fucus gardneri	-	1.75	1.80	-	<0.01	2.15	9.55	0.45	-	-
Gastroclonium subarticulatum	-	-	0.05	-	-	-	-	-	-	-
Gelidium coulteri	1.60	0.15	3.65	1.25	0.05	0.50	0.25	0.55	0.35	0.50
Gelidium pusillum	0.01	1.35	4.15	0.70	-	0.35	3.20	0.55	<0.01	<0.01
Halosaccion americanum	-	-	-	-	-	-	-	<0.01	-	-
Hesperophycus californicus	-	0.25	-	-	2.80	5.45	3.65	0.85	-	-
Mastocarpus jardinii	3.40	2.20	-	1.95	0.50	-	-	1.85	3.95	3.30
Mastocarpus papillatus	19.35	23.90	27.20	13.80	16.35	31.70	20.95	17.65	23.80	8.55
Mazzaella affinis	4.35	5.15	4.25	1.35	<0.01	0.15	7.40	3.75	2.80	0.65
Mazzaella flaccida	2.80	0.05	0.80	-	-	-	-	2.20	0.35	0.15
Mazzaella leptorhynchos	0.55	<0.01	-	0.00	<0.01	<0.01	0.30	-	0.20	0.40
non-coralline crust	11.10	14.65	10.65	30.60	6.40	8.60	6.80	13.00	32.55	9.60
Osmundea spectabilis	-	-	<0.01	-	-	-	-	<0.01	-	0.15
Phyllospadix spp.	-	-	-	-	-	0.05	-	-	-	-
Porphyra spp.	<0.01	1.55	0.10	<0.01	1.50	0.30	-	2.20	0.45	4.05
Prionitis lanceolata	-	-	-	-	-	-	-	0.10	0.10	-
Pterosiphonia dendroidea	-	-	-	-	-	-	-	<0.01	-	-
Silvetia compressa	6.60	26.00	15.65	-	24.10	26.65	29.15	25.65	4.35	32.15
Ulva/Enteromopha spp.	-	-	-	-	-	-	-	0.00	-	-
Total Upright Cover	191.95	206.70	190.75	189.25	221.91	205.35	158.56	204.90	209.80	208.91
Total Taxa	9.10	8.45	8.40	8.15	8.75	8.55	7.70	9.60	7.95	9.05
Bedrock	86.90	60.60	51.30	29.25	97.30	89.05	86.75	52.50	97.90	97.10
Boulder	6.50	32.00	45.10	52.35	1.50	10.00	10.00	36.40	-	0.75
Cobble	4.90	3.80	2.00	15.45	0.30	-	2.75	5.00	-	0.25
sand/gravel	1.70	3.70	1.60	2.95	0.90	0.95	0.50	2.60	2.10	1.90
Uncolonized rocks	43.60	38.05	39.80	41.89	71.40	43.20	21.80	41.10	21.25	39.95

Table 3. Invertebrate Abundance in Lower Band Transects

	PP Lot 4-C	PP Lot 4-E	PP Lot 5-N	PP Lot 2	PP Lot 1	Asilomar	Sea Wall	Restless Sea	Hopkins	Segment 10
Mean No./ 0.25 m^2										
Acmaea mitra	-	-	0.05	0.05	-	-	0.05	-	0.10	0.05
Alia spp.	-	0.10	-	-	1.05	-	-	-	-	0.10
Amphiporus imparviensis	0.15	0.25	-	0.15	0.10	-	0.05	0.05	0.15	-
Amphissa spp.	-	-	-	-	0.20	0.05	-	-	-	0.20
Asterina miniata	-	-	0.05	-	0.10	-	-	-	-	-
Bittium spp.	-	0.20	0.20	-	-	-	0.15	0.10	-	-
Calliostoma ligatum	-	-	-	-	0.05	-	-	-	0.10	0.10
Cancer antennarius	-	-	-	-	-	-	-	0.05	-	-
Crepidula spp.	4.45	3.35	3.60	0.95	3.50	3.60	4.15	2.60	2.70	3.30
Discurria insessa	-	-	0.05	-	-	-	-	0.10	-	-
Epiactis prolifera	0.05	-	-	0.05	0.40	0.40	-	0.10	-	-
Golfingia procera	0.10	-	0.60	-	-	0.10	0.15	0.05	-	-
Fissurella volcano	0.05	0.10	0.10	0.20	0.30	0.50	0.05	-	0.40	0.30
Haliotis cracherodii	-	-	0.05	-	-	-	-	-	-	-
Hemigrapsus nudis	-	-	-	0.05	-	-	-	-	-	-
Henricia leviuscula	-	-	-	-	-	0.30	-	-	-	-
Hermissenda crassicornis	-	-	-	-	-	-	-	-	-	0.10
Homalopoma spp.	0.25	-	-	0.05	-	-	-	-	-	0.20
Idotea wozneskii	-	-	-	-	-	-	-	0.05	-	-
Irusella lamellifera	-	-	-	0.05	-	-	-	-	-	-
Ishnochitonidae	0.05	-	0.10	-	-	-	-	0.05	0.15	-
Lacuna spp.	-	0.15	2.60	-	-	0.05	1.35	0.20	0.15	0.05
Lepidozona spp.	0.05	-	-	-	-	-	-	-	-	-
Leptasterias hexactis	0.15	0.40	0.60	0.50	0.95	0.25	0.45	0.35	0.45	0.30
Lithopoma gibberosa	-	-	-	-	-	-	-	-	-	0.05
Littorina scutulata	0.15	0.15	0.65	-	1.45	0.90	-	-	0.35	-
Lottia asmi	0.30	0.05	-	0.10	0.15	0.30	0.90	-	-	0.15
Lottia gigantea	-	-	-	-	0.20	-	-	-	-	-
Lottia limatula	0.25	0.40	0.30	0.30	0.55	0.20	0.25	-	0.15	0.10
Lottia pelta	0.65	0.20	0.35	0.30	0.55	0.30	0.45	0.20	0.65	0.15
Lottia scabra	-	-	-	-	-	-	-	0.05	-	-
Lottiidae	1.95	0.65	0.55	0.45	0.40	0.55	0.50	0.20	0.05	0.10
Mitra idae	0.05	-	-	-	-	-	-	-	-	-
Mopalia lignosa	-	-	-	-	-	-	-	0.20	-	0.05
Mopalia muscosa	0.35	0.25	0.25	-	-	0.05	-	-	-	0.05
Nerididae	0.05	0.05	-	-	-	0.15	0.05	0.05	-	0.05
Nitidiscala tinctum	-	-	-	-	-	-	-	0.05	-	-
Nuttalina californica	0.05	0.05	0.25	-	-	0.20	0.05	0.30	0.35	0.10
Ocenebra spp.	0.05	-	-	0.05	-	-	0.15	-	0.05	0.40
Onchidella borealis	-	-	0.40	-	-	-	-	0.35	-	-
Pachygrapsus crassipes	-	-	0.15	-	0.15	0.10	0.15	-	-	0.10
Pagurus spp.	7.35	7.55	6.90	5.00	11.55	5.35	3.45	7.40	7.85	13.40
Paranemertes peregrina	0.25	0.20	0.20	0.15	-	-	-	0.25	0.15	0.10
Petrolisthes spp.	-	-	0.10	-	-	0.05	-	0.05	-	-
Pisaster giganteus	-	-	-	0.10	-	-	-	-	-	-
Pisaster ochraceus	-	-	-	-	0.05	-	-	-	0.10	-
Pisaster/Henrecia spp. (juv.)	-	0.05	-	-	0.10	-	-	0.05	0.05	-
Pugettia producta	0.15	0.05	0.05	0.05	0.15	0.10	0.05	0.40	1.60	-
Pycnopodia helianthoides	-	-	-	0.10	-	-	-	-	-	-
Strongylocentrotus purpuratus	2.35	0.10	0.30	1.20	1.00	0.15	0.05	0.90	0.95	2.65
Tectura scutum	2.65	0.40	0.20	0.05	1.15	-	0.40	0.05	-	-

Table continued

Table 3 (continued). Invertebrate Abundance in Lower Band Transects

	PP Lot 4-C	PP Lot 4-E	PP Lot 5-N	PP Lot 2	PP Lot 1	Asilomar	Sea Wall	Restless Sea	Hopkins	Segment 10
Mean No./ 0.25 m^2										
Tegula brunnea	-	0.75	2.30	5.50	0.40	0.40	0.05	0.60	5.55	1.20
Tegula funebralis	68.00	19.90	11.50	48.80	46.30	53.45	58.25	1.05	8.35	48.90
Themistes pyroides	-	-	-	-	0.05	0.05	-	0.10	-	-
Tonicella lineata	-	-	-	-	-	-	-	-	-	0.05
Urticina spp.	-	-	0.05	-	-	-	-	0.20	-	-
Mean Percent Cover										
Aglaophenia latirostris	-	-	-	-	-	-	-	<0.01	-	-
Anthopleura eleg./sola	0.85	0.10	-	0.55	0.55	0.45	0.30	<0.01	0.30	0.15
Anthopleura xanthogrammica	-	-	-	-	0.20	-	-	-	-	-
Balanus spp.	-	-	-	-	-	-	-	-	<0.01	-
Bryozoa	<0.01	-	0.10	<0.01	<0.01	-	<0.01	0.05	0.05	<0.01
Chthamalus fissus	-	-	-	0.25	0.25	-	<0.01	-	-	-
Corynactis californica	-	-	-	0.35	0.00	-	<0.01	-	-	-
Dodecaceria spp.	-	-	-	-	-	-	-	1.00	0.65	-
Haliclona spp	-	-	-	0.05	-	-	-	-	-	-
Hydroida	-	-	-	-	-	-	-	<0.01	<0.01	-
Mytilus spp.	-	-	-	-	-	0.05	-	0.05	-	0.45
Pholadidae	0.05	-	-	-	-	-	-	-	-	-
Phragmatopoma californica	0.20	0.30	0.10	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	2.76
Pista spp.	-	<0.01	-	-	-	0.80	-	0.85	-	0.05
Porifera	-	0.50	<0.01	0.30	0.50	0.05	0.05	0.05	0.15	-
Serpulidae	-	-	0.10	<0.01	0.20	0.05	<0.01	<0.01	0.60	<0.01
Serpulorbis squamigerus	0.15	-	0.05	1.00	0.65	0.05	-	-	0.30	-
Spirorbidae	0.06	<0.01	0.15	0.05	0.01	-	0.01	0.10	<0.01	0.01
Tetraclita rubescens	0.05	-	0.10	0.05	0.10	0.65	0.65	0.35	0.20	0.25
Tunicata	<0.01	0.50	0.75	0.75	0.65	0.10	<0.01	2.20	2.10	0.60
Mean No. Species / 0.25 m^2	7.90	6.10	7.75	8.30	11.05	7.00	6.95	6.60	7.40	9.60

Table 4. Invertebrate Abundance in Upper Band Transects

	PP Lot 4-C	PP Lot 4-E	PP Lot 5-N	PP Lot 2	PP Lot 1	Asilomar	Sea Wall	Restless Sea	Hopkins	Segment 10
Mean No./ 0.25 m^2										
Acanthinucella spp.	0.20	0.05	0.45	-	0.15	0.25	0.05	0.10	0.10	0.90
Amphiporus imparviensis	0.10	0.05	-	-	-	0.05	-	0.05	-	-
Asterina miniata	-	-	-	0.10	-	-	-	-	-	-
Bittium spp.	-	-	0.40	-	-	-	0.05	-	-	-
Cirratulidae/Teribellidae	0.35	-	-	0.05	0.05	0.10	-	-	-	-
Crepidula spp.	2.40	1.60	1.20	1.20	-	0.85	1.60	1.35	0.25	0.60
Cyanoplax hartwedgii	1.95	0.05	0.05	-	3.30	1.45	0.05	0.35	0.70	2.75
Epilucina californica	-	-	0.05	-	-	-	-	-	-	-
Fissurella volcano	-	0.10	-	-	-	-	-	-	-	-
Golfingia procera	0.15	-	-	0.15	-	-	-	-	-	-
Haliotis cracherodii	-	-	-	-	-	-	-	0.05	-	-
Hemigrapsus nudis	-	-	-	0.05	-	-	-	0.05	-	-
Homalopoma spp.	-	0.05	-	-	-	-	-	-	-	-
Ishnochitonidae	0.20	-	-	-	-	-	-	-	0.20	0.05
Leptasterias hexactis	0.05	0.05	0.20	0.45	-	0.15	0.05	0.40	0.10	0.10
Littorina keenae	-	-	-	0.85	1.00	0.30	0.20	-	1.00	-
Littorina scutulata	1.40	0.70	0.50	3.35	13.50	2.95	2.85	4.30	17.50	3.25
Lottia asmi	1.00	0.65	1.65	0.20	-	0.45	1.15	0.30	-	0.60
Lottia digitalis	-	0.05	0.10	0.20	4.90	0.35	-	0.10	2.15	1.10
Lottia gigantea	-	0.20	-	-	-	-	-	-	-	-
Lottia limatula	2.80	0.50	1.25	0.25	0.65	1.45	0.35	0.60	0.95	1.65
Lottia pelta	0.85	0.50	-	0.20	1.45	1.50	0.10	1.95	1.40	3.30
Lottia scabra	2.80	1.65	12.45	5.40	5.05	2.50	0.25	1.30	9.50	10.10
Lottiidae	0.15	0.10	1.05	0.35	0.05	0.55	0.20	0.55	2.05	0.70
Mopalia muscosa	0.55	0.10	0.10	-	0.05	0.20	0.10	0.05	0.05	0.05
Nerididae	-	-	-	-	0.05	-	-	-	-	-
Notoplana spp.	-	-	-	-	-	-	-	-	0.05	-
Nucella emarginata	-	0.05	0.10	-	0.10	-	-	0.10	1.05	0.05
Nuttalina californica	0.40	0.20	0.15	0.05	-	-	-	0.25	1.15	0.70
Ocenebra spp.	0.05	-	2.20	-	-	0.05	0.05	-	-	0.05
Pachygrapsus crassipes	0.45	0.15	0.75	0.85	0.50	0.35	0.05	0.75	0.50	0.10
Pagurus spp.	3.35	2.30	4.50	6.20	0.30	3.45	2.85	6.45	1.90	1.85
Paranemertes peregrina	0.05	-	-	-	0.05	0.05	-	-	-	-
Petrolisthes spp.	0.05	-	-	0.10	-	-	-	-	-	-
Pugettia producta	-	-	-	-	-	0.75	-	-	0.10	-
Strongylocentrotus purpuratus	-	-	-	0.05	-	-	-	-	-	-
Tectura scutum	0.35	0.05	0.30	0.10	-	0.10	0.05	0.45	-	0.05
Tegula funebralis	70.55	58.70	100.65	50.40	17.20	63.60	67.80	23.75	18.80	43.30
Mean Percent Cover										
Anthopleura eleg./sola	5.70	0.15	0.15	0.05	1.45	0.85	0.05	2.05	0.35	2.05
Anthopleura xanthogrammica	-	-	-	-	-	-	-	-	0.45	-
Balanus spp.	-	0.40	0.05	0.85	<0.01	0.50	-	-	0.30	0.05
Chthamalus fissus	<0.01	0.05	4.95	1.65	<0.01	1.55	<0.01	0.10	1.76	0.50
Corynactis californica	-	-	<0.01	0.05	-	-	-	-	-	-
Haliclona spp	-	-	-	-	-	-	-	0.05	0.15	<0.01
Mytilus spp.	-	-	-	-	0.05	0.05	-	0.15	0.10	0.10
Phragmatopoma californica	-	-	0.05	0.05	<0.01	<0.01	-	-	<0.01	0.90
Pollicipes polymerus	-	-	-	-	0.05	-	-	-	0.20	<0.01
Serpulidae	0.05	-	-	<0.01	-	-	-	-	0.10	-

Table continued

Table 4 (continued). Invertebrate Abundance in Upper Band Transects

	PP Lot 4-C	PP Lot 4-E	PP Lot 5-N	PP Lot 2	PP Lot 1	Asilomar	Sea Wall	Restless Sea	Hopkins	Segment 10
Mean Percent Cover										
Spirorbidae	0.10	0.05	0.10	0.75	-	-	<0.01	-	0.15	<0.01
Tetraclita rubescens	-	0.10	<0.01	0.10	<0.01	0.05	<0.01	1.35	0.85	0.05
Tunicata	-	-	<0.01	-	-	-	-	-	-	-
Mean No. Species / 0.25 m^2	9.10	5.15	7.60	7.15	7.95	8.35	5.50	9.05	10.75	10.25

Table 5. Invertebrate Abundances in 2 x 20 m Band Transects

	Haliotis cracherodii	Asterina miniata	Pisaster ochraceus	Pycnopodia helianthoides	Lottia gigantea	Pisaster gigantea	Leptasterias hexactis	Cancer antennarius	Haliotis rufescens	Cryptochiton stelleri
UPPER										
PP Lot 4-Center	-	-	-	1	-	-	-	-	-	-
PP Lot 4-East	5	-	1	-	-	-	-	-	-	-
PP Lot 5-North	6	-	-	-	-	-	-	-	-	-
PP Lot 2	1	2	-	-	-	-	-	-	-	-
PP Lot 1	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Asilomar	1	-	-	-	-	-	-	-	-	-
Hopkins	3	1	3	-	-	-	-	-	-	-
Restless Sea	3	-	-	-	1	-	2	-	-	-
Segment 10	-	-	1	-	-	-	-	-	-	-
Sea Wall	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
LOWER	-	-	-	-	-	-	-	-	-	-
PP Lot 4-Center	-	-	1	-	-	-	-	-	-	-
PP Lot 4-East	2	-	-	-	-	-	-	-	-	-
PP Lot 5-North	27	5	1	-	2	2	-	-	-	-
PP Lot 2	7	18	1	1	-	-	1	1	1	-
PP Lot 1	-	13	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Asilomar	-	-	2	-	-	-	-	-	-	-
Hopkins	-	9	10	-	-	-	-	-	-	-
Restless Sea	1	-	2	-	-	-	1	-	-	1
Segment 10	1	-	1	-	-	-	-	-	-	-
Sea Wall	8	10	6	-	-	-	1	-	-	-

Table 1. SIMPER analysis depicting the percentage contribution of invertebrates comprising up to 80 percent of the dissimilarity between reference and visitor tidepools based on Bray-Curtis distances of square root transformed abundances (counts and percentage cover).

Rank	Species	% Contribution	Cumulative %
1	*Pagurus* spp.	19.84	19.84
2	*Tegula funebralis*	13.02	32.86
3	*Anthopleura elegantissima*/*sola*	9.21	42.07
4	*Strongylocentrotus purpuratus*	6.05	48.12
5	*Lottia limatula*	3.82	51.94
6	Lottidae	3.81	55.75
7	*Crepidula* spp.	3.61	59.36
8	*Lottia scabra*	3.31	62.67
9	*Acanthinucella* spp.	3.30	65.98
10	*Tectura scutum*	2.61	68.59
11	*Littorina scutulata*	2.27	70.85
12	*Leptasterias* spp.	2.14	73.00
13	*Mopalia muscosa*	2.14	75.14
14	*Pachygrapsus crassipes*	2.12	77.26
15	*Cyanoplax* spp.	1.99	79.25
16	*Lottia asmi*	1.88	81.13

Table 2. SIMPER analysis depicting the percentage contribution of invertebrates comprising up to 80 percent of the dissimilarity between reference and visitor tidepools based on Bray-Curtis distances of square root transformed average site abundances (counts and percentage cover).

Rank	Species	% Contribution	Cumulative %
1	*Pagurus* spp.	17.66	17.66
2	*Anthopleura elegantissima*/*sola*	6.84	24.50
3	*Strongylocentrotus purpuratus*	6.61	31.11
4	*Tegula funebralis*	5.68	36.79
5	Lottidae	4.52	41.31
6	*Lottia scabra*	3.97	45.27
7	*Lottia limatula*	3.33	48.61
8	*Littorina scutulata*	3.02	51.62
9	*Serpula vermicularis*	2.94	54.56
10	*Mytilus californianus*	2.82	57.39
11	*Crepidula* spp.	2.62	60.00
12	Serpulidae	2.56	62.57
13	*Nuttalina californica*	2.45	65.02
14	*Cirolana harfordi*	2.31	67.33
15	*Acanthinucella* spp.	2.05	69.38
16	*Phragmatopoma californica*	1.93	71.31
17	*Tectura scutum*	1.72	73.03
18	*Cirratulidae / Terebellidae*	1.60	74.63
19	*Cyanoplax* spp.	1.43	76.06
20	*Leptasterias* spp.	1.42	77.48
21	*Barleeia* spp.	1.37	78.85
22	*Serpulorbis squamigerus*	1.33	80.17

Table 3. Results of nested ANOVA of: a) invertebrate species abundances and species richness; and b) individual fish abundances from tidepools at the visitor and reference sites. Probability values less than 0.10 are bold.

Source	Trans-formation	F-Value	Pr > F	Power
a) Invertebrates				
Species richness	sqr root	<0.01	0.9925	0.0500
Pagurus spp.	log	3.45	0.1226	0.3261
Anthopleura elegantissima/sola	log	1.82	0.2352	0.1968
Strongylocentrotus purpuratus	log	10.59	**0.0226**	0.7396
Tegula funebralis	none	0.47	0.5236	0.0871
Lottia limatula	sqr root	0.13	0.7322	0.0603
Lottidae	log	0.18	0.6924	0.0638
Lottia scabra	none	0.08	0.7850	0.0565
Acanthinucella spp.	none	3.27	0.1303	0.3127
Tectura scutum	none	0.01	0.9388	0.0505
b) Fishes				
Artedius spp.	none	1.45	0.2830	0.1663
Cebidichthys violaceus	log	0.37	0.5707	0.0790
Cottidae	log	1.43	0.2850	0.1652

Table 4. SIMPER analysis depicting the percentage contribution of algae comprising up to 90 percent of the dissimilarity between and within reference and visitor sites based on Bray-Curtis distances of average percent coverage from quadrats surrounding tidepools.

Rank	Species	% Contribution	Cumulative %
Between Reference and Visitor Use Sites			
1	*Endocladia muricata*	26.06	26.06
2	*Mastocarpus papillatus*	25.48	51.54
3	*Silvetia compressa*	15.69	67.23
4	*Gelidium pusillum*	7.78	75.01
5	*Cladophora* spp.	3.57	78.58
6	*Gelidium coulteri*	3.46	82.04
7	*Mazzaella affinis*	3.38	85.42
8	*Hesperophycus californicus*	2.85	88.27
9	*Fucus gardneri*	2.70	90.97
Within Reference Sites			
1	*Mastocarpus papillatus*	59.29	59.29
2	*Endocladia muricata*	27.67	86.96
3	*Silvetia compressa*	3.94	90.90
Within Visitor Use Sites			
1	*Mastocarpus papillatus*	90.03	90.03

Table 5. SIMPER analysis depicting the percentage contribution of algae comprising up to 90 percent of the dissimilarity between reference and visitor sites based on Bray-Curtis distances of average site percentage cover from quadrats surrounding tidepools.

Rank	Species	% Contribution	Cumulative %
1	*Endocladia muricata*	28.35	28.35
2	*Mastocarpus papillatus*	20.27	48.62
3	*Silvetia compressa*	19.61	68.24
4	*Gelidium pusillum*	6.40	74.64
5	*Fucus gardneri*	3.63	78.26
6	*Mazzaella affinis*	3.53	81.79
7	*Cladophora* spp.	3.12	84.92
8	*Mastocarpus jardinii*	2.90	87.82
9	*Gelidium coulteri*	2.87	90.69

Table 6. Results of nested ANOVA of tidepool perimeter algal species percent cover, species richness, and total upright (non-crustose) cover. Probability values less than 0.10 are bold.

Source	Trans-formation	F-Value	Pr > F	Power
Total upright cover	arcsin	2.82	0.1539	0.2773
Species richness	none	3.63	0.1137	0.3432
Endocladia muricata	none	4.70	**0.0814**	0.4217
Mastocarpus papillatus	none	0.01	0.9199	0.0509
Silvetia compressa	none	0.01	0.9150	0.0510
Gelidium pusillum	none	0.37	0.5710	0.0792
Fucus gardneri	none	0.12	0.7455	0.0592
Mazzaella affinis	none	2.20	0.1957	0.2308
Cladophora spp.	none	0.01	0.9246	0.0508
Mastocarpus jardinii	none	5.31	**0.0661**	0.4721
Gelidium coulteri	none	0.00	0.9610	0.0502

Table 7. SIMPER analysis depicting the percentage contribution of invertebrates comprising up to 90 percent of the dissimilarity between and within reference and visitor sites based on Bray-Curtis distances of average abundances from quadrats surrounding tidepools.

Rank	Species	% Contribution	Cumulative %
Between Reference and Visitor Use Sites			
1	*Tegula funebralis*	19.07	19.07
2	*Littorina scutulata*	13.34	32.41
3	*Lottia scabra*	8.20	40.61
4	*Pagurus* spp.	5.97	46.58
5	*Anthopleura elegantissima/sola*	5.32	51.90
6	*Lottia digitalis*	4.73	56.63
7	*Crepidula* spp.	4.38	61.01
8	*Lottia limatula*	3.47	64.48
9	*Lottia asmi*	3.30	67.78
10	*Lottia pelta*	2.78	70.56
11	*Pachygrapsus crassipes*	2.53	73.10
12	*Nuttalina californica*	2.43	75.52
13	*Acanthinucella* spp.	2.39	77.91
14	*Littorina keenae*	2.12	80.03
Within reference sites			
1	*Tegula funebralis*	44.88	44.88
2	*Pagurus* spp.	13.10	57.98
3	*Littorina scutulata*	8.98	66.96
4	*Anthopleura elegantissima/sola*	5.71	72.67
5	*Lottia limatula*	5.08	77.75
6	*Lottia scabra*	4.82	82.57
Within visitor sites			
1	*Tegula funebralis*	57.68	57.68
2	*Pagurus* spp.	13.98	71.67
3	*Lottia scabra*	8.07	79.74
4	*Littorina scutulata*	7.63	87.37

Table 8. SIMPER analysis depicting the percentage contribution of invertebrates comprising up to 80 percent of the dissimilarity between and within reference and visitor sites based on Bray-Curtis distances of average site abundances from quadrats surrounding tidepools.

Rank	Species	% Contribution	Cumulative %
Between reference and visitor sites			
1	*Tegula funebralis*	13.46	13.46
2	*Littorina scutulata*	12.09	25.56
3	*Lottia digitalis*	6.19	31.74
4	*Anthopleura elegantissima/sola*	4.98	36.72
5	*Lottia pelta*	4.70	41.42
6	*Littorina keenae*	3.91	45.33
7	*Nuttalina californica*	3.69	49.03
8	*Mytilus californianus*	3.58	52.61
9	*Lottia scabra*	3.39	55.99
10	*Tetraclita rubescens*	3.06	59.06
11	*Acanthinucella* spp.	2.64	61.69
12	*Pagurus* spp.	2.53	64.22
13	*Cyanoplax* spp.	2.37	66.59
14	*Lottia asmi*	2.19	68.78
15	*Crepidula* spp.	1.98	70.76
16	*Chthamalus fissus*	1.97	72.73
17	Lottidae	1.95	74.68
18	*Pollicipes polymerus*	1.88	76.56
19	*Tectura scutum*	1.80	78.36
20	*Mopalia muscosa*	1.78	80.13
Within reference sites			
1	*Tegula funebralis*	32.00	32.00
2	*Pagurus* spp.	10.21	42.21
3	*Littorina scutulata*	9.17	51.38
4	*Lottia scabra*	8.18	59.56
5	*Anthopleura elegantissima/sola*	5.40	64.95
6	*Crepidula spp.*	5.17	70.12
7	*Lottia limatula*	4.62	74.74
8	*Lottia asmi*	3.74	78.48
9	*Pachygrapsus crassipes*	3.34	81.82
Within visitor sites			
1	*Tegula funebralis*	43.65	43.65
2	*Pagurus* spp.	14.49	58.14
3	*Lottia scabra*	11.68	69.82
4	*Littorina scutulata*	10.41	80.22

Table 9. Results of nested ANOVA of tidepool perimeter invertebrate abundances and species richness. Probability values less than 0.10 are bold.

Source	Trans-formation	F-Value	Pr > F	Power
Species richness	none	13.57	**0.0133**	0.8415
Tegula funebralis	none	0.55	0.4928	0.0933
Littorina scutulata	none	2.01	0.2133	0.2151
Lottia scabra	none	0.02	0.8878	0.0517
Pagurus spp	none	0.04	0.8509	0.0531
Anthopleura elegantissima/sola	none	0.07	0.7989	0.0557
Lottia digitalis	none	1.03	0.3556	0.1329
Lottia limatula	none	1.67	0.2525	0.1848
Lottia pelta	none	3.25	0.1281	0.3171

Table 10. SIMPER results showing percentage contribution of algae comprising up to 90 percent of the dissimilarity between reference and visitor sites based on Bray-Curtis distances of average percent coverage data from upper tidal elevation transects.

Rank	Species	% Contribution	Cumulative %
1	*Silvetia compressa*	26.77	26.77
2	*Endocladia muricata*	26.19	52.96
3	*Mastocarpus papillatus*	14.22	67.19
4	*Mazzaella affinis*	5.09	72.28
5	*Fucus gardneri*	4.72	77.00
6	*Hesperophycus californicus*	3.87	80.87
7	*Mastocarpus jardinii*	3.12	83.99
8	*Cladophora* spp.	2.97	86.97
9	*Porphyra* spp.	2.61	89.57
10	*Gelidium pusillum*	2.58	92.15

Table 11. Results of nested ANOVA and ANCOVA of algal abundances, total algal cover and algal species richness from upper tidal elevation transects. Probability values less than 0.10 are bold although covariate tests used a probability level of 0.20.

	Transfor-mation	ANOVA-No Covariate Reference vs Visitor Sites	ANOVA Power	ANCOVA Slope = 0	ANCOVA Slopes Equal	ANCOVA Equal Slope Model Reference vs. Visitor Sites
Silvetia compressa	arcsin	0.2177	0.2190	0.6483		
Endocladia muricata	none	0.1483	0.2919	0.9983		
Mastocarpus papillatus	arcsin	0.8887	0.0519	**0.0452**	**0.0283**	
Mazzaella affinis	arcsin	0.9061	0.0513	0.5003		
Fucus gardneri	none	0.3865	0.1279	0.6779		
Hesperophycus californicus	arcsin	0.3485	0.1425	0.5459		
Total Algal Cover	log(x+0.1)	**0.0071**	0.8805	0.8114		
Algal Species Richness	log(x+0.1)	**0.0179**	0.7397	0.4283		

Table 12. SIMPER results showing percentage contribution of algae comprising up to 90 percent of the dissimilarity between reference and visitor sites based on Bray-Curtis distances of average percent coverage data from lower tidal elevation transects.

Rank	Species	% Contribution	Cumulative %
1	*Mazzaella flaccida*	19.61	19.61
2	*Chondracanthus canaliculatus*	12.79	32.40
3	*Mazzaella leptorhynchos*	11.01	43.41
4	*Mastocarpus papillatus*	7.47	50.88
5	*Mazzaella affinis*	7.19	58.07
6	*Gastroclonium subarticulatum*	6.87	64.94
7	*Gelidium coulteri*	5.23	70.17
8	*Egregia menziesii*	3.87	74.04
9	*Cryptopleura violacea*	3.86	77.89
10	*Mazzaella phyllocarpa*	3.23	81.12
11	*Phyllospadix* spp.	3.04	84.16
12	*Mastocarpus jardinii*	2.46	86.62
13	*Ulva/Enteromopha* spp.	1.65	88.26
14	*Chondracanthus spinosus*	1.64	89.90
15	*Endocladia muricata*	1.37	91.28

Table 13. Results of nested ANOVA and ANCOVA of algal abundances, total algal cover and algal species richness from lower tidal elevation transects. Probability values less than 0.10 are bold although covariate tests used a probability level of 0.20.

	Transfor-mation	ANOVA-No Covariate Reference vs. Visitor Sites	ANOVA Power	ANCOVA Slope = 0	ANCOVA Slopes Equal	ANCOVA Equal Slope Model Reference vs Visitor Sites
Mazzaella flaccida	none	0.8735	0.0524	**0.0655**	0.7506	**0.0821**
Chondracanthus canaliculatus	none	0.4703	0.1029	0.5041		
Mazzaella leptorhynchos	none	0.5636	0.0832	**0.0003**	**0.0017**	
Mastocarpus papillatus	none	0.8492	0.0535	0.5461		
Mazzaella affinis	arcsin	**0.0361**	0.5983	0.2748		
Gastroclonium subarticulatum	arcsin	0.2957	0.1673	0.9964		
Gelidium coulteri	none	0.9405	0.0505	0.1185	0.4050	0.1695
Egregia menziesii	arcsin	0.6050	0.0764	0.2130		
Cryptopleura violacea	none	0.1244	0.3278	0.4533		
Mazzaella phyllocarpa	arcsin	0.1618	0.2746	0.1690	0.7992	**0.0301**
Total Algal Cover	none	0.2762	0.1782	0.8505		
Algal Species Richness	none	0.3948	0.1251	0.4933		

Table 14. SIMPER results showing percentage contribution of invertebrates comprising up to 70 percent of the dissimilarity between reference and visitor sites based on Bray-Curtis distances of average count and percent coverage data from upper tidal elevation transects.

Rank	Species	% Contribution	Cumulative %
1	*Littorina scutulata*	8.58	8.58
2	*Lottia scabra*	8.27	16.85
3	*Anthopleura elegantissima/sola*	5.94	22.79
4	*Tegula funebralis*	5.75	28.54
5	*Chthamalus fissus*	5.63	34.17
6	*Cyanoplax hartwedgii*	5.62	39.79
7	*Lottia pelta*	5.32	45.11
8	*Lottia digitalis*	5.25	50.36
9	*Pagurus* spp.	4.98	55.34
10	*Crepidula* spp.	3.63	58.97
11	*Lottia limatula*	3.39	62.36
12	Lottiidae	3.39	65.75
13	*Lottia asmi*	3.23	68.98
14	*Littorina keenae*	2.81	71.79

Table 15. Results of nested ANOVA and ANCOVA of invertebrate abundances, invertebrate species richness and total limpet abundance from upper tidal elevation transects and 2 m x 20 m plots. Probability values less than 0.10 are bold although covariate tests used a probability level of 0.20.

	Transfor-mation	ANOVA-No Covariate Reference vs. Visitor Sites	ANOVA Power	ANCOVA Slope = 0	ANCOVA Slopes Equal	ANCOVA Equal Slope Model Reference vs. Visitor Sites
<u>0.25 m2 transect quadrats</u>						
Littorina scutulata	none	0.5608	0.0837	0.5141		
Lottia scabra	none	0.7996	0.0562	0.8809		
Anthopleura elegantissima/sola	log(x+0.1)	0.6794	0.0667	0.9544		
Tegula funebralis	none	0.3689	0.1344	0.8011		
Chthamalus fissus	log(x+0.1)	0.9968	0.0500	0.9244		
Cyanoplax hartwedgii	log(x+0.1)	0.9906	0.0500	0.3997		
Lottia pelta	log(x+0.1)	0.1166	0.3413	0.7956		
Lottia digitalis	square root(x+0.1)	0.8692	0.0526	0.3546		
Pagurus spp.	none	0.9822	0.0500	**0.0365**	0.1931	0.1532
Lottia limatula	none	0.8669	0.0527	0.9749		
Invertebrate Species Richness	log(x+0.1)	0.2486	0.1958	0.8571		
Total Limpet Abundance	none	0.9884	0.0500	0.8547		
<u>2 m x 20 m plots</u>						
Pisaster ochraceus	none	0.4861	0.0991			
Asterina miniata	none	0.8716	0.0525			
Haliotis cracherodii	none	0.8761	0.0523			

Table 16. SIMPER results showing percentage contribution of invertebrates comprising up to 70 percent of the dissimilarity between reference and visitor sites based on Bray-Curtis distances of average count and percent coverage data from lower tidal elevation transects.

Rank	Species	% Contribution	Cumulative %
1	*Tegula funebralis*	14.41	14.41
2	*Tegula brunnea*	4.58	18.99
3	*Tectura scutum*	3.53	22.52
4	Tunicata	3.15	25.68
5	*Lacuna* spp.	3.04	28.72
6	*Pagurus* spp.	2.97	31.69
7	*Strongylocentrotus purpuratus*	2.85	34.54
8	*Littorina scutulata*	2.68	37.22
9	*Phragmatopoma californica*	2.67	39.89
10	*Tetraclita rubescens*	2.27	42.17
11	*Serpulorbis squamigerus*	2.27	44.43
12	*Pista* spp.	2.22	46.65
13	Lottiidae	2.04	48.70
14	*Dodecaceria* spp.	2.00	50.70
15	*Anthopleura eleg./sola*	1.91	52.60
16	*Pugettia producta*	1.89	54.49
17	Porifera	1.88	56.37
18	*Lottia asmi*	1.81	58.18
19	*Crepidula* spp.	1.69	59.87
20	*Mopalia muscosa*	1.65	61.52
21	*Nuttalina californica*	1.47	62.99
22	*Alia* spp.	1.44	64.44
23	*Lottia limatula*	1.43	65.87
24	*Golfingia procera*	1.42	67.29
25	*Fissurella volcano*	1.40	68.69
26	*Epiactis prolifera*	1.36	70.05

Table 17. Results of nested ANOVA and ANCOVA of invertebrate abundances, invertebrate species richness and total limpet abundance from lower tidal elevation transects and 2 m x 20 m plots. Probability values less than 0.10 are bold although covariate tests used a probability level of 0.20.

	Transfor-mation	ANOVA-No Covariate Reference vs. Visitor Sites	ANOVA Power	ANCOVA Slope = 0	ANCOVA Slopes Equal	ANCOVA Equal Slope Model Reference vs. Visitor Sites
Tegula funebralis	none	0.7655	0.0586	0.2979		
Tegula brunnea	none	0.8761	0.0523	0.8380		
Tectura scutum	log(x+0.1)	0.1157	0.3429	0.9423		
Tunicata	log(x+0.1)	0.5002	0.0958	0.4026		
Lacuna spp.	none	0.7477	0.0600	**0.0065**	0.6995	**0.0593**
Pagurus spp.	square root(x+0.1)	0.9680	0.0502	0.5601		
Strongylocentrotus purpuratus	none	0.9369	0.0506	0.5215		
Littorina scutulata	log(x+0.1)	0.5051	0.0947	0.4346		
Phragmatopoma californica	log(x+0.1)	0.6764	0.0670	**0.0145**	**0.0042**	
Tetraclita rubescens	log(x+0.1)	**0.0243**	0.6810	0.5574		
Invertebrate Species Richness	log(x+0.1)	0.5306	0.0894	0.2490		
Total Limpet Abundance	log(x+0.1)	0.6213	0.0740	0.7527		
2 m x 20 m plots						
Pisaster ochraceus	none	0.2838	0.1739			
Asterina miniata	none	0.5618	0.0835			
Haliotis cracherodii	none	0.4873	0.0988			

Table 18. Results of nested ANOVA and ANCOVA of differences between upper and lower elevation transects for algal and invertebrate abundances, algal total cover, algal and invertebrate species richness and total limpet abundance. Probability values less than 0.10 are bold although covariate tests used a probability level of 0.20.

	Transfor-mation	ANOVA-No Covariate Reference vs. Visitor Sites	ANOVA Power	ANOVA Slope = 0	ANOVA Slopes Equal	ANCOVA Equal Slope Model Reference vs. Visitor Sites
Mastocarpus papillatus	arcsin	0.7278	0.0618	**0.0600**	0.1291	**0.0928**
Mazzaella affinis	arcsin	0.3861	0.1281	0.4037		
Tegula funebralis	log(x+0.1)	0.6462	0.0707	0.2521		
Pagurus spp.	none	0.9593	0.0502	0.2391		
Total Algal Cover	none	0.1278	0.3221	0.9660		
Algal Species Richness	none	0.3536	0.1404	0.3925		
Invertebrate Species Richness	none	0.1064	0.3606	0.1923	0.1496	**0.0752**
Total Limpet Abundance	log(x+0.1)	0.8311	0.0544	0.9875		
2 m x 20 m plots						
Pisaster ochraceus		0.2631	0.1863			
Asterina miniata		0.4932	0.0974			
Haliotis cracherodii		0.4366	0.1120			

Table 19. Summary statisitics and results of ANOVA and Kolmogorov-Smirnov (K-S) tests for length data for owl limpets and black abalone at reference and visitor use areas.

	Mean	Standard Deviation	N	ANOVA F-value	ANOVA p=value	K-S Test p-value
Owl limpets				0.09	0.7671	> 0.05
Reference	40.43	11.39	1393			
Visitor	41.04	9.07	891			
Abalone				0.18	0.6746	> 0.05
Reference	58.12	19.95	136			
Visitor	57.34	20.34	129			

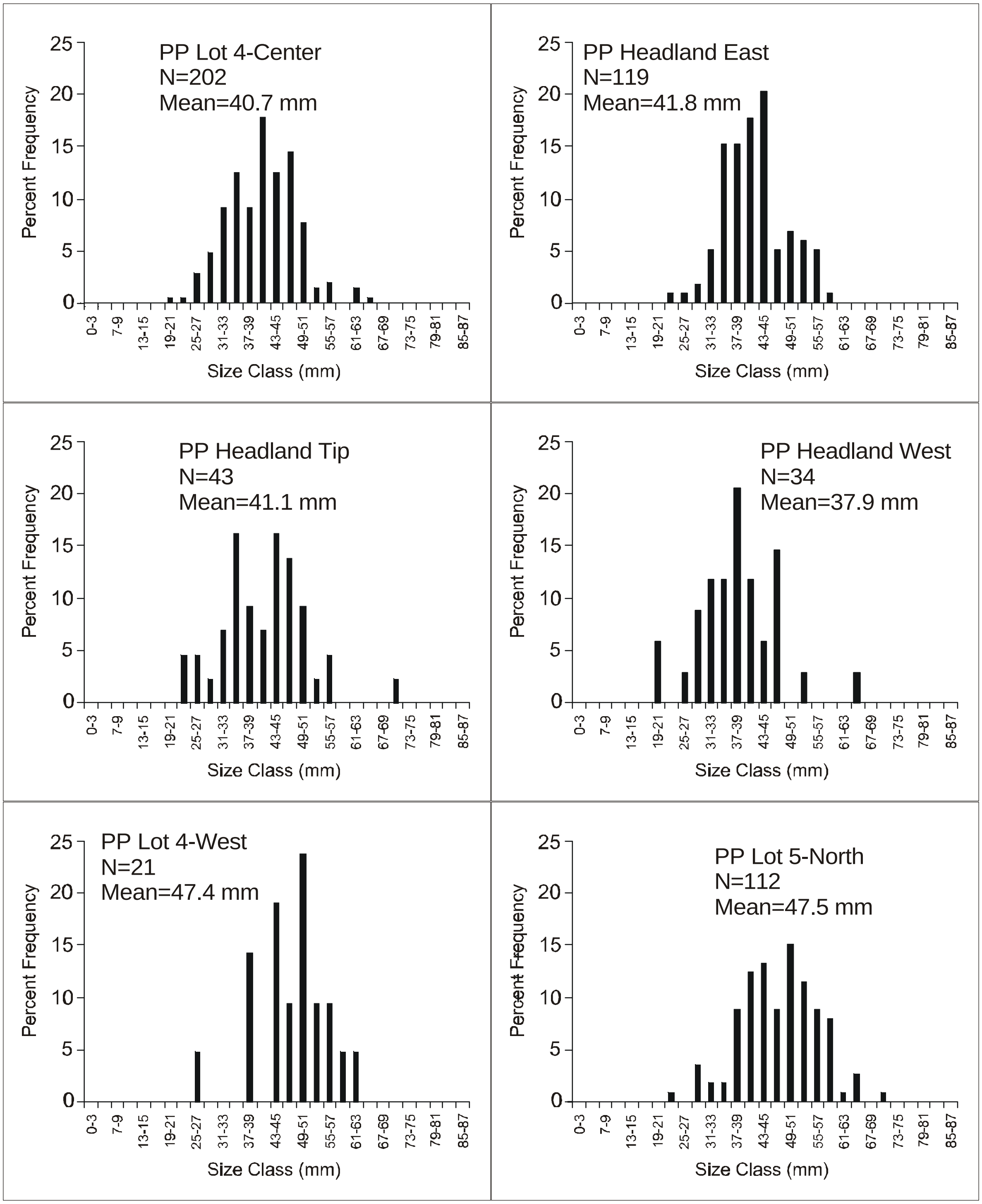

Figure 1. Owl limpet shell size frequencies

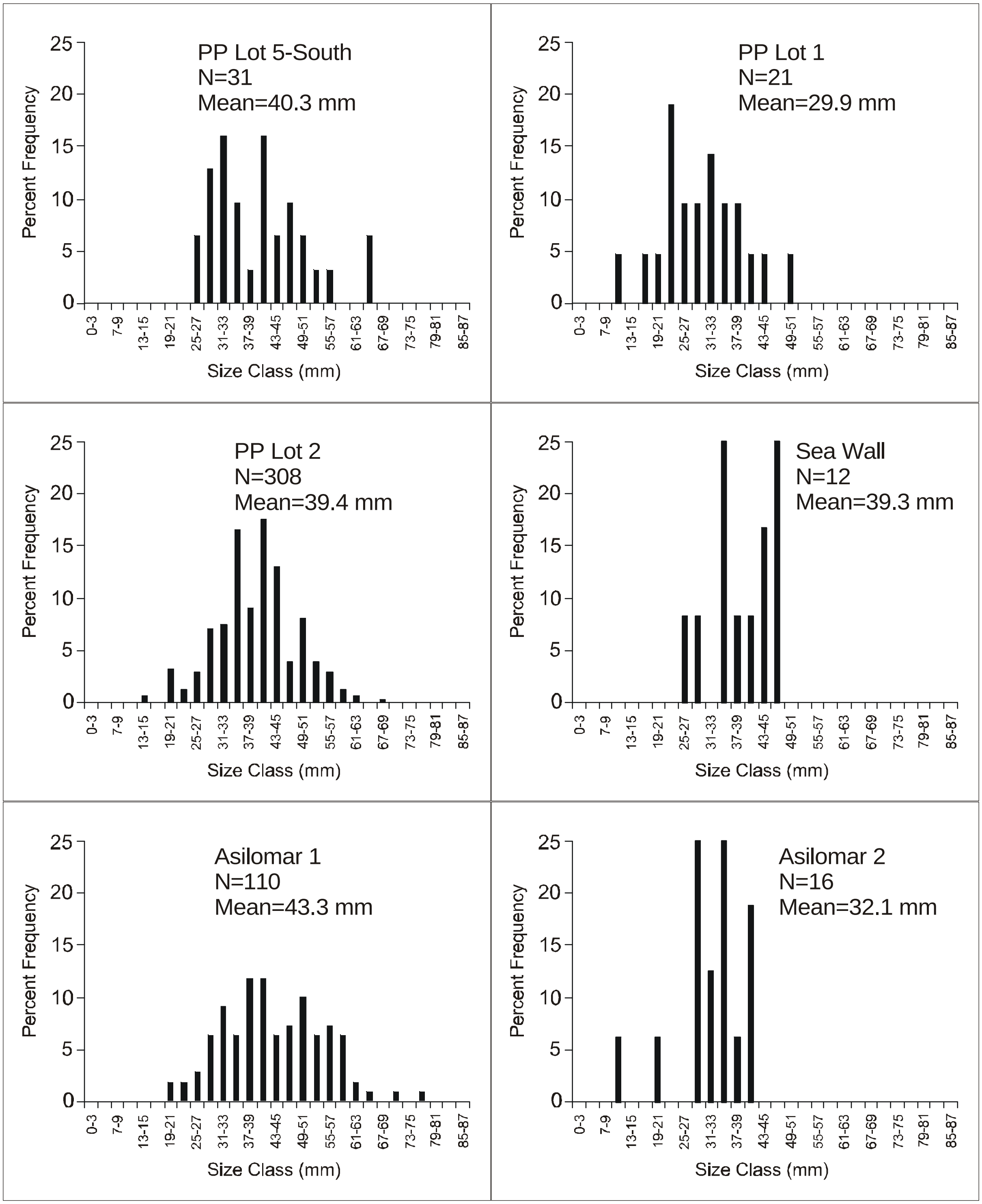

Figure 1 (continued). Owl limpet shell size frequencies

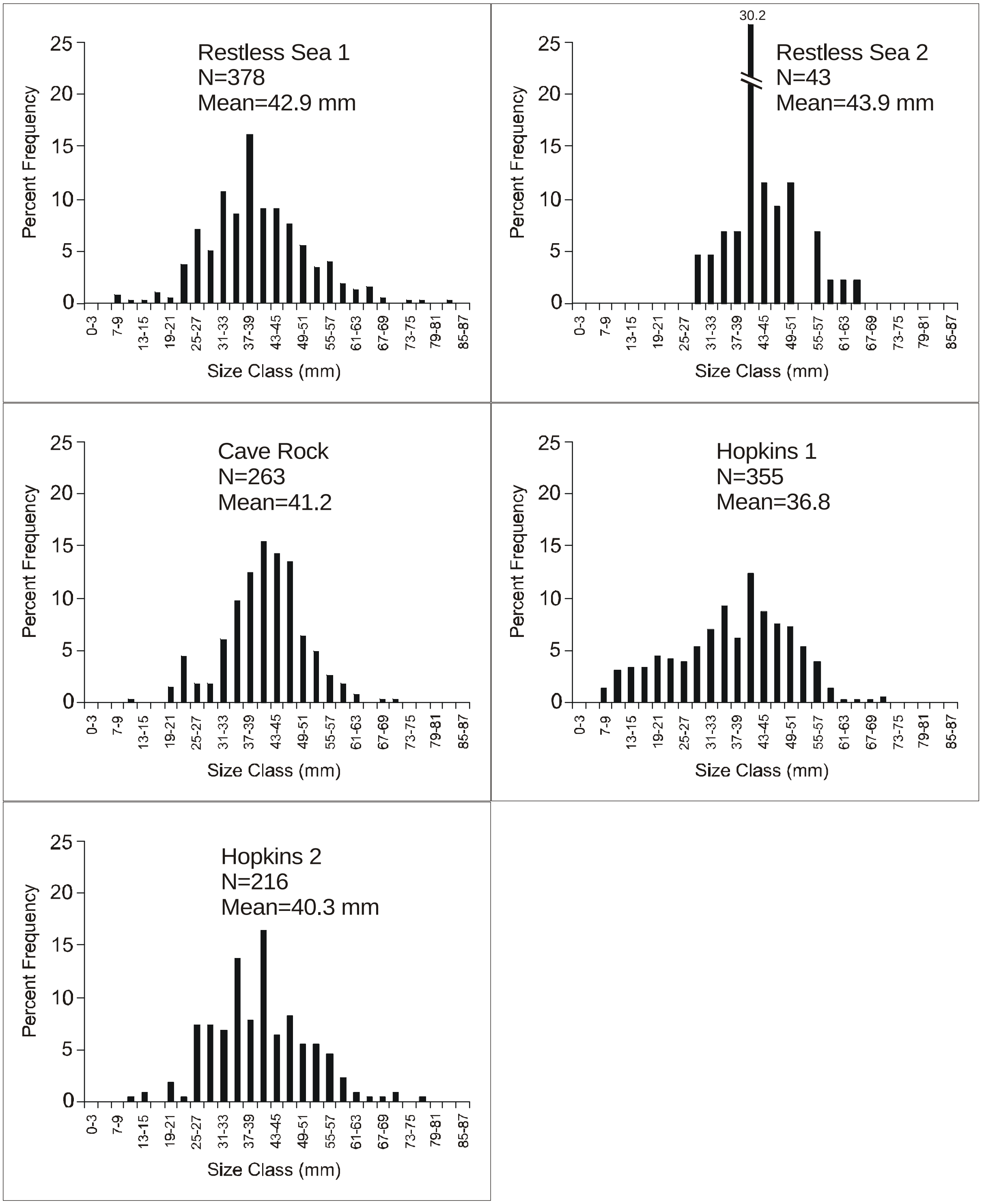

Figure 1 (continued). Owl limpet shell size frequencies

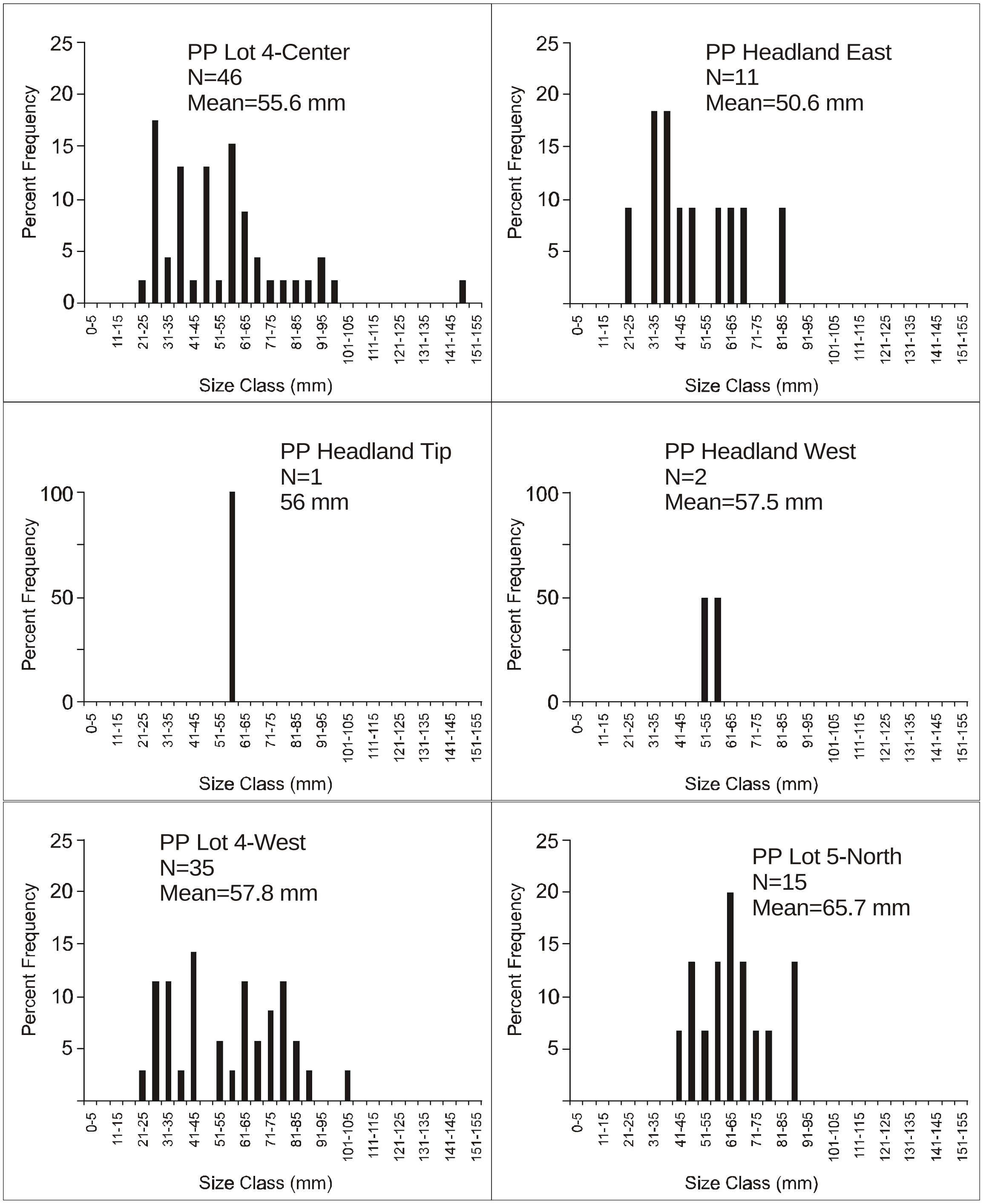

Figure 2. Black abalone shell size frequencies

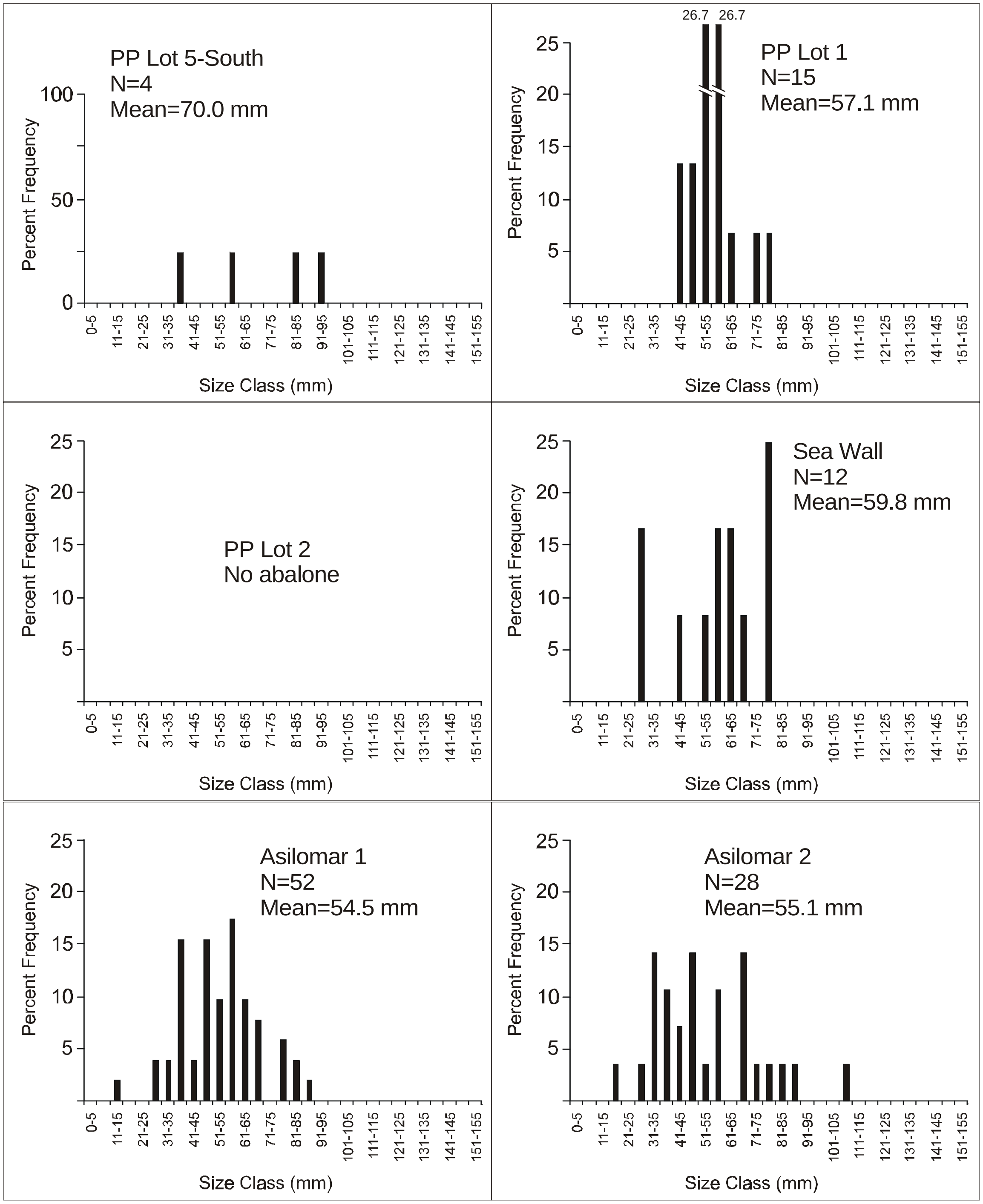

Figure 2 (continued). Black abalone shell size frequencies

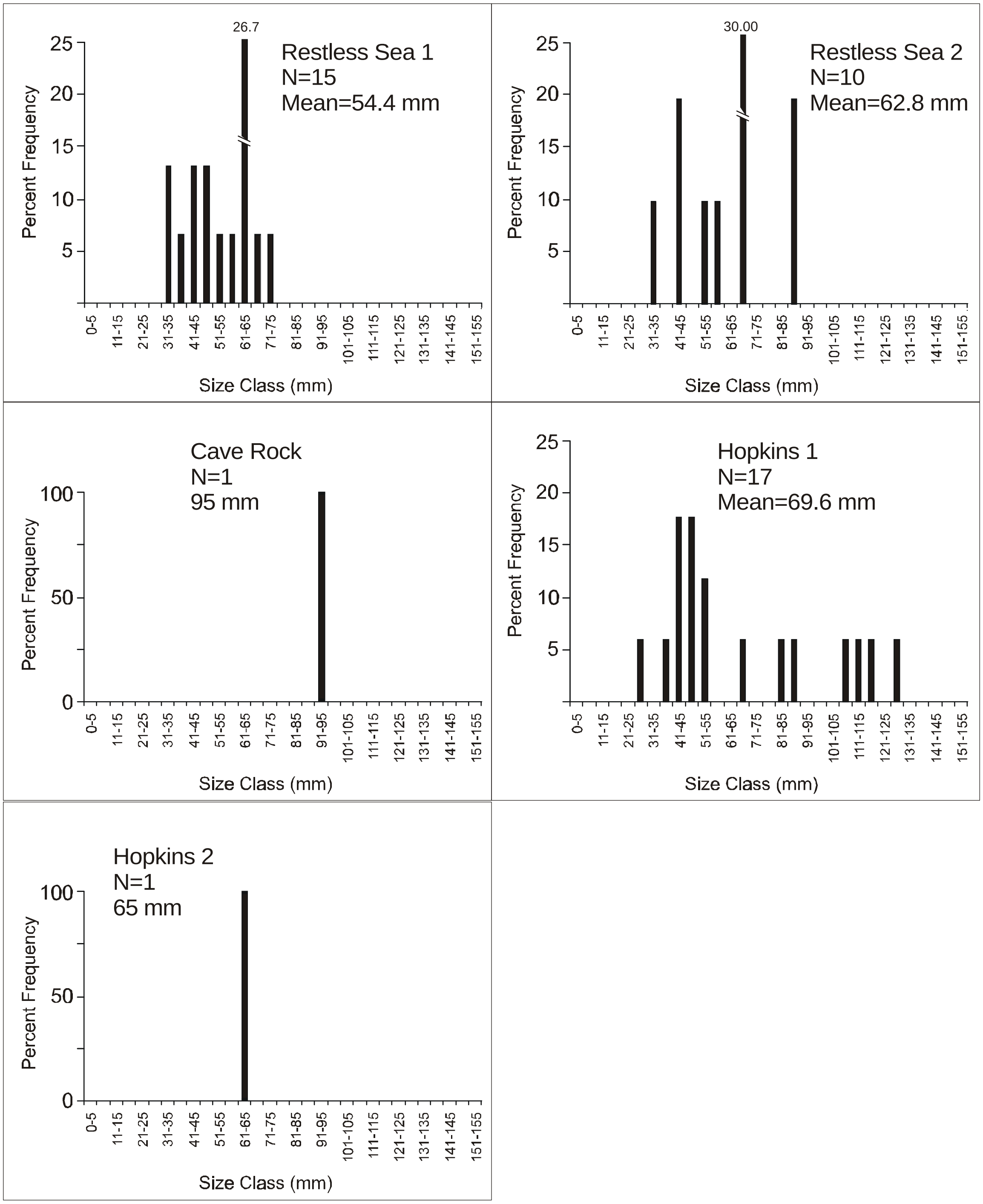

Figure 2 (continued). Black abalone shell size frequencies

Dr. Isabella Abbott

Occupation

- Marine phycologist; co-author of Marine Algae of California
- Faculty member of algae classes (28 years)
- Faculty member in Marine Ecology with late husband Dr. Donald P. Abbott (20 years)
- Published 34 papers (including three books) on California marine algae (out of 144 total publications on marine algae)

Affiliated Organization

- Hopkins Marine Station (1950-82)
- University of Hawaii (1982-present)

Time Period of Visits at Point Pinos

- 1950-82

Purpose of Visits

- Participant in sewage outfall studies at Point Pinos
- Monitoring growth of high intertidal fucoids (rockweeds)
- Monitoring species of drift algae near Asilomar Point

Frequency of Visits

- Frequent field trips to Middle Reef of Moss Beach along 17-Mile Dr. for collecting algae
- Dr. D.P. Abbott visited Point Pinos several times per year, and sometimes several times within a month (especially the Great Tidepool). I never collected there.

Biological Observations

I do not have any specific comments concerning the biota at Point Pinos, other than Point Pinos was considered by the two of us as offering a very representative cross section of animals and plants to study. We found in our sewage outfall studies that the algae were surprisingly resistant to the sewage and chlorine treatment (more resistant than the animals). Algal diversity appeared 'normal' outside of 50 m to either side of the discharge pipe and 100 m straight out.

I haven't been in the Monterey Peninsula tidepools since moving to Hawaii in 1982. Before, the increase in seawater temperature had changed things, at least at Mussel Point (Hopkins Marine Station). I need another lifetime.

Comments

Dr. D.P. Abbott favored the Great Tidepool. In the latter years at Hopkins, starting about 1975, he used to complain about the number of people who visited the Great Tidepool

Abbott: Page 2 of 2

and turned rocks and left them upside down. I only collected there once. He became upset at the gradual, accumulative destruction of visitor use such that he tried to take his classes elsewhere. However, there were animals in the Great Tidepool that were not as easily found elsewhere. Reading Dr. Steve Murray's papers on the effect people have in southern California (more feet than elsewhere on the California coast) made me speak out about the same thing happening here on Oahu where both University and high school classes use the same places for collecting. Furthermore, we have another predator that is not present in California, and that is people collecting algae to eat. The resulting trouble is that we must travel to further locations for our research and field trips, which makes it difficult to schedule around class periods and other commitments.

It made a big impression on me to have Yale Dawson record how a patch of algae disappeared at Leo Carillo Park (in Santa Monica?) because people stepped on the algae to get around a fence that went into the intertidal. This was impressive because the observation was made by Dawson at least 50 years ago, long before people noticed that kind of thing happening in the intertidal.

Dr. Alan Baldridge

Occupation

- Librarian

Affiliated Organization

- Hopkins Marine Station

Time Period of Visits at Point Pinos

- 1966-93+

Purpose of Visits

- Professional interest

Frequency of Visits

- Occasional

Biological Observations

- No personal recollections of changes or outstanding features
- Concern that poaching is frequent

Dr. Charles Baxter

Occupation

- Emeritus Senior Lecturer

Affiliated Organization

- Hopkins Marine Station, Stanford University

Time Period of Visits at Point Pinos

- 1963 to the present: specifically referring to the area from Point Pinos to the Great Tidepool

Purpose of Visits

- Collecting, class field trips, and participating in research projects

Frequency of Visits

- 1963 to 1973: 5-10 times per year:
- 1974 to 1993: 25-50 times per year
- 1994-present: 2-10 times per year

Biological Observations

- Less *Fucus* and more *Pelvetia* (*Silvetia*)
- Abundance of *Anthopleura elegantissima* seems far lower while *A. sola* is higher
- Abundance and diversity of under-boulder fauna, in general, is much reduced: echinoderms seem generally lower and asteroids and under-boulder brittle stars markedly less abundant
- Nudibranchs seem less abundant
- Serpulorbis (tube worm) in greater numbers
- Chitons seem to have declined in abundance and diversity

Comments

The above are my general impressions, and of course have many sources of potential error. Fewer recent visits probably lead to some changes being missed. Several times in the last ten years I have looked for *Polycheirus carmelensis* (large red acoel with tail) and have not found it in what used to be standard collecting locals. I will have to see if I can spend more time in the intertidal and refresh my memory. I have the feeling much of this is consistent with response to climate warming and the changes at Point Pinos lagged behind similar changes taking place at Hopkins Marine Station.

Richard Chamberlain

Occupation

- Teacher, semi-retired

Affiliated Organization

- Pacific Grove High School

Time Period of Visits at Point Pinos

- 1962-68, but have not returned

Purpose of Visits

- Taught marine biology class: population studies using transects and quadrats at Great Tidepool and at the end of Esplanade Street

Frequency of Visits

- 1-2 times per year

Biological Observations

- Area was lush and diverse
- Nudibranchs were abundant at Point Pinos but not as abundant at Esplanade Street site

Faylla Chapman

Occupation

- Teacher
- Past biological consultant

Affiliated Organization

- Morro Bay High School (teacher)
- Hopkins Marine Station (lab assistant, technician)
- Self-employed consultant

Time Period of Visits at Point Pinos

- 1972-84

Purpose of Visits

- Collecting data on algae and invertebrates before and after the Pacific Grove sewer line was decommissioned
- Collecting and observational surveys for Sea Grant sponsored research

Frequency of Visits

- 1972-73: frequently over 6 month period
- 75-80: about twice per year
- 80-84: about once per year

Biological Observations

Most of my observations centered around changes at the Pacific Grove sewer outfall at Point Pinos. The area directly around outfall was highly depauperate of algae and animals before the sewer was decommissioned. The red alga *Prionitis lanceolata* was the most conspicuous species and was highly stunted. After the outfall was decommissioned, a number of algal species increased in abundance along with increases in invertebrate abundances.

In the Sea Grant project, I visited specific areas around Point Pinos, but also other areas between Point Pinos and Hopkins Marine Station, looking for specific algae. I don't recall any suspicious or problem areas; the lower intertidal zones looked normally populated. Most of the higher intertidal areas around Point Pinos though had little algal cover most of the time, and the lower intertidal areas appeared to be quite lush, due to wave exposure and the greater difficulty of people reaching and trampling the lower shores.

Dr. Eugene Haderlie

Occupation

- Professor, retired

Affiliated Organization

- Naval Postgraduate School, Monterey, CA

Time Period of Visits at Point Pinos

- Past 50 years

Purpose of Visits

- School research

Frequency of Visits

- About twice per year for classes and more often for personal visits

Biological Observations

- Large, quick recovery after sewer taken offline
- Increase in bryozoans and tube snails (*Serpulorbis*)

Dr. James Nybakken

Occupation

- Professor

Affiliated Organization

- Moss Landing Marine Laboratories

Time Period of Visits at Point Pinos

- Mainly 1970-98

Purpose of Visits

- Personal research and class projects

Frequency of Visits

- Several times per year (general Monterey Peninsula)

Biological Observations

Most of my biological observations were made in the Asilomar area located slightly downcoast of Point Pinos. There I did repeated timed-search surveys examining nudibranch composition and abundance from 1970-74. My work was permissible with Fish and Game via my collecting permit. In never started any long-term studies at Point Pinos due to my work being unauthorized according to the Pacific Grove police department. I have not returned since.

In about 1973, I shifted my class visits to Carmel Point located further downcoast. In general, I did not see any large dramatic changes there in the macrofauna. In my last visits, however, I did suspect some subtle changes had occurred. These include fewer numbers.of juvenile red abalone (*Haliotis rufescens*) and fewer large-size owl limpets (*Lottia gigantea*). Also, the small flatworm *Polychoerus carmelensis* that mainly inhabits tidepools appeared less common, as was the hydrozoan *Hydractina* spp. that lives on the undersides of rocks. The mechanisms for the changes remain unknown, whether they were natural or human induced, and whether the changes were local or components of regional changes. Certainly the suspected declines in juvenile abalone, flatworms, and hydrozoans were probably not associated with visitor use. The decline in large-size owl limpets, however, could have been due to poaching, but could have also been due to natural causes.

I published my Asilomar research on nudibranch composition and abundance. A few classroom follow-up surveys were completed to provide one-time survey results for course exercise assignments. Consequently, the follow-up surveys were not designed or intended for comparing the results to the earlier work. Any re-analysis of the follow-up surveys for this purpose would have to account for sampling differences. Mainly, the area of study and sampling teams differed between the early and follow-up surveys. The size of the search area was larger in the follow up surveys, and the observers in the follow-up surveys had less training and experience than those in the earlier surveys.

Dr. John Pearse

Occupation

- Research Professor/Professor Emeritus, Ecology and Evolutionary Biology

Affiliated Organization

- Long Marine Laboratory
- University of California, Santa Cruz (UCSC)

Time Period of Visits at Point Pinos

- First visits in summer of 1959 while taking Don Abbott's course at Hopkins Marine Station
- Again in 1964 while taking a course at Hopkins Marine Station
- 1968 and 1971 while teaching courses at Hopkins Marine Station
- Periodically between 1972 and 1994 with University of California, Santa Cruz classes
- 2000-present with high school classes

Purpose of Visits

- Student (1959)
- College professor in invertebrate zoology, ecological physiology, and marine ecology courses from 1964-1994 (1971 class focused on the impact of the sewage outfall on the biota at Point Pinos and the 1994 class did an intensive comparative survey of species diversity there)
- Currently helping the Monterey Bay National Marine Sanctuary develop a long-term monitoring program at Point Pinos with high school students

Frequency of Visits

- One to several times over three months during the classes I took or taught
- Currently, 3-6 times a year for the past three years for work with high school students

Biological Observations

The Point Pinos area was my introduction to the rocky intertidal of California, and I was overwhelmed by its beauty and diversity, especially the crevice and under rock habitats. We were instructed early on to replace rocks to the positions we found them. Throughout my teaching career, Point Pinos was a very special place to take students because of its beauty and biological diversity.

In my last year as a faculty member at UCSC (1994), I had my class compare the species diversity at Point Pinos with other sites we had surveyed (Natural Bridges, Carmel Point, Big Creek, and Franklin Point). My class had been doing surveys at Natural Bridges for years. In 1993, we compared Natural Bridges to Carmel Point and Big Creek (Big Sur coast). Franklin Point is located on the open coast of San Mateo, and is a spectacular intertidal region for which there is little information on species diversity. The surveys in 1993 and 1994, done by college students in very similar ways, showed that Point Pinos and Carmel Point had the highest diversity of many groups of animals, and Point Pinos was highest in animal diversity overall. Point Pinos was also very diverse in algae, but decidedly lower than at Carmel Point (unpubl. data).

Beginning in 1994, including our more recent and current work with high school students, we have focused on the southwest side of Point Pinos in an area approximately 40 m beyond the old sewer outfall. The area there, especially around the outfall, was very different in the early 1970s when primary-treated domestic sewage was being discharged in the intertidal. Classes in the early 1970s at Hopkins Marine Station, including one I co-taught in 1971, used the area to learn more about the effects of sewage on intertidal life. Unfortunately, all those studies focused on how sewage, or components of the sewage, affected individual species, and no surveys were done on species diversity or abundance in the area. However, there is no question that the discharge had a dramatic effect on the biota of the area. The rock outcrops northeast of the end of the outfall were caked with sewage sludge and supported few macro-organisms, while the intertidal boulder field within 50 m from the end of the outfall was dominated by stunted coralline algae, mainly *Corallina vancouverensis*, and a few other species of red algae, especially *Prionitis lanceolata*. Other species of algae and surfgrass were conspicuously absent. That situation was also seen around the intertidal outfalls in Carmel Bay and at Soquel Point in Santa Cruz County.

Although no one followed the changes in the biota when the sewage discharge was terminated (in the early 1980s?), I presume that they were similar to what we found in our studies at Soquel Point. Some species probably colonized the area quickly, while others, particularly surfgrass, took decades to become re-established. Even today, an area of approximately 5-10 m diameter around the end of the outfall pipe has remained dominated by mainly coralline algae and *P. lanceolata*. Otherwise, the immediate surrounding area has a high overall biotic diversity, comparable to areas further from the outfall. Of course, there is also the possibility that areas further from the outfall were nourished and enriched by the sewage. Unfortunately, that possibility was never investigated.

While my impression is that the intertidal at Point Pinos remains among the richest and most diverse in California, it does not seem as spectacular as in the past. Perhaps I am jaded, or perhaps there has been a real change. Nudibranchs and other colorful organisms do not seem to be as common as they once were. Also, the under-rock animals, such as brittle stars and isopods seem to have declined in numbers. In particular, the conspicuous orange acoel flatworm *Polychoerus carmelensis*, found only in the rocky intertidal of the Monterey Peninsula, is not as abundant in pools and under rocks as it once was, either at Point Pinos or Carmel Point. These suspected decreases, if they are actual, are not the

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result of collecting or trampling, but may be a signal of subtle widespread environmental change.

One decrease that I am confident is real is in the population of the small viviparous brittle star *Amphipholis squamata*. My student, Steve Rummril, documented the reproduction of these animals in the early 1980s and found dozens to hundreds under each rock he turned over in the Great Tide Pool. He mapped his study area in his thesis so that I could go back to the same spot he studied. A few years later I returned to his study plot. In some two hours of searching, my wife and I found only 5 specimens. I also note that my students did not find any specimens of this species in their survey at Point Pinos in 1994 (or at Carmel Point in 1993). Yes, the place is changing, but the change is subtle and the cause or causes are far from clear.

Comments

I have been going to Point Pinos off and on for many years, and I still find it to be an extraordinarily rich and beautiful rocky intertidal environment. It is also clear that more and more people are visiting the area, and some are collecting animals for food or curiosity. I think the time has come for the area to be given special reserve status with managed visits of large groups and carefully regulated collecting. It needs the same kind of management that is presently given to the Fitzgerald Marine Reserve at Moss Beach. On the other hand, there is no evidence that I am aware of that limited collecting by scientists and students has had any adverse effects on the area. Indeed, collecting is often necessary to document the biota, and thereby protect it. Moreover, monitoring programs need to be established and followed to detect and better understand changes. Being at the interface of the land, sea, and air, the intertidal biota can serve as an important and relatively inexpensive and effective "canary" of the health of the coastal environment.

Milos Radakovich

Occupation

- Coastal Naturalist, Educator-Guide

Affiliated Organization

- Scientific Enterprises
- Bay Net director (MBNMS volunteer network)

Time Period of Visits at Point Pinos

- 1971-2002

Purpose of Visits

- Research, education, business, pleasure

Frequency of Visits

- Several times a month

Biological Observations

- Increase in population of coastal marine birds: pelicans, cormorants, terns, gulls, murres, guillemots, and others
- Decrease in the number, size, and distribution of many previously abundant intertidal invertebrates: sea stars (*Pisaster*, *Asterina*, *Leptasterias*, *Pycnopodia*), crabs (*Hemigrapsus*, *Pachygrapsus*, *Petrolisthes*, *Mimulus*, *Cancer*), limpets, chitons, nudibranchs and others
- Substantial increase in the number and frequency of visitors: families and group tours from all over the world, and school groups (grade school to university level), from Redding to Bakersfield

Comments

Many factors play a role in the biodiversity and population dynamics of any ecosytem. Changes in ocean/global climate, El Niños, introductions of exotic species, or new predators (or increase of existing), and changes in water quality can produce cyclic and/or permanent alterations. However, in any area that receives as much visitor traffic as the Point Pinos intertidal zone of Pacific Grove, the effect of human activities must be considered. Normally minimal impact activities such as turning rocks, trampling, removing or relocating animals, and even shell collecting can have profound consequences when conducted on a large scale, throughout the year, by people largely unaware of the subtle dynamics and needs of the ecosystem inhabitants. While monitoring and the enforcement of existing regulations are important components of a protective strategy, the presence of on-site interpreter guides and multilingual signage (interpretive as well as advisory) will have the quickest effect in the short-term and the broadest effect in the long-term.

Mark Silberstein

Occupation

- Executive Director of Community non-profit organization

Affiliated Organization

- Elkhorn Slough Foundation

Time Period of Visits at Point Pinos

- I visited the Point Pinos and Pacific Grove tidepools intensively in 1969-75, frequently in 1975-80, and infrequently since.

Purpose of Visits

- Early trips were field excursions with invertebrate zoology classes. In 1972 the visits were as a student in Dr. Don Abbott's intensive summer course in marine invertebrate zoology. In 1975, I served as Dr. Abbott's teaching assistant. Subsequent visits included observations while as a graduate student at the Moss Landing Marine Laboratories. In 1977-78 qualitative observations were conducted as part of a study to designate this location as an Area of Special Biological Significance.

Frequency of Visits

- During summer of 1972 and 1975, visits were made at every low (minus) tide from June through August. Subsequent visits varied in frequency. Total visits are estimated at approximately 120 over the entire time span of 12 years.

Biological Observations

It is impossible to summarize the scope of observations. However, I have distinct memories of Point Pinos when the sewage outfall was active. The water at the terminus of the pipe was turbid and the odor of chlorine was evident. The density and cover of green algae was much greater than today and was an obvious response to the outfall. Localized diversity in this vicinity was qualitatively lower than at areas away from the pipe. In this area, there has been tremendous recovery and increase in diversity. With regard to the educational and scientific collecting that we did, we carefully collected animals for lab observations of species that were evident in abundance. Most of the specimens were returned to the environment after observations.

Dr. James Watanabe

Occupation

- Lecturer

Affiliated Organization

- Hopkins Marine Station, Stanford University

Time Period of Visits at Point Pinos

- 1974 – present

Purpose of Visits

- Teaching, field trips

Frequency of Visits

- 1974-93: 1-3 visits per year
- 1994- present: 4-5 visits per year

Biological Observations

- *Mid intertidal:* under-rock fauna seems less abundant, esp brittle stars; polychaetes still diverse, but sparse (always been like this)
- *Low intertidal:* under-overhangs, the upper limit of compound tunicates, encrusting sponges, and hydroids seem to have moved lower on shore (formerly at +0.5 ft MLLW down to 0 ft MLLW was easy to find lots of tunicates etc; now still abundant, but mostly below 0 ft MLLW)
- Algal community still lush: *Silvetia* (=*Pelvetia*) waned for a while in the late 1980's, but has come back (same happened at Hopkins Marine Station)
- Nudibranchs still abundant, but possibly lower on the shore now than before
- Owl limpets abundant on high wave-exposed rocks (typical habitat)
- Limpets abundant under algae: *Asterina* abundant in low pools throughout my observations

Comments

- The intertidal environment hasn't remained constant, but fluctuations have appeared within normal variation
- No observations of overt human impacts; studies by students at Hopkins Marine Station indicate that most activity by visitors is focused above the high tide line with fishing appearing to be the most common extractive process.
- Recent data (summer 2002) shows large owl limpets abundant wherever appropriate habitat is present, and most abundant in areas with highest human use. The presence of these slow-growing animals that live high on the shore and are easily accessible to visitors suggests that extractive activities may not be too severe.
- High cover of lush fleshy algae suggests that trampling is not as severe as at other sites in California.

Dr. Steve Webster

Occupation

- Senior Marine Biologist-Monterey Bay Aquarium
- Professor-San Jose State University
- Teaching Assistant-Stanford University

Affiliated Organization

- Monterey Bay Aquarium

Time Period of Visits at Point Pinos

- 1966-present

Purpose of Visits

- Research, tidepool interpretation

Frequency of Visits

- Several times per year on average

Biological Observations

- Brittle stars less abundant
- Turban snails now possibly smaller in size
- Sea cucumbers (Synatptid/sand burrowers) appear less abundant now
- Tube snail (Serpulorbis) appear more abundant now
- Nudibranchs are sometimes common still but sometimes not
- Changes most likely regional rather than site specific

Jim Willoughby

Occupation

- Marine activist, conservationist
- Science teacher, retired-public schools (San Jose, CA)

Affiliated Organization

- Coalition to Preserve and Restore Point Pinos Tidepools

Time Period of Visits at Point Pinos

- Mainly in 1970 - present
- 1938: began observations as a child at Hopkins Marine Station where father was a work superintendent
- Completed some research at the Point Pinos tidepools for the California Academy of Sciences on the behavior of limpets (published in the July/August l974 issue)
- Completed a study under the direction of Dr. James Nybakken on *Lottia asmi-Tegula funebralis* relationships (Hopkins Marine Station and at Point Pinos circa l990)

Purpose of Visits

- Photography of local biota for preparing a children's book on marine biology
- Conduct biological observations at Point Pinos related to Master's Thesis work on limpets at Davenport, CA
- Visitor use observations

Frequency of Visits

- 1970-75: two weeks per year
- 1975-85: very few visits due to teaching concentration in San Jose
- 1986: built house in Pacific Grove in the Point Pinos neighborhood; viewed and enjoyed the area frequently
- 1998: formed the Coalition to Preserve and Restore Point Pinos Tidepools; visits to Point Pinos have since been nearly daily

Biological Observations

- A greater number of species could be found in the past with less difficulty (numbers of species are still high, but fewer number of individuals per species)
- Greater difficulty finding cryptochitons and red and black abalone
- Mussel beds and gooseneck barnacles are less abundant now, and mussels are smaller in size
- Brown rock crabs (*Cancer antennarius*) and red rock crabs (*C. productus*) have declined, probably from sea otter predation

Willoughby: Page 2 of 2

- Few owl limpets (*Lottia gigantea*) in the size range of 70-80 mm at Point Pinos, but at my 'Site B' that is nearby but with difficult access, these larger size animals are abundant among the healthy mussel beds because they have not been subjected to frequent collecting for food and other scientific purposes

Comments

- Biological changes have occurred at Point Pinos, and cannot be due solely to shifts in oceanographic conditions
- Human predation and collecting are responsible for many of the changes in species abundances
- There is variation in algal coverage and possibly species differentiation revealed in personal tidepool photographs that were taken in the l970's at Point Pinos and surrounding areas
- A recent visit to Hopkins Marine Station found that the area was more diverse than Point Pinos, based on shorewalk observations
- A recent visit to Point Lobos found the area was more greatly populated by certain species (e.g., sea urchins) than at Point Pinos
- The lack of scientific surveys in past years make it very difficult if not impossible to draw conclusions about the species diversification and abundance of marine invertebrates. However, I feel that comparisons of my personal photographs of two habitats in the Pacific Grove Marine Gardens Fish Refuge to be very significant. One has easy access and the other is protected by a precipitous and unsafe access. It simply proves that oceanographic and natural factors have a much lesser impact than human predation on the flora and fauna of Point Pinos.

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