THE STATUS OF ROCKY INTERTIDAL COMMUNITIES IN CHANNEL ISLANDS NATIONAL PARK

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ABSTRACT

Channel Islands National Park began monitoring the rocky intertidal community in 1982. Black abalone, owl limpets, mussels, acorn barnacles, rockweed, and turfweed are monitored biannually on all five park islands in fixed plots. The monitoring was designed to collect baseline information to determine normal variation and discover abnormal conditions as well as examine trends and watch for species introductions. Generally, three patterns in species abundance were seen among the sessile organisms: a steady population over time, a slow decline, or a dip in the population numbers around 1990 with a return to previous levels in recent years. Some declines can be explained by increased sea star predation. Sea star numbers were high (1 per m^2 or greater) at four sites and were responsible for declines in the mussel population at two sites. Storm waves had significant localized impacts on mussels and rockweed. Other agents of change are not so evident. Since 1986, black abalone populations declined over 99% parkwide due to withering syndrome (WS), a bacterial disease. Only a few remnant populations of black abalone remain, mostly on San Miguel Island. The loss of this spatial dominant from the community has been significant at all sites.

Keywords: Rocky intertidal, monitoring, *Haliotis cracherodii, Lottia gigantea, Mytilus californianus*.

RESEARCH NOTE

The Channel Islands offer some of the richest and least disturbed rocky intertidal areas in southern California. Yet, these areas are at risk of disruption from a variety of sources including fishery harvest, alien species, oil spills, marine pollution, and visitation. A rocky intertidal community ecological monitoring program run by the National Park Service (NPS) originally was designed to monitor the effects of visitation at Anacapa Island and started in 1982. The program was expanded to other park islands for a more general monitoring outlook in 1985 to 1988, bringing the total number of sites to 14. Six monitoring sites were established on Santa Cruz Island for the California Coastal Commission in 1994 (Engle et al. 1998). The NPS began monitoring these sites in 1998.

Ground cover of dominant taxa, bare rock and tar was determined at each site biannually in 20, 50 x 75 cm fixed plots distributed in four zones characterized by barnacles: *Balanus glandula*, *Chthamalus* sp., and *Tetraclita rubescens;* turfweed: *Endocladia muricata*; rockweeds: *Pelvetia compressa* and *Hesperophycus californicus;* or mussels: *Mytilus californianus*. Abundance and sizes of owl limpets, *Lottia gigantea*, and black abalone, *Haliotis cracherodii,* were monitored in fixed plots of various sizes. Sea stars (mostly *Pisaster ochraceus*) were monitored in transects at three sites and in abalone plots at all sites (Richards and Davis 1988).

Over 99% of the *Haliotis cracherodii* present when monitoring began in 1985 were gone by 1998 at all sites. Once one of the spatial dominants of the lower rocky intertidal zone, *H. cracherodii* are rarely encountered now except at San Miguel Island and the western end of Santa Rosa Island. The severe population declines are attributed to mass moralities from withering syndrome (WS) (Haaker et al. 1992; Richards and Davis 1993). Symptoms include an atrophied and flaccid foot muscle, lack of gonad development, weakness and decreased tactile response.

Withering syndrome was first observed in 1986 on south facing reefs on Anacapa and Santa Rosa islands. Dramatic declines occurred in 1987 as dead abalone and empty shells accumulated on the beaches. The *H. cracherodii* density at Middle Anacapa dropped from 42 to 14 per m^2 between March and December 1987. Different patterns of decline occurred. At Crook Point, San Miguel Island, the numbers declined gradually. At Santa Barbara Island, the low-density population appeared healthy until 1988, then virtually disappeared within two years. At Harris Point, San Miguel Island, there was an acute mortality in 1988, then several years of relative stability or gradual decline. Harris Point has had the highest density of *H. cracherodii* since 1991, but it too fell below 1 per m^2 in 1998. Juvenile abalone, once common there, were rarely found past 1993. As plot densities declined, timed searches of whole reefs were conducted to maintain some measure of relative density and presence of abalone. Throughout the 1990s, *H. cracherodii* were only rarely found at Santa Barbara and Anacapa islands.

Withering syndrome continues to be a problem with moribund abalone still being found through 1998. A Rickettsiales-like protozoan (Friedman et al. 1997) is the

probable cause of the syndrome that has devastated the *H. cracherodii* population. The black abalone fishery was closed in 1993 but the decline has continued and black abalone are in danger of disappearing from the Southern California Bight completely. Other abalone species are affected by WS, and there is concern that green abalone, *H. fulgens*, may be in as much trouble as black abalone (P. Haaker, pers. comm.).

Heavy growth of *Phragmatopoma californica* was noted at WS impacted sites on both Santa Rosa and Anacapa islands in early 1988. *P. californica* colonies were very dense in the abalone plots recently left empty by *H. cracherodii* and sometimes surrounded surviving abalone. The presence of *P. californica* reduces the amount of bare rock in the lower intertidal.

Lottia gigantea densities at Johnson's Lee and Ford Point on Santa Rosa Island peaked in 1992. Johnson's Lee *L. gigantea* densities declined precipitously since then, and in 1998 were only 13% of the 1988 density. The Ford Point *L. gigantea* densities have shown less fluctuation over the years, but the 1998 average density was only 66% of the 1988 level. At Crook Point, *L. gigantea* were never present in very high numbers in plots primarily established for abalone. As the abalone numbers declined within the plots, so did the owl limpets (from 8 per m^2 to less than 1 per m^2). From casual observations, *L. gigantea* in other areas of this site, particularly on some of the vertical faces of surge channels, did not appear to decline. With the decline of *Haliotis cracherodii* at Crook Point, *Phragmatopoma californica* became much more abundant, eventually covering the rock surface over most of the plots and eliminating suitable habitat for the limpets.

The mean size of *Lottia gigantea* appears to stay consistent over time. Ford Point and Johnson's Lee, Santa Rosa Island both showed some depression of mean size in the early 1990s. Density peaks coincided with those size minimums. By 1996, mean sizes about equaled the 1988 sizes but the densities were lower. At Otter Harbor, where *L. gigantea* were monitored in mussel bed habitat within abalone plots, the mean size (~40 mm) was the smallest of any of the sites monitored and the density was also one of the lowest (7 per m^2). At Northwest Talcott, Santa Rosa Island the *L. gigantea* density was also about 7 per m^2 but the mean size was around 60 mm with individuals reaching 100 mm shell length.

In 1984, following a major El Niño Southern Oscillation (ENSO) there was a depression of the *Endocladia muricata* cover in plots at all Anacapa Island sites (Richards 1994). The algae quickly recovered and cover remained high throughout the later 1980s and 1990s. The 1997-1998 ENSO did not have the same effect however, and *E. muricata* cover declined only slightly in 1997 and 1998 at most sites, even increasing at East Point and Northwest Talcott on Santa Rosa Island. At a majority of the sites on all islands, *E. muricata* cover was depressed between fall 1988 and 1991. There were exceptions however. At East Point, cover was high through winter 1989-1990, and at Otter Harbor, San Miguel Island and Landing Cove, Santa Barbara Island the *E. muricata* cover remained high throughout this period.

Acorn barnacle, *Balanus glandula*, cover was depressed at roughly half of the sites between 1988 and 1991 while remaining stable at the others. Rockweed and mussel cover both seemed to be relatively stable; however, both were affected by storm waves. Storm waves occasionally had great impacts on individual mussel plots but these were localized patches of destruction usually of only a few square meters.

Pisaster ochraceus abundance was high at Johnson's Lee (3 to 6 per m^2) and Fossil Reef (1 per m^2), Santa Rosa Island. *P. ochraceus* were observed feeding on the mussel beds here and were presumed the cause of declines in *Mytilus californianus* percent cover. Mussel plots higher on the reef above the range of *P. ochraceus* were not affected. Various red algae, *Phragmatopoma californica,* and *Anthopleura elegantissima* were the typical dominants after a mussel decline. Despite high numbers of *P. ochraceus* at Crook Point, San Miguel Island (4 per m^2) and Landing Cove, Santa Barbara Island (1 per m^2) there was consistently high mean cover of *M. californianus*. Mussel cover at Harris Point and Cuyler Harbor, San Miguel Island declined steadily between 1985 and 1998 with no obvious cause.

Both *Hesperophycus californicus* and *Pelvetia compressa* invaded barnacle plots at Cat Rock, Anacapa Island over the years of monitoring. The two rockweed species were not scored separately and their combined cover in the barnacle plots increased from a trace in 1982 to about 30% cover in 1998. One barnacle plot at Otter Harbor, San Miguel Island was established near an aggregation of black abalone on a nearly vertical wall. As the abalone disappeared, the relatively clean rock became covered with red algae (mostly *Mastocarpus papillata* and *Rhodoglossum affine*).

At Sea Lion Rookery, Santa Barbara Island the monitoring reef has been used increasingly by the California sea lion, *Zalophus californianus,* since monitoring began in 1985. *Z. californianus* lay on the rocks of the upper intertidal zone and transit the area between the haulout area and the water. Sea lion defecation accumulates in the upper pools where there are few macro-organisms. A low dense mat of sea lettuce, *Ulva* sp., dominated rocks in this area through most of the 1990s. Cover by the red algae, *Gelidium coulteri* and *Rhodoglossum affine,* increased in the early 1990s at least partially replacing *Endocladia muricata* in many of the plots. On the upper reef, these algae persist only as a low turf protected by rugosities in the rock. One turfweed plot on a vertical face had significantly more limpets than plots on horizontal rocks. Based on counts of sea lions at the site, I estimate Sea Lion Rookery to have at least 10 times the visitor days (by sea lions) than the nearly 3,000 visitor days (human) at South Frenchy's Cove, Anacapa Island.

General searches of the sites and photoplots for species presence/absence turned up some interesting species occurrences. *Neorhodomela larix* and its epiphyte *Soranthera ulvoidea* are two algal species usually not found south of Government Point (Abbott and Hollenberg 1976).

Both these species are common and persistent around the west-end of Santa Rosa Island. The brown alga, *Analipus japonicus,* has been found at Crook Point on at least two occasions. The chiton, *Tonicella linearis,* was found on San Miguel and Santa Rosa Islands. Two examples of species with southerly distributions found at the Channel Islands are Zebra perch, *Hermosilla azurea*, whose juveniles were found in tidepools at Santa Barbara Island and turban snails, *Tegula gallina*, found at Santa Barbara, Anacapa, and Santa Rosa islands.

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