



Rocky Intertidal Community Monitoring at Channel Islands National Park

2016–17 Annual Report

Natural Resource Data Series NPS/MEDN/NRDS—2021/1311



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ON THE COVER

Rocky intertidal habitat at Fraser Cove, Santa Cruz Island

Photograph by: Hillary Krumbholz

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Executive Summary

Channel Islands National Park includes the five northern islands off the coast of southern California and the surrounding waters out one nautical mile. There are approximately 176 miles of coastline around the islands, about 80% of which is composed of rock. The diversity and undisturbed nature of the tidepools of this rocky coastline were recognized as special features of the islands in the enabling legislation. To conserve these communities unimpaired for future generations, the NPS has been monitoring the rocky intertidal communities at the islands since 1982. Sites were established between 1982 and 1998. Site selection considered visitation, accessibility, presence of representative organisms, wildlife disturbance, and safety. This report summarizes the 2016–17 sampling year efforts (from November 2016 to April 2017) and findings of the Channel Islands National Park (CHIS) Rocky Intertidal Community Monitoring Program.

Specific monitoring objectives are 1) to determine the long-term trends in percent cover of key sessile organisms in the rocky intertidal ecosystem (Table 1), and 2) to determine population dynamics of *Haliotis cracherodii*, *Lottia gigantea*, and *Pisaster ochraceus*. Objectives were met by monitoring percent cover of core species in target intertidal zones using photo-plots and transects, and measuring size frequency and abundance of black abalone, owl limpets, and sea stars using fixed plots or timed searches.

Thirteen key species or assemblages have been monitored twice per year at 21 sites on the five park islands (Figure 1) as part of the Rocky Intertidal Community Monitoring Program. Fixed photo-plots were used to monitor the percent cover of thatched and acorn barnacles (*Tetraclita rubescens*, *Balanus glandula*/*Chthamalus* spp., respectively), mussels (*Mytilus californianus*), rockweeds (*Silvetia compressa*, and *Hesperophycus californicus*), turfweed (*Endocladia muricata*), red algal turf (*Pterocladia* spp. and *Gelidium* spp.), goose barnacles (*Pollicipes polymerus*) and tar. Point-intercept transects were used to determine the percent cover of surfgrass (*Phyllospadix* spp.). Information about size distribution (i.e. “size-frequency” data) was collected for owl limpets (*Lottia gigantea*) in circular plots. Size distribution and relative abundance of black abalone (*Haliotis cracherodii*) and ochre sea stars (*Pisaster ochraceus*) were determined using timed searches. The maximum number of shorebirds and pinnipeds seen at one time were counted at each site. The number of concession boat visitors to the Anacapa tidepools was collected and reported.

All sites were sampled during the 2016–17 monitoring season. In 2015–16, we officially reduced our sampling interval from twice per year (spring and fall) to once in the fall to streamline the program and allow for the implementation of additional protocols. Weather conditions during the site-visits were satisfactory, but high wind coupled with strong swell and surge limited or prevented the completion of some of the abalone and sea star searches.

The percent cover for most key species or assemblages targeted in the photo-plots was highly variable among sites. Mussel, *Mytilus californianus*, cover remained below average at Anacapa and Santa Barbara Islands. Record or near record-low abundances for *M. californianus* were measured at Anacapa Middle West, Harris Point, Prisoner’s Harbor, Sea Lion Rookery and South Frenchy’s Cove. The only sites that appeared to have above average *Mytilus* cover were Crook Point and

Orizaba Cove. Most other sites had mussel cover near or below the long-term mean. Qualitatively, *Mytilus* cover appeared to be increasing at most locations last year as newly-recruited mussels were common. This year, recruitment levels were not high, but the majority of recruits from last year appeared to have persisted. Both rockweed species, *Silvetia compressa* and *Hesperophycus californicus*, continued to decrease markedly in abundance this year at the majority of sites compared to combined averages for previous years. Barnacle, *Chthamalus/Balanus* spp., cover fell below the long-term means at all islands except Anacapa whereby barnacle cover was approximately average. *Endocladia muricata* abundances remained comparable to grand means calculated for previous years at Santa Barbara and Santa Rosa Islands, while cover of the alga decreased slightly below the long-term means at Anacapa, San Miguel and Santa Cruz.

Black abalone abundances at the islands remain less than one percent of 1985 population levels. Zero abalone were found throughout the entire site at Landing Cove, Sea Lion Rookery and South Frenchy's Cove. At the majority of sites, counts for black abalone in 2016–17 were greater than the long-term mean generated from post-1995 count data. For the third consecutive year since Withering Syndrome decimated populations of black abalone, size frequencies for all islands except Santa Barbara reflected signs of recruitment through the presence of juvenile (< 50 mm) abalone.

Ochre sea star populations crashed in 2014 at all monitoring sites due to Sea Star Wasting Syndrome, an illness characterized by a suite of symptoms that generally result in death. The mortality event was widely considered to be the largest mortality event for marine diseases ever seen. Beginning in June 2013, the disease swiftly and significantly impacted *P. ochraceus* (among other species of sea stars) populations along the North American Pacific coast from Alaska to Baja California, Mexico. By the beginning of 2014, *P. ochraceus* abundances had declined by >95% at nearly all Channel Islands long-term intertidal monitoring sites, in addition to numerous other locations along the west coast. At various times during the past decade, extremely high abundances (~ 500 *P. ochraceus*) have been observed at multiple sites, and most locations have supported >100 sea stars counted during 30-minute site-wide searches. This year, abundances ranged 0–26 individuals per site with all but two sites (Crook Point and Willows Anchorage) having fewer than 15 *P. ochraceus* seen during routine searches.

Giant owl limpet densities in 2016–17 were comparable or slightly below the long-term mean at all sites except Fossil Reef, Otter Harbor and Willows Anchorage. At the three latter sites, owl limpet abundances were exceptionally-high relative to past years. The sizes of *L. gigantea* this year varied among sites and islands. The smallest *L. gigantea* were observed at Willows Anchorage followed closely by Anacapa Middle West and the largest were seen Northwest-Talcott. Temporally, the mean sizes of *L. gigantea* in 2016–17 decreased at all islands where they are measured.

Surfgrasses are typically monitored at two sites each on Santa Cruz and Santa Rosa Islands. This year, all transects were monitored at the two Santa Cruz sites. At Santa Rosa Island, the transects at East Point were not sampled due to high surf. Only two of the three transects at Northwest-Talcott were sampled because the identification bolt for Transect-3 could not be located. Relative to past years, cover of surfgrass increased above the long term mean at Fraser Cove, East Point and Northwest-Talcott.

Overall, the abundances and diversity of shorebirds in 2016–17 at all sites appeared similar to observations made in recent years. Black oystercatchers were the most ubiquitous shorebird seen at all sites. Contrary to past years, no American oystercatchers were sighted this year. Black turnstones were slightly less common relative to past years whereby 1–3 were seen at four sites.

Harbor seals, *Phoca vitulina*, were seen at in the vicinity of five sites this year. As in past years, harbor seals were most abundant at Otter Harbor. Elephant seals, *Mirounga angustirostris*, were seen at six sites during the year whereby abundances ranged 1–30 individuals per location. California sea lion abundances were slightly lower this year relative to recent past years. The greatest number of sea lions was seen at the aptly named site, Sea Lion Rookery.

Acknowledgments

The National Park Service (NPS), Channel Islands National Park (CHIS) funded this program. The NPS Mediterranean Coast Network Inventory and Monitoring (MEDN I&M) Program provided support for data analyses and database assistance. Temperature loggers were provided by the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) Marine Science Institute, University of California, Santa Barbara (UCSB) and the MEDN I&M Program.

Dr. Pete Raimondi at UCSC, provided two junior biological technicians (Hillary Krumbholz and Emily Hardison) to assist the CHIS Rocky Intertidal Monitoring Program (RIMP) during the entire field season. The two researchers helped tremendously with duties including conducting searches and measurements for black abalone, sea stars and owl limpets as well as assisting with photographing plots and site panoramas.

As with any large project there are many people “behind the scenes” that make it possible to actually conduct the work. We are indebted to the administrative clerks, dispatchers, boat operators, maintenance workers, and rangers of CHIS that help with the day-to-day operations.

This work was performed in part at the University of California Natural Reserve System, Santa Cruz Island Reserve on property owned and managed by The Nature Conservancy. Thanks to Dr. Lyndal Laughrin and staff at the UC reserve field station for their assistance.

We are grateful to the many people that assisted with the monitoring during the 2016–17 sampling seasons including Josh Sprague (Marine Ecologist, CHIS) and Kenan Chan (Biological Technician, CHIS).

We are especially grateful for the database support that Lena Lee (MEDN I&M) provided to ensure smooth program operation.

Glossary

ANI	Anacapa Island
C	Centigrade
CDFG	California Department of Fish and Game
CHIS	Channel Islands National Park
CINMS	Channel Islands National Marine Sanctuary
ENSO	El Niño Southern Oscillation
GIS	Geographic Information System
MARINe	Multi-Agency Rocky Intertidal Network
MEDN I&M	Mediterranean Network Inventory and Monitoring
MLLW	Mean Lower Low Water
NMFS	National Marine Fisheries Service
NOAA	National Oceanographic and Atmospheric Administration
NPS	National Park Service
PISCO	Partnership for Interdisciplinary Studies of Coastal Oceans
PIT	Passive Integrated Transponder
PVC	Polyvinyl chloride
SCA	Student Conservation Association
SBI	Santa Barbara Island
SCI	Santa Cruz Island
SMCA	State Marine Conservation Area
SMI	San Miguel Island
SMR	State Marine Reserve
SRI	Santa Rosa Island
TNC	The Nature Conservancy
UCLA	University of California Los Angeles
UCSB	University of California Santa Barbara
UCSC	University of California Santa Cruz
WS	Withering Syndrome

Introduction

The rocky intertidal zone is a compact, biologically diverse area between marine and terrestrial habitats. Marine organisms living in this zone are highly adapted to physical disturbance and severe temperature fluctuations. They are subject to both marine and terrestrial predators. The intense pressure from both physical and biological entities has promoted highly diverse invertebrate and algal assemblages within the rocky intertidal zone, evident in the vast number of organisms that cannot live without the alternating exposure to both air and sea.

CHIS and CINMS encompass the four northern Channel Islands and Santa Barbara Island off the coast of southern California. The park islands and surrounding waters bear the designations International Biosphere Reserve and State of California Areas of Special Biological Significance. The State of California maintains jurisdiction over the marine resources and manages them through the California Department of Fish and Game (CDFG). In 2003, a network of marine reserves was established around the Channel Islands. Four of the rocky intertidal monitoring sites fall inside State Marine Reserves and two more are immediately adjacent to reserve boundaries (Figure 1).

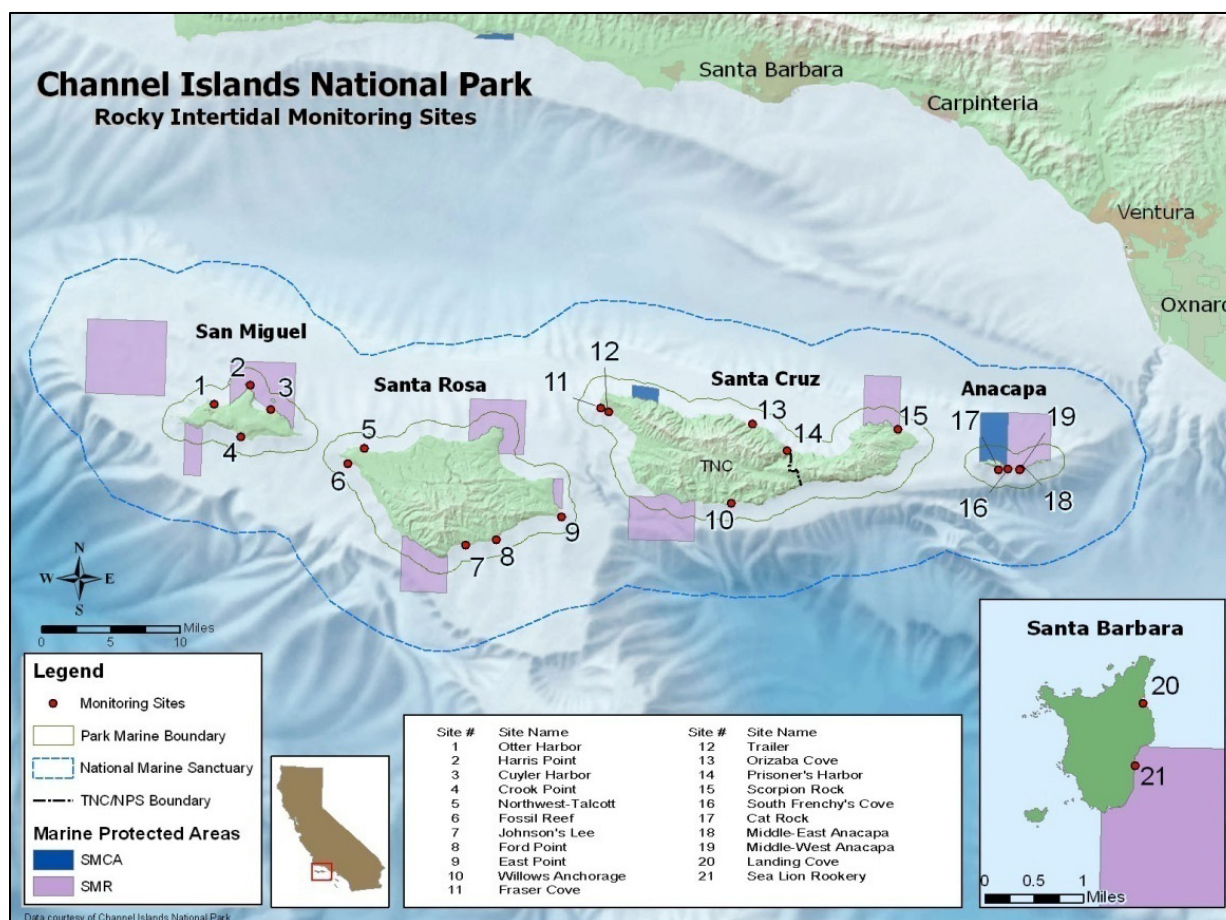


Figure 1. Rocky Intertidal Community Monitoring site locations in Channel Islands National Park. Note: TNC= The Nature Conservancy, SMCA= State Marine Conservation Area, SMR= State Marine Reserve; Sites 18 and 19 are on adjacent reefs.

The “undisturbed tide pools” are unique features specifically mentioned in the enabling legislation for CHIS. The law establishing the park (16-USC-410) also mandated the development of inventories and monitoring of natural resources in the park. Rocky intertidal monitoring began in 1982 with the following goals: 1) to monitor trends in population dynamics of selected indicator organisms, 2) to determine normal limits of variation, 3) to discover abnormal conditions, 4) to provide remedies for management problems, and 5) to measure the success of management actions.

Specific monitoring objectives are: 1) to determine the long-term trends in percent cover of key sessile organisms in the rocky intertidal ecosystem, and 2) to determine population dynamics of *Haliotis cracherodii*, *Lottia gigantea*, and *Pisaster ochraceus*. Objectives are met by monitoring percent cover of core species in targeted intertidal zones using fixed photoplots and fixed transects, monitoring species composition and abundance of motile invertebrates using photoplots, and measuring size frequency and abundance of black abalone, owl limpets, and seastars using fixed plots or timed searches.

Monitoring has been conducted twice each year, during spring and fall, to assess the effects of winter storms and summer warm water. This year, however, in an effort to streamline and modify the program, the decision was made to sample each site annually. The basis for this decision was primarily supported by a power analysis conducted by Dr. Pete Raimondi (UCSC) which indicated there was sufficient power to detect changes within species assemblages targeted by the program (Raimondi 2018). This year and during subsequent years, monitoring will occur in fall and winter, and low tide series in the spring will be reserved for making up any monitoring missed during the primary survey window.

Rocky intertidal monitoring initially began at Anacapa Island (VTN Oregon 1984) following concerns that visitor usage (e.g., trampling, collecting, etc.) may increase and thus negatively impact rocky intertidal communities (Littler 1978). Beginning in 1985, the program was expanded to include sites at Santa Barbara, Santa Rosa and San Miguel Islands. Sites were added at Santa Cruz Island in 1994–1998 by UCSB personnel and assumed by CHIS in 1998. Monitoring of the intertidal zone was part of a long-term “vital signs” ecological monitoring program developed at CHIS (Davis et al. 1994) that eventually served as the model for ecological monitoring conducted through the NPS Inventory and Monitoring Program (Davis 2005). CHIS is one of three parks in the Mediterranean Coast Network of the NPS Inventory and Monitoring Program.

Because intertidal areas are so heterogeneous, an impractically high number of plots would be necessary to detect temporal changes in species abundance using probability-based sampling (see Ambrose et al. [1992, 1995] and Murray et al. 2006). A sampling design involving fixed plots was selected, therefore, in an attempt to maximize the ability to detect temporal changes in target species distribution and abundance. The disadvantage of this sampling design is that results from plots cannot be extrapolated to the larger, un-sampled population (Engle 2008), and statistical comparison among sites is not possible (Murray et al. 2006).

CHIS Rocky Intertidal Monitoring is part of a government and non-government consortium called the Multi-Agency Rocky Intertidal Network (MARINe) (Dunaway et al. 1998). Within MARINe, the

goal is to standardize collection of data at sites spanning from Baja California to Alaska, including the Channel Islands, and make it available to member groups in a centralized database (Engle 2008). By working with MARINe we have access to consistent data that can be used for much broader regional analyses of changes to intertidal communities.

This report summarizes the 2016–17 sampling season (Fall-Spring) efforts (from November 2016 to April 2017) and documents activities and observations of the CHIS Rocky Intertidal Community Monitoring Program. Monitoring results were previously reported in Richards 1986, 1988, 1998; Richards and Lerma 2000, 2002, 2005; Richards et al. 2011, 2013; Richards and Rich 2009, 2012; Richards and Whitaker 2012a, 2012b, 2012c, 2012d; Whitaker and Richards 2012, 2020; Whitaker 2020a, 2020b, 2021. Additional black abalone monitoring results have been presented in Haaker et al. 1992, Davis et al. 1992, and Richards and Davis 1993.

Methods

Study Area

The California Channel Islands comprised eight islands in the Southern California Bight; five of the islands are located within the CHIS. The five park islands have about 323 kilometers (176 miles) of coastline, the majority (approximately 80%) of which is rocky shore. Rock types vary from hard, weathered volcanic basalt or breccias to easily eroded Monterey shale and sandstone. Sites were originally established to include the various exposures and rock types of each of the islands, though broad rocky benches were targeted.

The Park islands span the transition zone between cooler waters of the Oregonian biogeographic province and the warmer Californian waters from the south. Mean annual air temperature along the mainland in this area is 15°C. Mean rainfall is about 38 cm per year (Dailey et al. 1993). There is a climatic gradient across the island chain with San Miguel Island having the most precipitation, cloud cover, and wind. Santa Barbara Island to the southeast is the warmest and driest. The mean monthly sea temperatures range from 13°C in April at San Miguel Island to nearly 20°C at Santa Barbara Island in August and September (Engle and Richards 2001). Swell varies throughout the year with storms bringing high northwest wind and waves during the winter and spring, and distant southern hemisphere storms sending large swells to the south-facing shores in summer.

Monitoring

The CHIS Rocky Intertidal Community Monitoring Program has 21 sites on the five park islands (Figure 1) that were established between 1982 and 1998. Note that one site, Anacapa Middle East, was dropped indefinitely this year in an effort to streamline the program. Anacapa Middle East was originally set up to serve as a control for Anacapa Middle West which is located on the adjacent reef.

Sites generally consist of an array of 15–35 photoplots, 3–5 irregular-shaped and circular plots used to monitor black abalone and owl limpet densities, respectively, and *P. ochraceus* transects. Surfgrass transects are monitored at four sites. Site selection considered visitation, accessibility, presence of representative organisms, wildlife disturbance, and safety. Sampling is usually conducted twice each year, once in spring and fall. In fall 2015 and winter 2016, monitoring occurred at 17/21 sites. Monitoring protocols detailed in Richards and Davis (1988) and Engle et al. (1998) were followed. Updated protocol summaries can be found in Richards and Lerma (2000), Richards et al. (2011), and Engle (2008). See Appendix A for additional notes about the 2015–16 program.

Data are maintained in Microsoft Access databases in the NPS MEDN I&M and MARINe. Electronic data were verified (checked against the original datasheet) and validated (queried to identify outliers or nonsensical values) and then certified as ready to analyze.

The percent coverage of thirteen core species or assemblages is monitored in fixed photoplots (Table 1). The chosen target species and assemblages commonly occur throughout the SCB and are generally used to define a band or zone within the intertidal zone. Target species and assemblages include thatched and acorn barnacles (*Tetraclita rubescens*, *Balanus glandula*/*Chthamalus* spp., respectively), mussels (*Mytilus californianus*), rockweeds (*Silvetia compressa*, and *Hesperophycus*

californicus), turfweed (*Endocladia muricata*), red algal turf (*Pterocladia* spp. and *Gelidium* spp.), goose (or leaf) barnacles (*Pollicipes polymerus*), and tar which occurs naturally from oil seeps in the channel and can form a thick, persistent cover over substrata. An additional 32 taxa or substrata are also monitored when present (see Table 1 for list of taxa¹). Fixed plots (50 x 75 cm) are photographed on each visit. In most cases, there are five replicate plots in each zone that were initially established over high densities of the target species. Not all core species (zones) are represented at each site. Four new *M. californianus* plots were established in the *Mytilus* zone at Johnson's Lee in fall 2008 to replace plots that had been devoid of mussels for over 15 years (Whitaker and Richards 2012).

Table 1. Core Species, Higher Taxa, and Substrata Scored in Photoplots, Point Intercept Transects, Circular Plots, Abalone/Seastars, and Mobile Invertebrate ^a Counts at all CHIS Sites.

Category	Species or Substrate	Photoplots	Point Intercept Transects	Circular Plots	Abalone/ Sea star	Motile Inverts
Green algae	<i>Cladophora columbiana</i>	X	–	–	–	–
	<i>Ulva/Enteromorpha</i>	X	–	–	–	–
	Other Green Algae (any greens not listed above)	X	X	–	–	–
Brown algae	<i>Egregia menziesii</i> (Boa Kelp)	X	X	–	–	–
	<i>Eisenia arborea</i>	–	X	–	–	–
	<i>Endarachne/Petalonia</i>	X	–	–	–	–
	<i>Halidrys dioica/Cystoseira</i> spp.	–	X	–	–	–
	<i>Hesperophycus californicus</i>^b (= <i>H. harveyanus</i>)	X	–	–	–	–
	<i>Sargassum muticum</i>	–	X	–	–	–
	<i>Scytosiphon</i> spp.	X	–	–	–	–
	<i>Silvetia compressa</i>^b (= <i>Pelvetia fastigiata</i>)(Rockweed)	X	–	–	–	–
	Other Brown Algae (any browns not listed above)	X	X	–	–	–
	Ephemeral browns	X	–	–	–	–

^a Motile invertebrate counts were dropped from the standard protocol in 2011.

^b Target species (also shown in bold)

¹ Taxa are defined as species or groups of similar species that may not be easily separated in the field. Core taxa are those identified by MARINE as species to be searched for and counted by all groups (Engle 2008).

Table 1 (continued). Core Species, Higher Taxa, and Substrata Scored in Photoplots, Point Intercept Transects, Circular Plots, Abalone/Seastars, and Mobile Invertebrate^a Counts at all CHIS Sites.

Category	Species or Substrate	Photoplots	Point Intercept Transects	Circular Plots	Abalone/ Sea star	Motile Inverts
Red algae	<i>Endocladia muricata</i> ^b (Turfweed)	X	–	–	–	–
	<i>Chondracanthus canaliculatus</i> (= <i>Gigartina canaliculata</i>)	X	–	–	–	–
	<i>Chondracanthus spinosus</i>	X	–	–	–	–
	<i>Gelidium coulteri</i> / <i>Pterocladia capillacea</i>	X	–	–	–	–
	<i>Mastocarpus papillatus</i> (blade)	X	–	–	–	–
	<i>Mazzaella affinis</i> (= <i>Rhodoglossum affine</i>)	X	–	–	–	–
	<i>Mazzaella</i> spp. (= <i>Iridaea</i> spp.)	X	–	–	–	–
	<i>Porphyra</i> spp.	X	–	–	–	–
	<i>Prionitis</i> spp.	X	–	–	–	–
	Articulated Corallines (Erect Corallines)	X	X	–	–	–
	Crustose Corallines (Encrusting Corallines)	X	X	–	–	–
	Other Red Algae (any reds not listed above)	X	X	–	–	–
Algae/plants	<i>Phyllospadix scouleri/torreyi</i> ^b (Surfgrass)	X	X	–	–	–
	Non-Coralline Crusts (reds and browns)	X	X	–	–	–
	Other Plant/Algae	–	X	–	–	–
Anemones	<i>Anthopleura elegantissima/sola</i> (Green Anemone)	X	X	–	–	–
Polychaete worms	<i>Phragmatopoma californica</i>	X	X	–	–	–
Molluscs	<i>Acanthina</i> spp.	–	–	–	–	X
	Chitons	X	–	–	–	X
	<i>Fissurella volcano</i>	–	–	–	–	X
	<i>Haliotis cracherodii</i> ^b (Black Abalone)	–	–	–	X	–
	<i>Lepidochitona hartwegii</i>	–	–	–	–	X
	<i>Littorina</i> spp.	–	–	–	–	X
	<i>Lottia gigantea</i> ^b (Owl Limpet)	–	–	X	–	X

^a Motile invertebrate counts were dropped from the standard protocol in 2011.

^b Target species (also shown in bold)

Table 1 (continued). Core Species, Higher Taxa, and Substrata Scored in Photoplots, Point Intercept Transects, Circular Plots, Abalone/Seastars, and Mobile Invertebrate Counts at all CHIS Sites.

Category	Species or Substrate	Photoplots	Point Intercept Transects	Circular Plots	Abalone/ Sea star	Motile Inverts
Molluscs (continued)	<i>Mopalia</i> spp.	–	–	–	–	X
	<i>Mytilus californianus</i> ^b (California Mussel)	X	X	–	–	–
	<i>Nucella emarginata</i>	–	–	–	–	X
	<i>Nuttallina</i> spp.	–	–	–	–	X
	<i>Ocenebra circumtexta</i>	–	–	–	–	X
	<i>Chlorostoma funebris</i> (= <i>Tegula funebris</i>)	–	–	–	–	X
	<i>Chlorostoma gallina</i> (= <i>Tegula gallina</i>)	–	–	–	–	X
	<i>Chlorostoma</i> spp. (= <i>Tegula</i> spp.)	X	–	–	–	–
	Limpets	X	–	–	–	–
	Large Limpets > 15mm (excluding <i>L. gigantea</i>)	–	–	–	–	X
	Medium Limpets 5–15mm	–	–	–	–	X
	Small Limpets < 5mm	–	–	–	–	X
	<i>Littorina</i> spp.	X	–	–	–	X
	<i>Septifer/Brachydontes</i>	X	–	–	–	–
Barnacles	<i>Chthamalus dalli/fissus</i> & <i>Balanus glandula</i> ^b (Acorn Barnacle)	X	–	–	–	–
	<i>Tetraclita rubescens</i> ^b (Thatched Barnacle)	X	–	–	–	–
	<i>Pollicipes polymerus</i> ^b (Goose Barnacle)	X	–	–	–	–
	Barnacles	–	X	–	–	–
Echinoderms	<i>Pisaster ochraceus</i> ^b (Ochre Star)	X	X	–	X	X
	<i>Pisaster giganteus</i>	–	–	–	X	X
	<i>Patiria miniata</i>	–	–	–	X	X
	<i>Strongylocentrotus purpuratus</i>	–	–	–	–	X
Crustaceans	<i>Pachygrapsus crassipes</i>	–	–	–	–	X
	<i>Pagurus</i> spp.	–	–	–	–	X

^a Motile invertebrate counts were dropped from the standard protocol in 2011.

^b Target species (also shown in bold)

Table 1 (continued). Core Species, Higher Taxa, and Substrata Scored in Photoplots, Point Intercept Transects, Circular Plots, Abalone/Seastars, and Mobile Invertebratea Counts at all CHIS Sites.

Category	Species or Substrate	Photoplots	Point Intercept Transects	Circular Plots	Abalone/ Sea star	Motile Inverts
Invertebrates	Other Invertebrates (Other Animals) (any inverts not listed above)	X	X	–	–	–
Substrates	Rock (Bare Rock)	X	X	–	–	–
	Sand	X	X	–	–	–
	Tar	X	X	–	–	–
Undetermined	Unidentified (cannot tell if plant, invert or substratum)	X	X	–	–	–

^a Motile invertebrate counts were dropped from the standard protocol in 2011.

^b Target species (also shown in bold)

In 2016–17, all photoplots were photographed with a digital camera (Olympus 1030 SW). The percent cover of core organisms was determined either in the field by laying a grid (50 x 75 cm) of one-hundred evenly-spaced points (10 x 10) over the plot (Figure 2), or in rare cases in the office from digital images of the plots, when conditions were unfavorable or there was insufficient time. In the office, a digitized grid was created in Adobe Photoshop and overlaid on the image to provide complete coverage of the plot. Under both scoring protocols, layered organisms were not counted separately. Therefore the total cover of the top-most layer (with few exceptions—see Engle 2008) summed 100%. Data were recorded onto pre-printed data sheets, transcribed into the computer database, verified (checked against the original datasheet), validated (queried to identify outliers or nonsensical values) and then certified as ready to analyze.

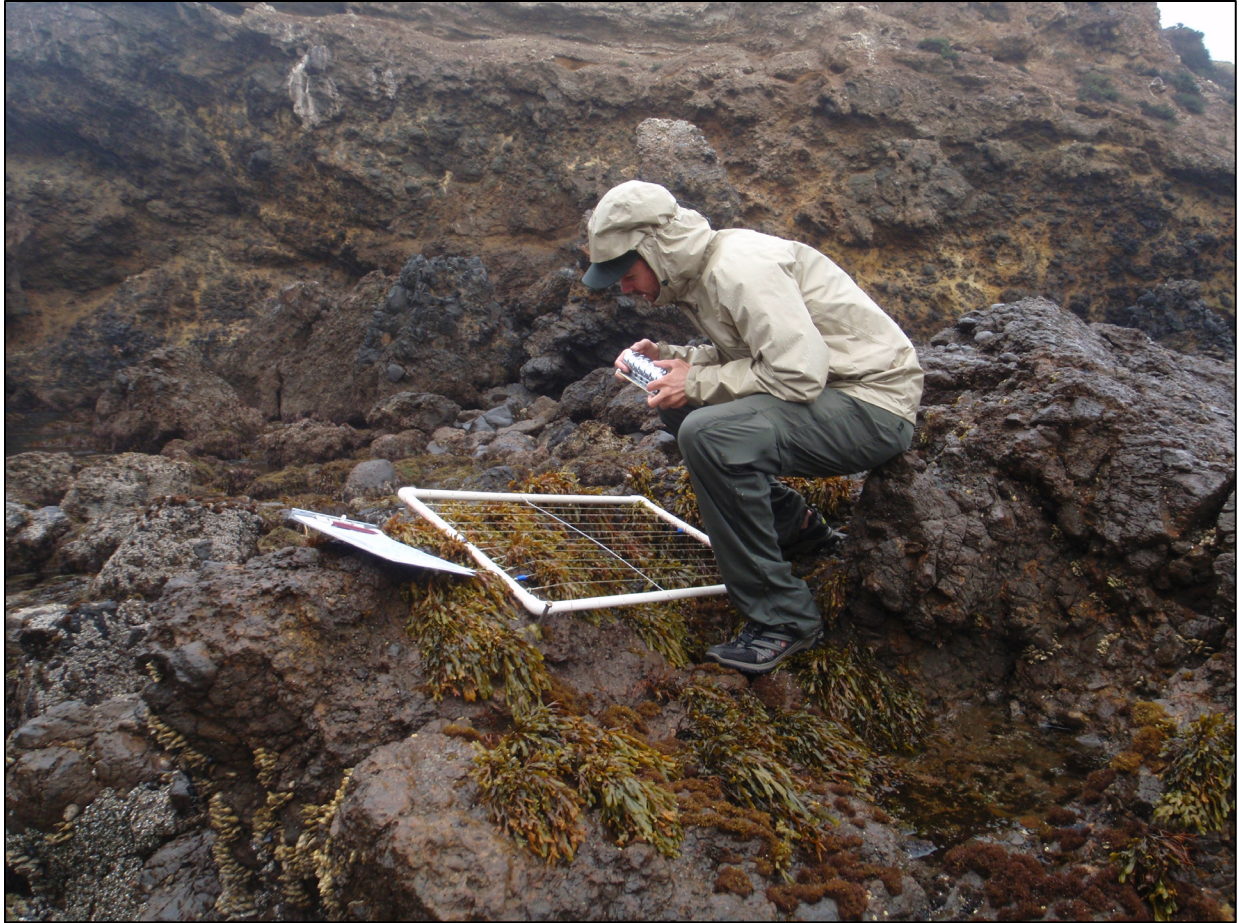


Figure 2. Stephen Whitaker scoring a rockweed photoplot at Scorpion Rock, Santa Cruz Island.

Relative abundance and size structure data were collected for black abalone at each site by searching a defined area of the reef or by utilizing a timed-interval search. The sites vary in size and natural breaks in the reef defined the areas, facilitating repeated searches of similar area. Timed searches are typically 30-minutes long. More time has been devoted to searches at sites that have the greatest numbers of abalone (e.g., Otter Harbor, San Miguel Island and Willows Anchorage, Santa Cruz Island), but a concerted effort is made to limit search time to 30 minutes per site to remain consistent with other surveys. These protocols were implemented in response to the decline of abalone population levels. Prior to the effects of Withering Syndrome (WS), black abalone were counted and measured in fixed-irregular plots (5 plots per site) at 11 sites. Fixed plots were used when abalone were abundant and often too numerous to count and measure over the whole reef. The fixed plots became inadequate for sampling, however, by the early 1990s as abalone disappeared. Fixed plots are still checked for comparison to early samples, but abalone are rarely encountered in the plots.

During the timed or defined-area searches for black abalone, typically one observer searches for individuals by carefully inspecting crevices and cavities among boulders and checking under kelp or other canopy-forming seaweeds. Abalone are identified to species, shell lengths are measured with vernier calipers or estimated if an accurate measurement is not possible, and the nearest neighbor

distance is recorded using five spatially-descriptive categories (touching, < 10 cm, 10–100 cm, 1–5 m, >5 m). Aggregation sizes (number of abalone within one meter of another) are generally noted as well. Shell size serves as a proxy for age, and thus provides a glimpse of the population structure. Nearest neighbor distance and aggregation size provide insight to the theory that abalone aggregate naturally. The information may also serve as an indication of spawning potential, since, as broadcast spawners, black abalone reproductive options increase with proximity to other individuals.

Lottia gigantea, giant owl limpet, abundance and size structure are assessed within fixed, circular plots (3 to 5 plots per site) at 12 sites. Within each plot, an area of 3.14 m² delineated by circling a fixed bolt with a pre-measured (1 m in length) line is used to measure and count all owl limpets > 15 mm (< 15 mm limpets can be difficult to identify to species by less-experienced observers) for maximum shell length.

Pisaster ochraceus, ochre seastars, are counted along with other species of seastars (*Pisaster giganteus*, *Patiria miniata* and *Pycnopodia helianthoides*) in a general search of the reef (for 30-minutes). When possible (time and weather permitting), 50–100 *P. ochraceus* are measured (center of disk to tip of longest ray) for size distribution.

From 2002 to 2011, smaller motile invertebrates (Table 1) were counted by carefully searching each photoplot. Select species were measured for size-frequency distribution. Abundant littorine snails and small limpets were sub-sampled in three small plots (either 20cm x 20cm or 10cm x 10cm, depending on density) within the photoplot area. Motile-invertebrates were usually sampled once annually. However, after 2011 the protocol was no longer implemented due to changes in personnel and insufficient assistance. The motile invertebrate protocol was extremely time-consuming and required a relatively high level of expertise to conduct. In addition, it was determined by another intertidal monitoring group in the region that the protocol may require adjustments to improve effectiveness to detect significant changes in motile invertebrate communities (Miner et al. 2015). Therefore the decision was made to cancel routine monitoring of smaller motile invertebrates until staffing increased and/or a complete data analysis is conducted. Motile invertebrate data from earlier years are included in CHIS Rocky Intertidal Community Monitoring Program annual reports for years 2009–2011.

Phyllospadix spp., surfgrass, cover is measured on fixed point-intercept transects (10 m long, 100 points) (three transects per site) at four sites (Trailer, Fraser Cove, East Point, Northwest-Talcott). Special circumstances and general conditions that may have affected sampling were described on daily logs, and reported in the trip reports. Surfgrass transect scoring methods follow the MARINE protocol, adding *Phyllospadix* spp. understory for surfgrass covered by algae.

Shorebird and pinniped observations are made on arrival and throughout the day at each site visit. The numbers reported for each species are the greatest number observed at any one time while working at a site. Concessionaires (Island Packers Company and Truth Aquatics) reported numbers of visitors to the park. No independent counts of visitors were made to verify reported figures.

Fieldwork is conducted during low tides, generally below mean low water (minus tides) known as spring tides, as opposed to neap tides. Spring tides occur twice each month but often during dark hours. Sampling dates for spring and fall seasons are chosen for minus tide series occurring during daylight hours. Stephen Whitaker conducted sampling with assistance from others for data recording and sea star counts. Notes regarding sampling variations, personnel changes, and equipment are documented in trip reports in Appendix B.

Optic Stowaway temperature loggers from Onset Computer Corporation were placed in PVC (Polyvinyl Chloride) pipe housings and fixed with epoxy to rocks near the mean-tide line at 17 sites. Units are downloaded in the field to an Optic Shuttle device and processed with Onset's Boxcar software.

Taxonomy and nomenclature follow Smith and Carlton (1975), Carlton (2007), Abbott and Hollenberg (1976), McLean (1978), Morris et al. (1980), and http://ucjeps.berkeley.edu/californiaseaweeds_refs.html. Note that in this report, we have adopted the taxonomy of Carlton (2007) with the genus name change from *Tegula* to *Chlorostoma* for turban snails.

Data Analysis

The purpose of this report is to present data collected in fall/winter 2016–17. Advanced statistical analyses on the data have not been performed. Any trends presented are simple summary statistics and should be viewed as preliminary. Basic trends of percent cover, averaged by zone, were graphed for key species in photoplots (acorn barnacles, thatched barnacles, mussels, rockweeds [*Silvetia* and *Hesperophycus*], goose barnacles, red algal turf, and tar) using JMP (JMP, Version 12. SAS Institute Inc., Cary, NC, 1989–2019). To minimize variability, photoplot target types were not pooled from different zones for analysis. For example, the percent cover of mussels in only mussel zone plots was considered. Descriptive statistics (density, average size), averaged by site were determined for all circular owl-limpet plots, and the trend through time was graphed by sampling event. Readers are cautioned that although abundances are provided for comparative purposes, plots were chosen within high density areas, were not randomly placed, and should not be considered to be representative of larger areas. Surfgrass trends were plotted for temporal reference.

Photoplots, circular plots, and line transects were all “fixed” or measured in the same location every season. It is not possible to extrapolate trends in the plots to entire sites without using additional information specific to the area (Murray et al. 2006). Therefore, results from photoplots, transects, and circular plots should be interpreted with care.

Results and Discussion

Photoplots

Photoplot data are summarized for each target zone. Mean percent cover of target species and other dominant taxa along with bare rock cover are pooled for all replicate plots per zone by site.

Departure from the long-term mean graphs are displayed for each target species pooled across sites at each island.

As in most years, the mean percent cover of nearly all targeted species in 2016–17 was highly variable among sites. The mean cover of target taxa within representative plots (e.g., *Mytilus* within *Mytilus* plots) was typically near or below the long-term mean value calculated for most sites. In rare cases, the mean percent cover measured in 2016–17 increased above the long-term mean.

Mussel, *Mytilus californianus* mean percent cover in 2016–17 remained comparable to the mean of previous years at most sites (Figures 3–5). However, record or near record-low abundances for *M. californianus* were measured at Anacapa Middle West, Harris Point, Prisoner’s Harbor, Sea Lion Rookery and South Frenchy’s Cove. In the cases of Anacapa Middle West and Prisoner’s Harbor mussels plummeted to near zero percent cover. Alternatively, mussel cover reached near record-high abundances at Crook Point and Orizaba Cove. Note that the graph for Johnson’s Lee represents the addition of four new mussel plots that were added in 2009. Without the additional plots, the five original *M. californianus* plots averaged approximately 25% mussel cover in 2016–17. Overall, mussel cover has decreased below the long-term mean at Anacapa and Santa Barbara Islands during the past five years (Figure 4). *M. californianus* percentages were approximately equal to long-term means at Santa Cruz, Santa Rosa and San Miguel Islands in 2016–17 (Figure 4). At most sites, with several exceptions, mussel plots have been and remain populated with moderate to high cover of *M. californianus* and relatively low cover of *Phragmatopoma* among other species.

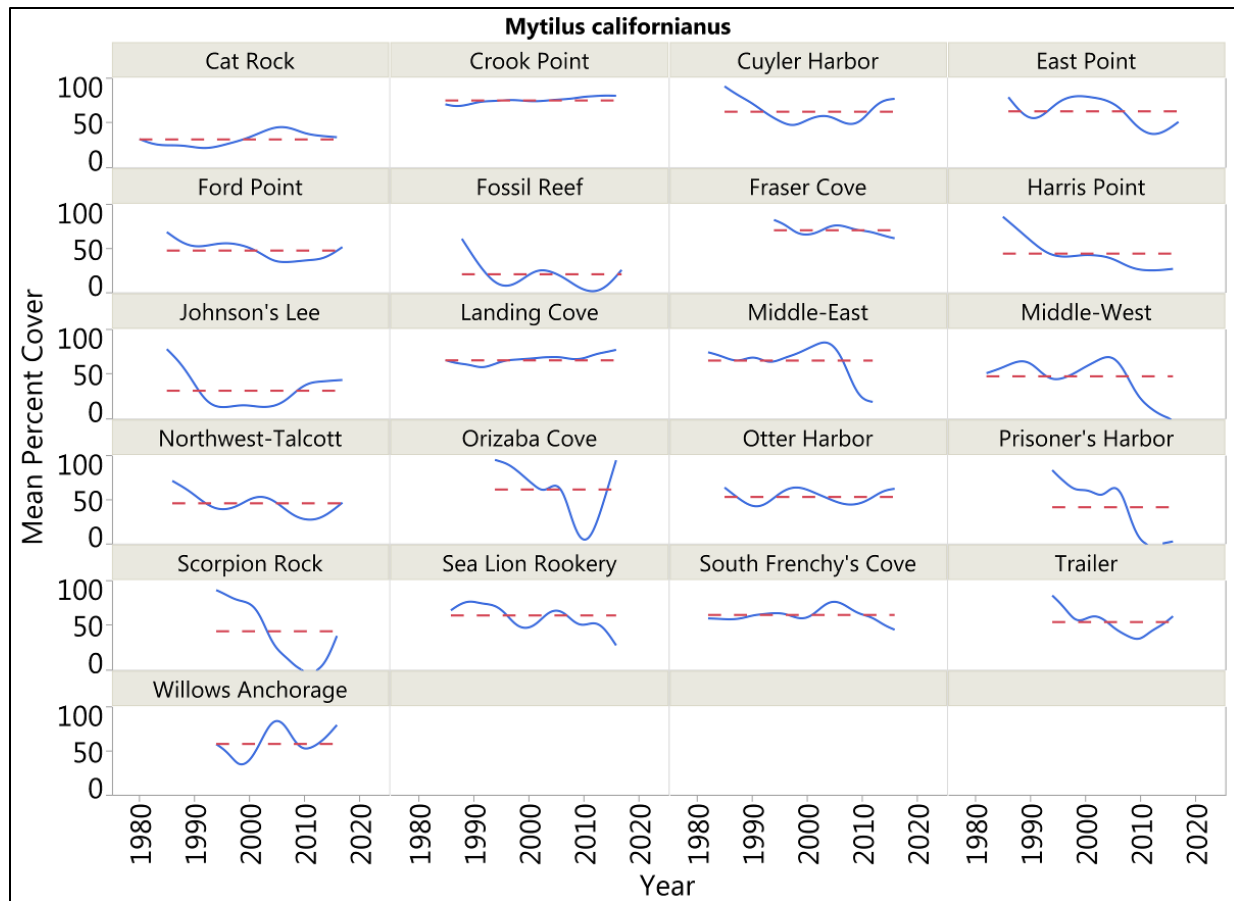


Figure 3. Departure from the long-term mean for *Mytilus californianus*. Blue lines represent mean cover of *M. californianus* within the representative zone pooled across plots at each site. Red dashed lines represent long-term mean. Note that Anacapa Middle East has not been sampled since 2013.

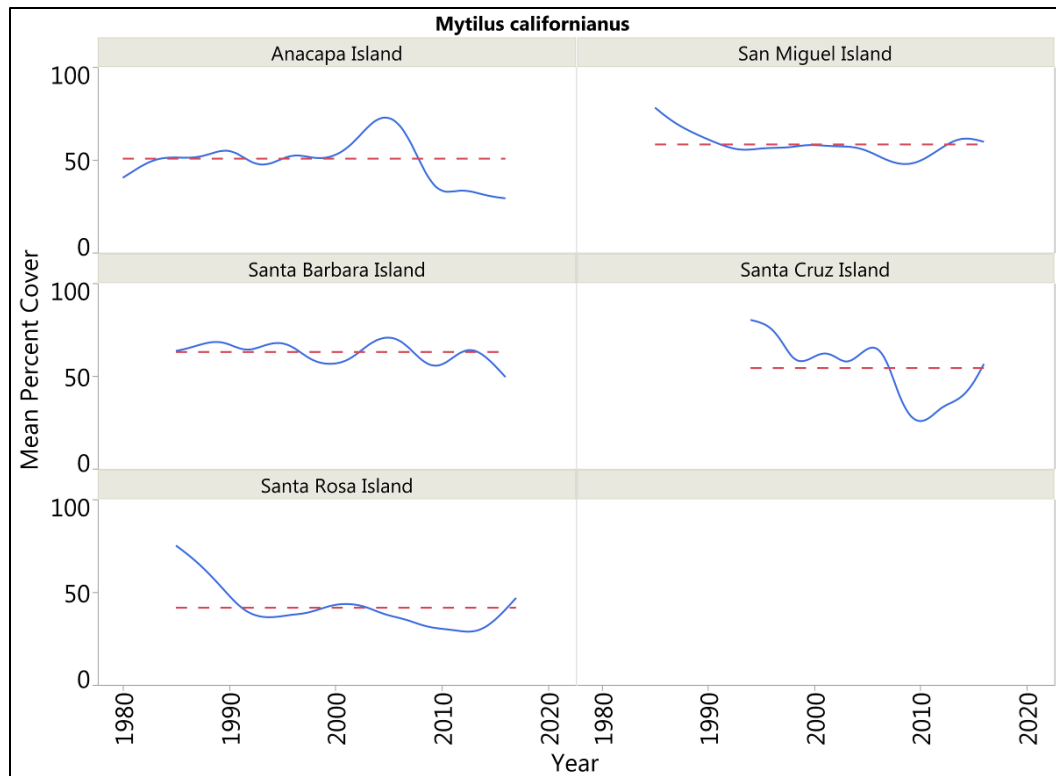


Figure 4. Departure from the long-term mean for *Mytilus californianus*. Blue lines represent mean cover of *M. californianus* within the representative zone pooled across plots and sites at each island. Red dashed lines represent long-term mean.

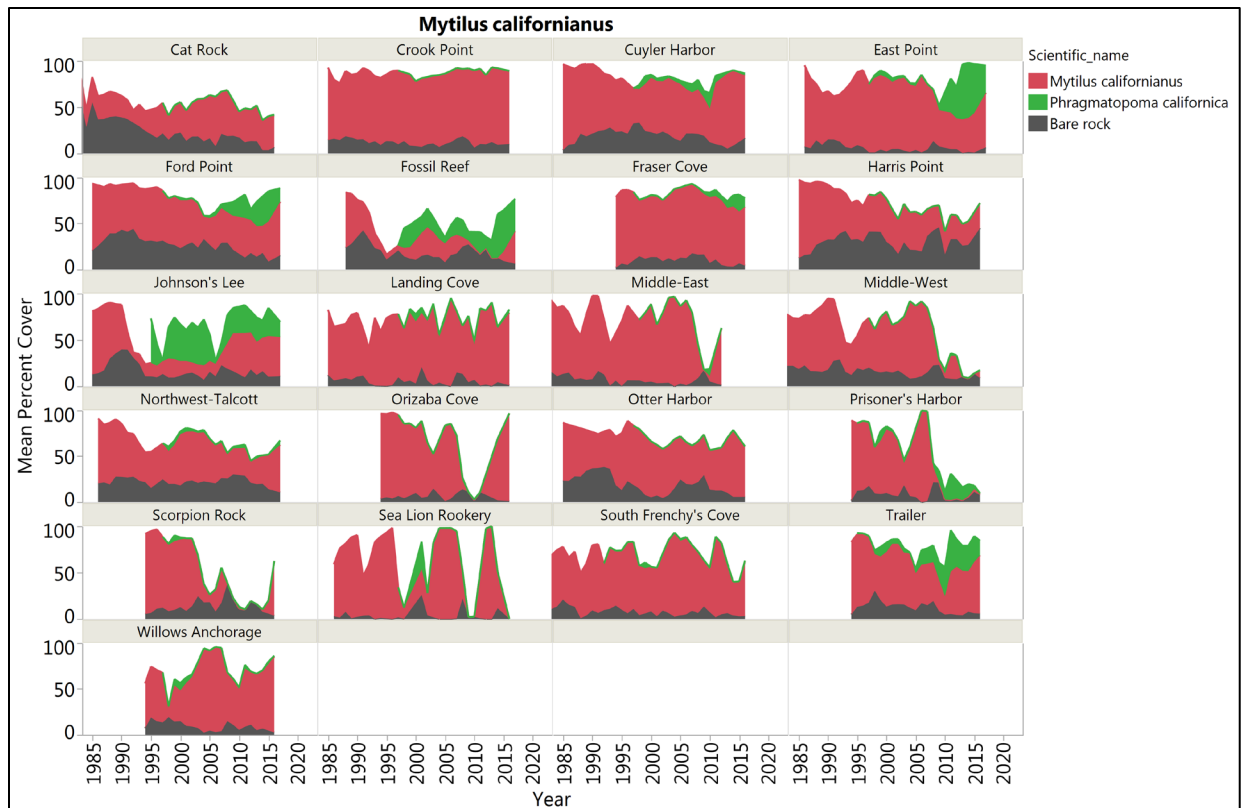


Figure 5. Percent cover of *Mytilus californianus* along with *Phragmatopoma californica* and bare rock in fixed plots within the *Mytilus* zone at each site. Colored areas represent the mean percent cover for representative and dominant taxa/substrata from replicated (usually five) *Mytilus* plots. Note that Anacapa Middle East has not been sampled since 2013.

Rockweed, *Silvetia compressa*, abundances were very low at most sites in 2016–17 compared to previous years. *S. compressa* cover averaged across representative plots at each site was well below long-term averages and measured < 20% absolute cover at most sites (12 of 16 sites) (Figures 6–8). In fact, *S. compressa* cover plummeted to near zero percent cover at nine sites. Fossil Reef was the only site that exhibited above average cover of rockweed. Most sites exhibited marked declines in *S. compressa* abundances beginning in 2000–2006 with little recovery observed for the rockweed through 2016–17. When pooled across sites, *S. compressa* cover at all islands except Santa Rosa was markedly lower than the long-term averages for those locations (Figure 7). At most sites, plots have been dominated primarily by *S. compressa* and other less common species such as *Chthamalus*/*Balanus* and *Endocladia* (Figure 8).

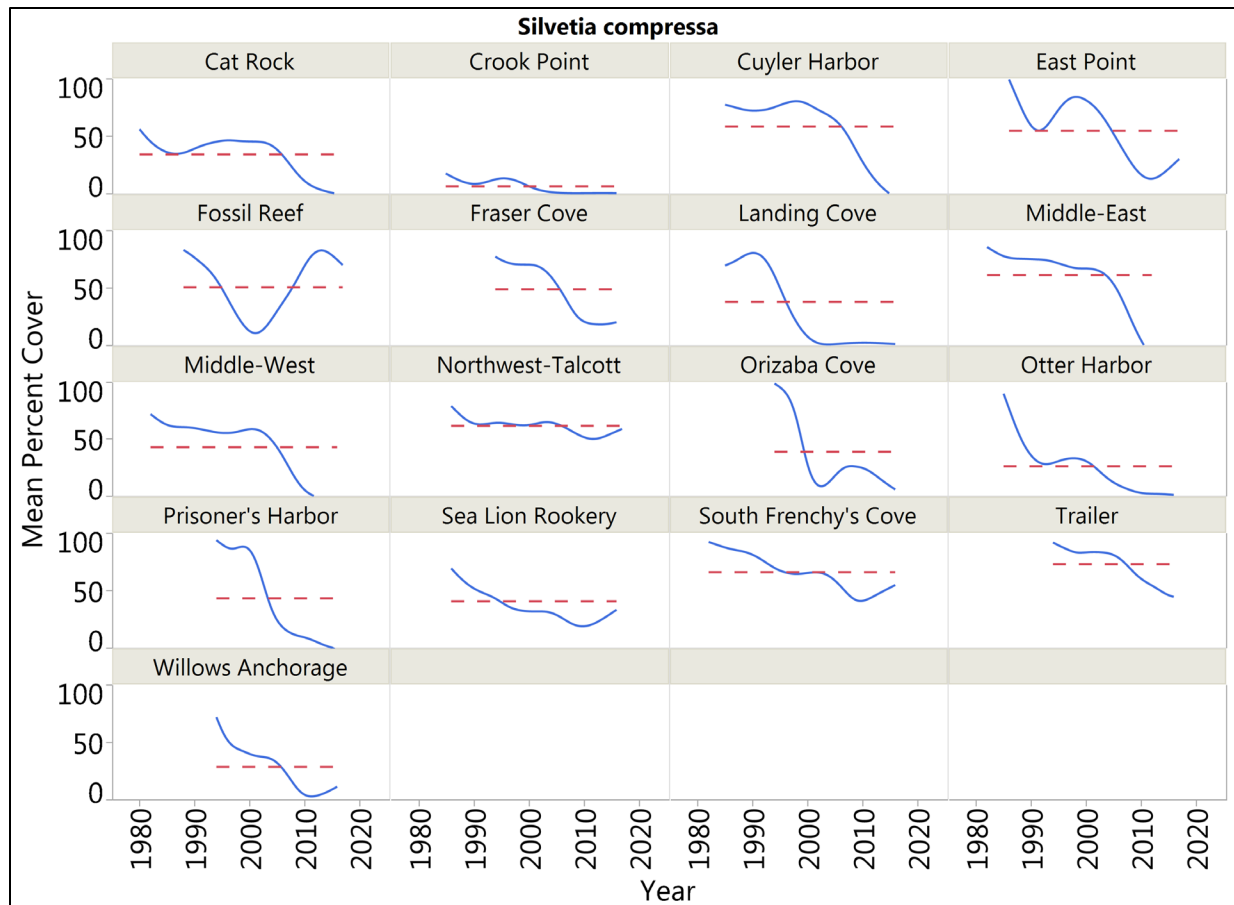


Figure 6. Departure from the long-term mean for *Silvetia compressa*. Blue lines represent mean cover of *S. compressa* within the representative zone pooled across plots at each island. Red dashed lines represent long-term mean. Note that Anacapa Middle East has not been sampled since 2013.

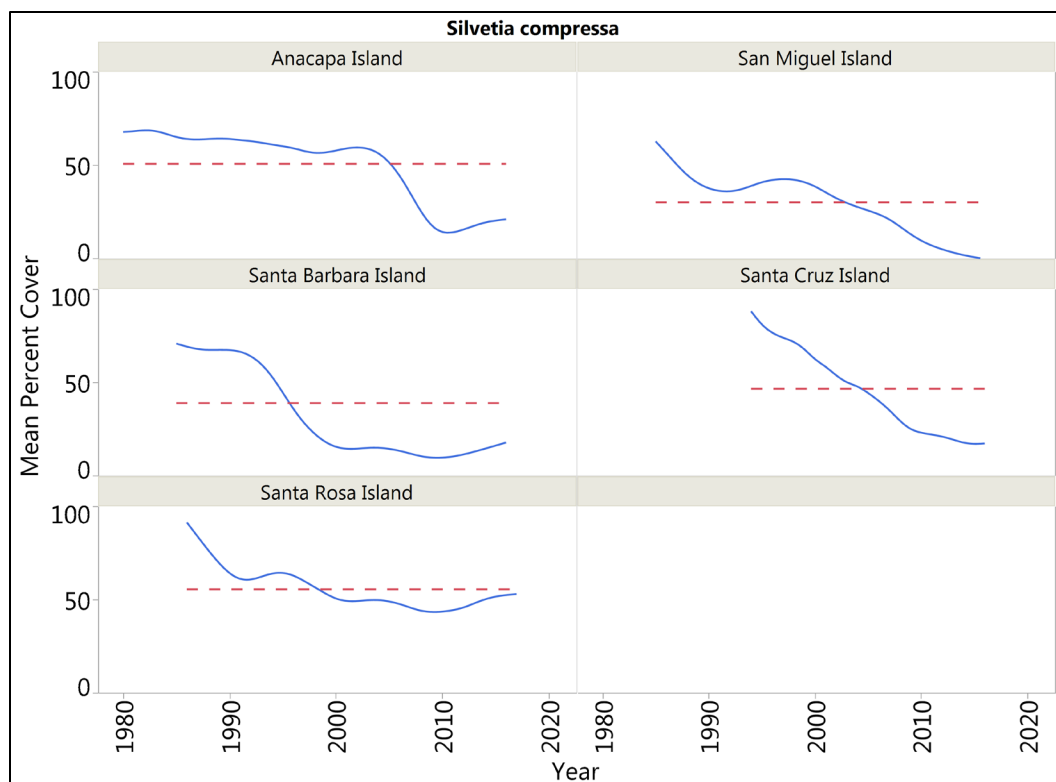


Figure 7. Departure from the long-term mean for *Silvetia compressa*. Blue lines represent mean cover of *S. compressa* within the representative zone pooled across plots and sites at each island. Red dashed lines represent long-term mean.

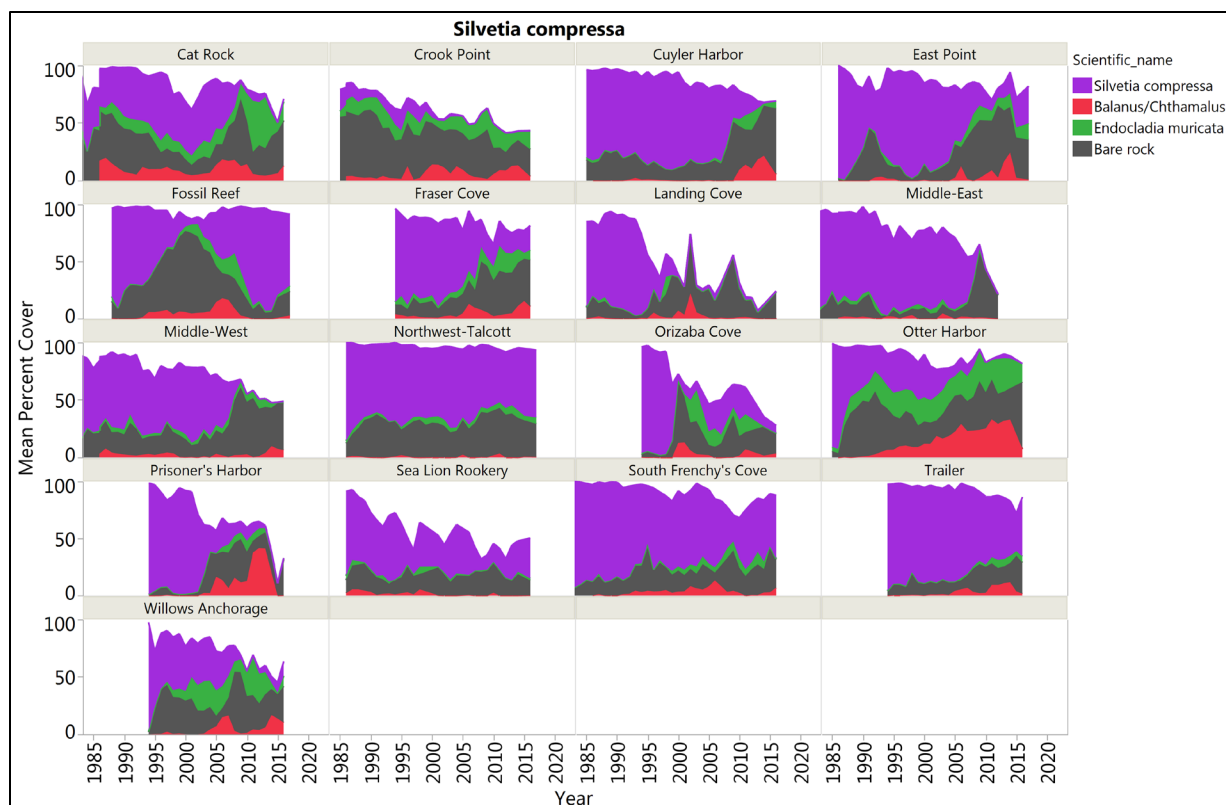


Figure 8. Percent cover of *Silvetia compressa* along with other dominant taxa and bare rock in fixed plots within the *Silvetia* zone at each site. Colored areas represent the mean percent cover for representative and dominant taxa/ substrata from replicated (usually five) *Silvetia* plots. Note that Anacapa Middle East has not been sampled since 2013.

The other rockweeds, *Hesperophycus californicus* and *Pelvetiopsis hybrida* that occur in the region, also declined or remained low in abundance at all but one monitoring site (Orizaba Cove) (Figures 9–11). Note that *P. hybrida* was only recently identified as a separate species from *H. californicus*. Morphologically, *P. hybrida* is similar to *H. californicus* and therefore it has historically been identified as *H. californicus*. Beginning this year, we identified the two species separately, but we lumped the two species for purposes of reporting.

H. californicus cover reached near record-low abundance at Fraser Cove, Harris Point, Prisoner's Harbor, Scorpion Rock, Trailer and Willows Anchorage. Orizaba Cove had average *H. californicus* cover in 2016–17 (Figure 9). Pooled across sites at each island, *H. californicus* cover measured below the long-term mean at all three islands where the species complex is monitored (Figure 10). In fact, near record-low rockweed cover was measured this year at all three of the islands. Over time, plots at most sites have been composed largely of *H. californicus*, *S. compressa*, *E. muricata*, and *Chthamalus/ Balanus* (Figure 11).

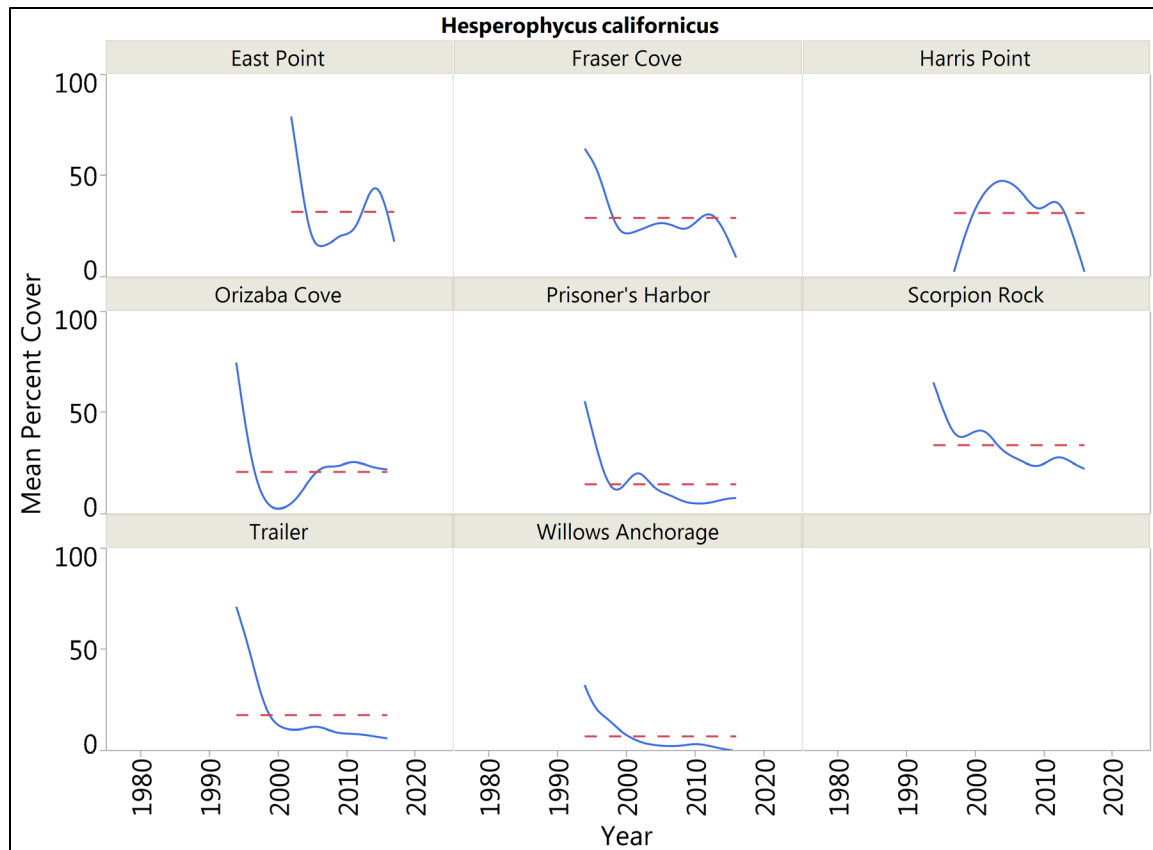


Figure 9. Departure from the long-term mean for *Hesperophycus californicus*. Blue lines represent mean cover of *H. californicus* within the representative zone pooled across plots at each site. Red dashed lines represent long-term mean.

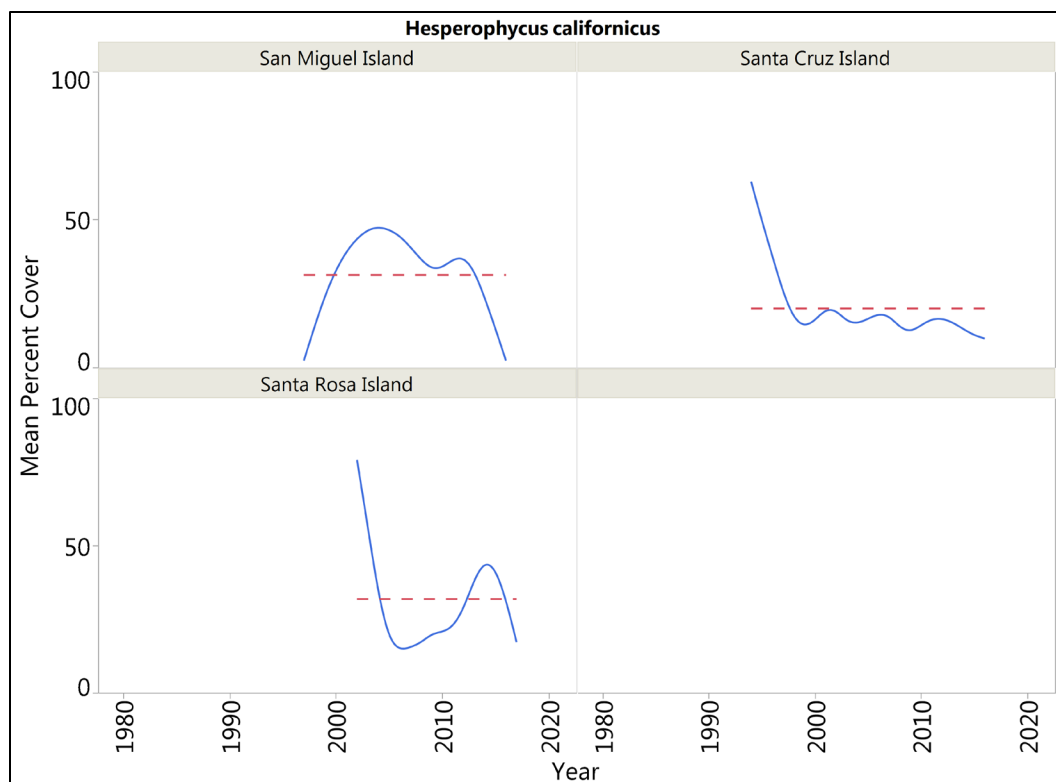


Figure 10. Departure from the long-term mean for *Hesperophycus californicus*. Blue lines represent mean cover of *H. californicus* within the representative zone pooled across plots and sites at each island. Red dashed lines represent long-term mean.

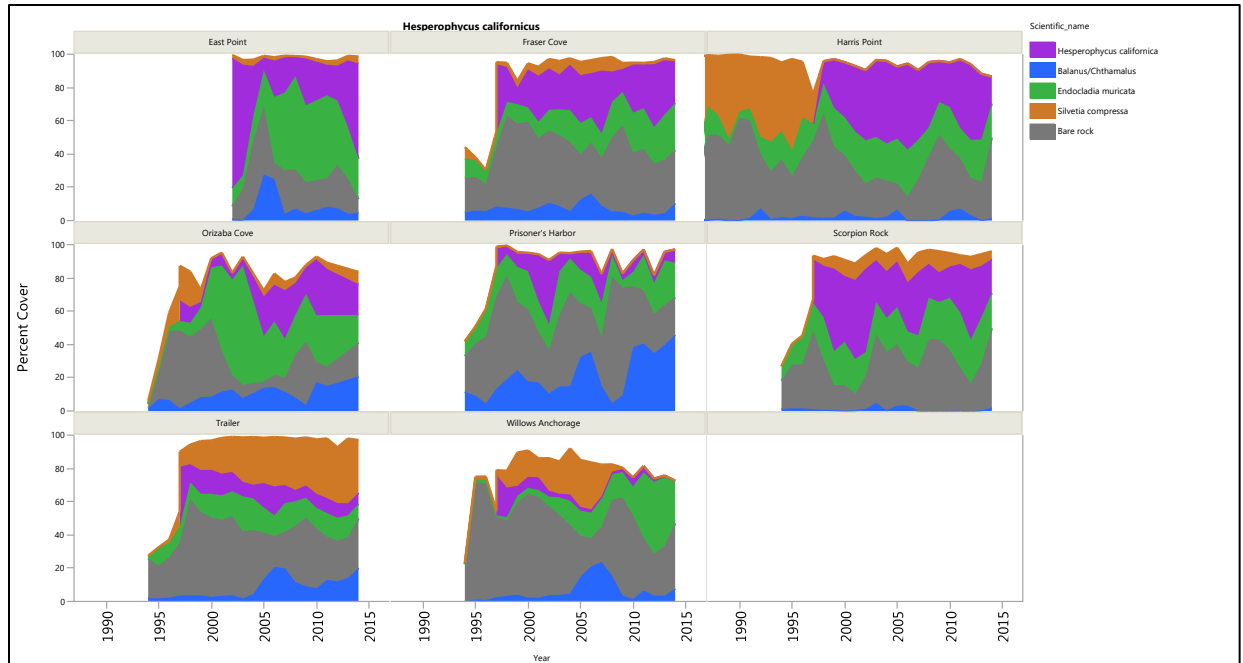


Figure 11. Percent cover of *Hesperophycus californicus* along with other dominant taxa and bare rock in fixed plots within the *Hesperophycus* zone at each site. Colored areas represent the mean percent cover for representative and dominant taxa/ substrata from five *Hesperophycus* plots.

Endocladia muricata cover in 2016–17 remained roughly equivalent to mean abundances measured in past years at most sites (Figures 12–13). Near record-low abundances of *E. muricata* were measured at ten sites, but in nearly all cases, the mean abundance measured in 2016–17 was relatively close to the long-term mean for the respective sites. In contrast, above average cover of *E. muricata* was not measured at any of the sites this year. Pooled across sites, *E. muricata* abundances were approximately average at Santa Barbara and Santa Rosa. Cover of the alga was slightly below the long-term means at Santa Cruz, San Miguel and particularly Anacapa Islands (Figure 14). Other dominant species in *E. muricata* plots have been *S. compressa* and *Chthamalus/ Balanus* (Figure 14).

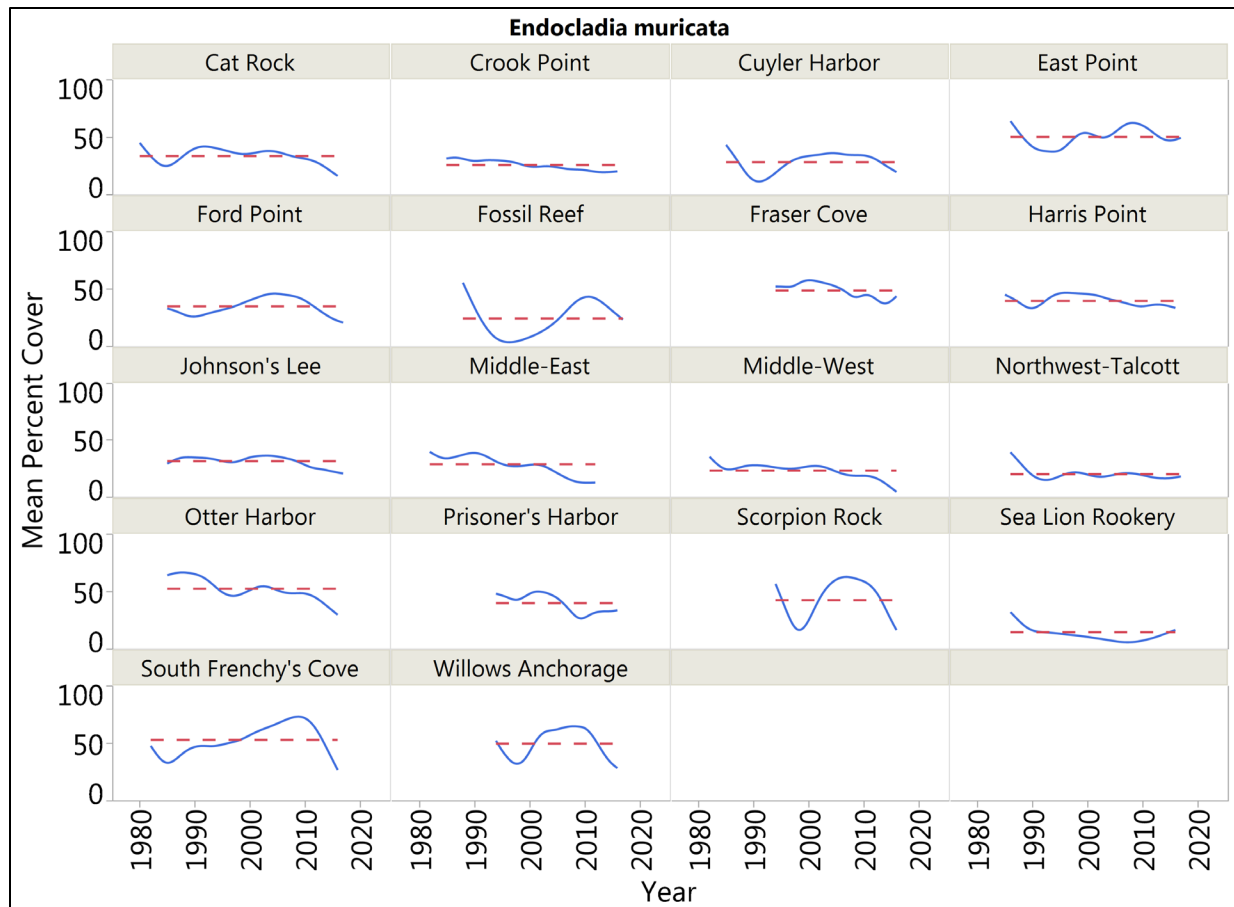


Figure 12. Departure from the long-term mean for *Endocladia muricata*. Blue lines represent mean cover of *E. muricata* within the representative zone pooled across plots at each site. Red dashed lines represent long-term mean. Note that Anacapa Middle East has not been sampled since 2013.

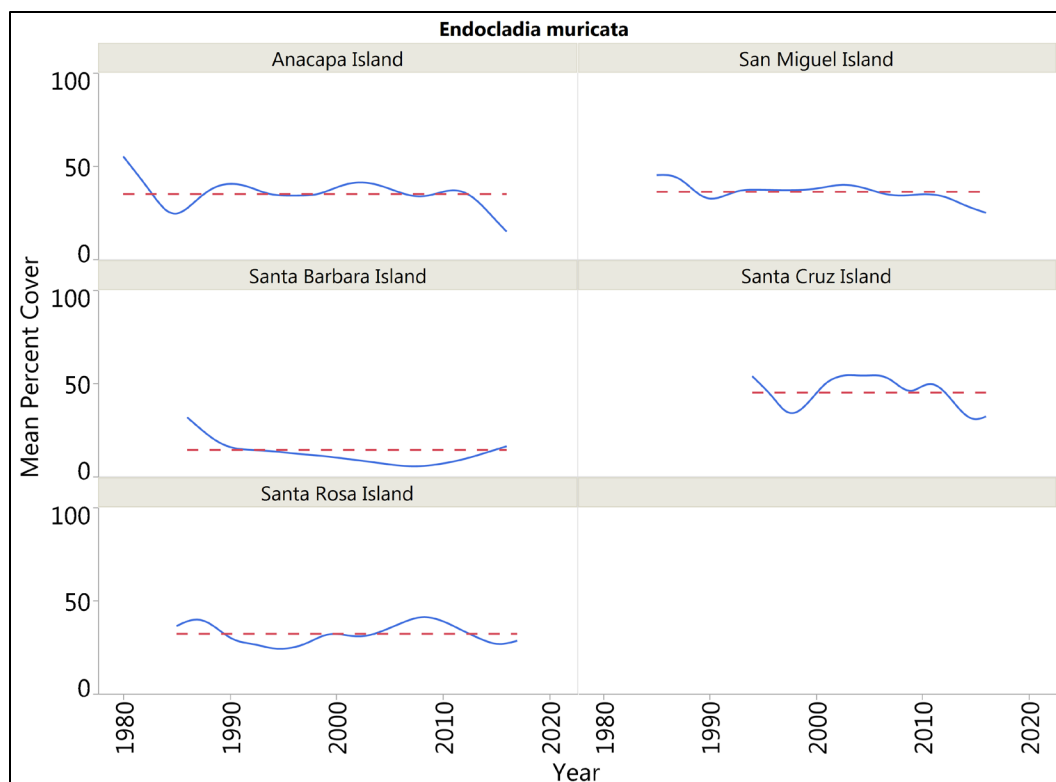


Figure 13. Departure from the long-term mean for *Endocladia muricata*. Blue lines represent mean cover of *E. muricata* within the representative zone pooled across plots and sites at each island. Red dashed lines represent long-term mean.

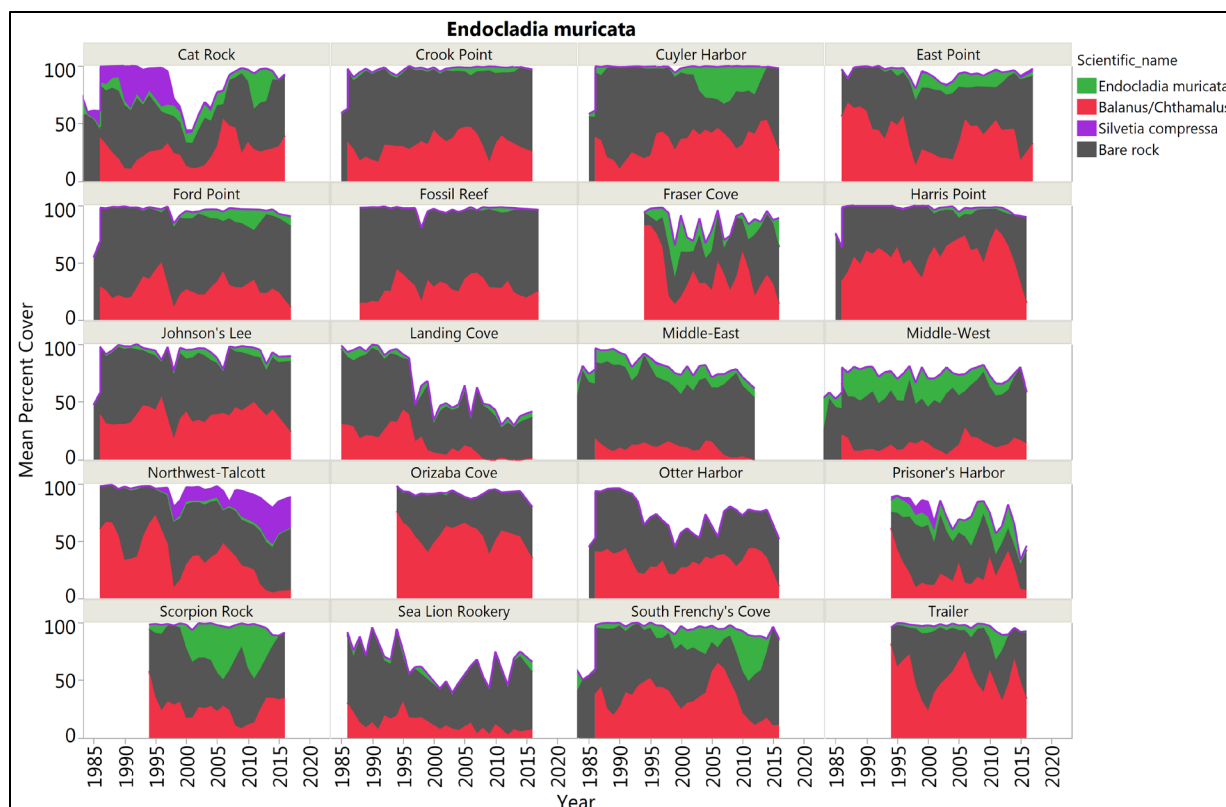


Figure 14. Percent cover of *Endocladia* along with other dominant taxa and bare rock in fixed plots within the *Endocladia* zone at each site. Colored areas represent the mean percent cover for representative and dominant taxa/ substrata from replicated (usually five) *Endocladia* plots. Note that Anacapa Middle East has not been sampled since 2013.

Barnacle, *Chthamalus/Balanus* spp. abundances pooled across sites in 2016–17 fell below the long-term means at all islands except Anacapa (Figure 15). Record-low barnacle abundances were measured at San Miguel, Santa Rosa and Santa Barbara Islands. At Anacapa, barnacle abundance was comparable to the long-term mean. At the site level, *Chthamalus/Balanus* spp. abundances in 2016–17 measured below the long-term mean at the majority of sites; near record-low abundances were measured at Ford Point, Fraser Cove, Harris Point, Johnson’s Lee, Landing Cove, Northwest-Talocott, Orizaba Cove, Otter Harbor, Prisoner’s Harbor, Sea Lion Rookery and South Frenchy’s Cove (Figure 16). Even though a lot of sites had below-average abundances of barnacle cover, many were only slightly below the long-term mean. Scorpion Rock and Cat Rock were the only sites that had above-average (slightly) cover of *Chthamalus/Balanus* spp. Other dominant species in *Chthamalus/Balanus* spp. plots have primarily been *S. compressa* and *E. muricata* (Figure 17).

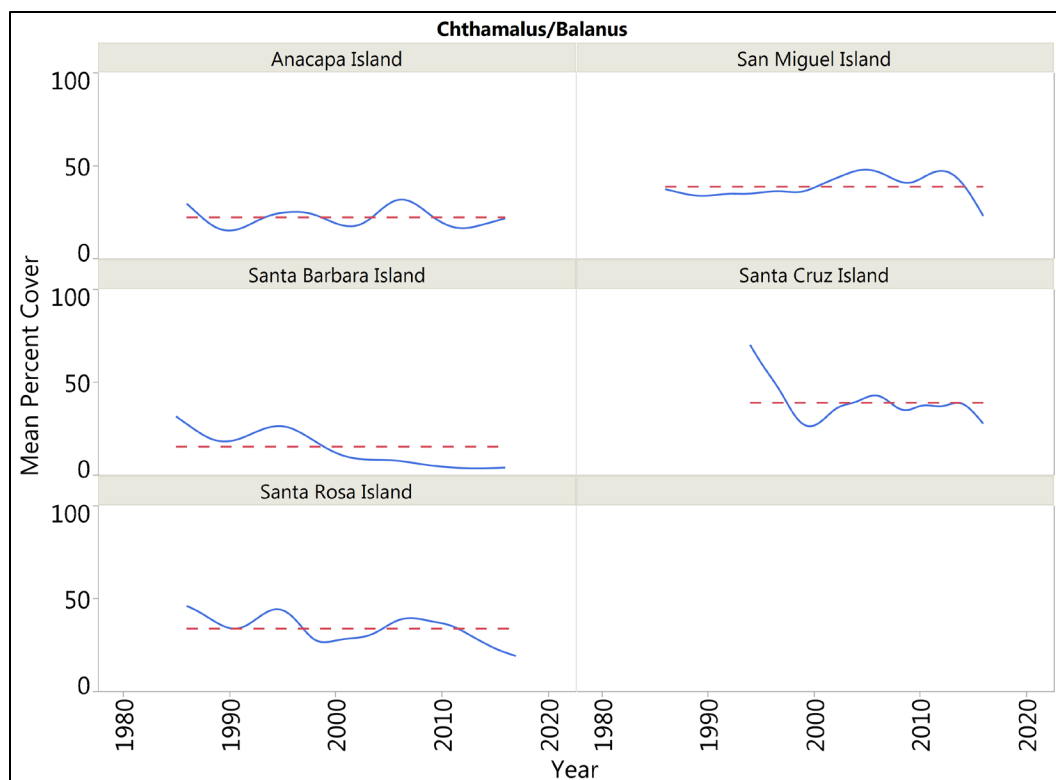


Figure 15. Departure from the long-term mean for *Chthamalus/Balanus*. Blue lines represent mean cover of *Chthamalus/Balanus* within the representative zone pooled across plots and sites at each island. Red dashed lines represent long-term mean.

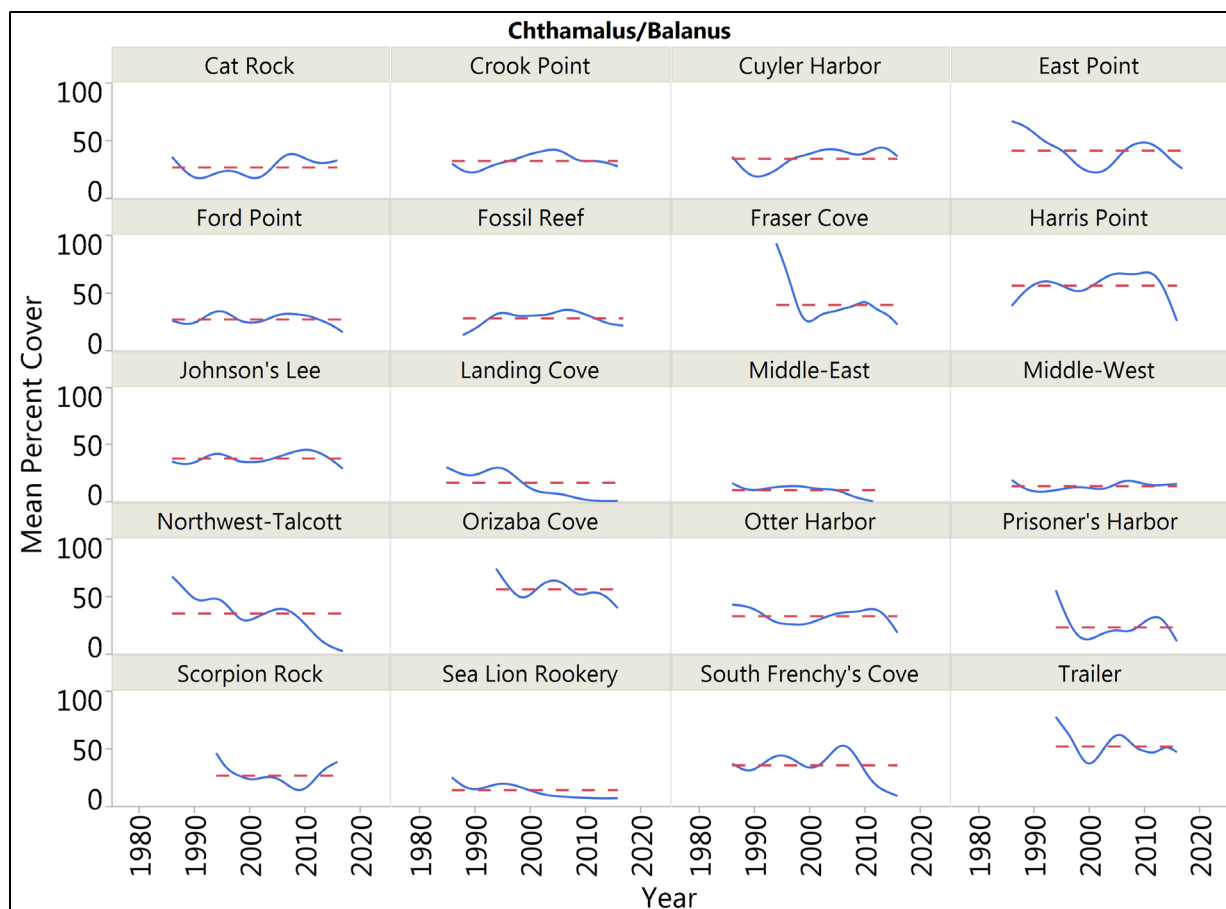


Figure 16. Departure from the long-term mean for *Chthamalus/Balanus*. Blue lines represent mean cover of *Chthamalus/Balanus* within the representative zone pooled across plots at each site. Red dashed lines represent long-term mean. Note that Anacapa Middle East data has not been sampled since 2013.

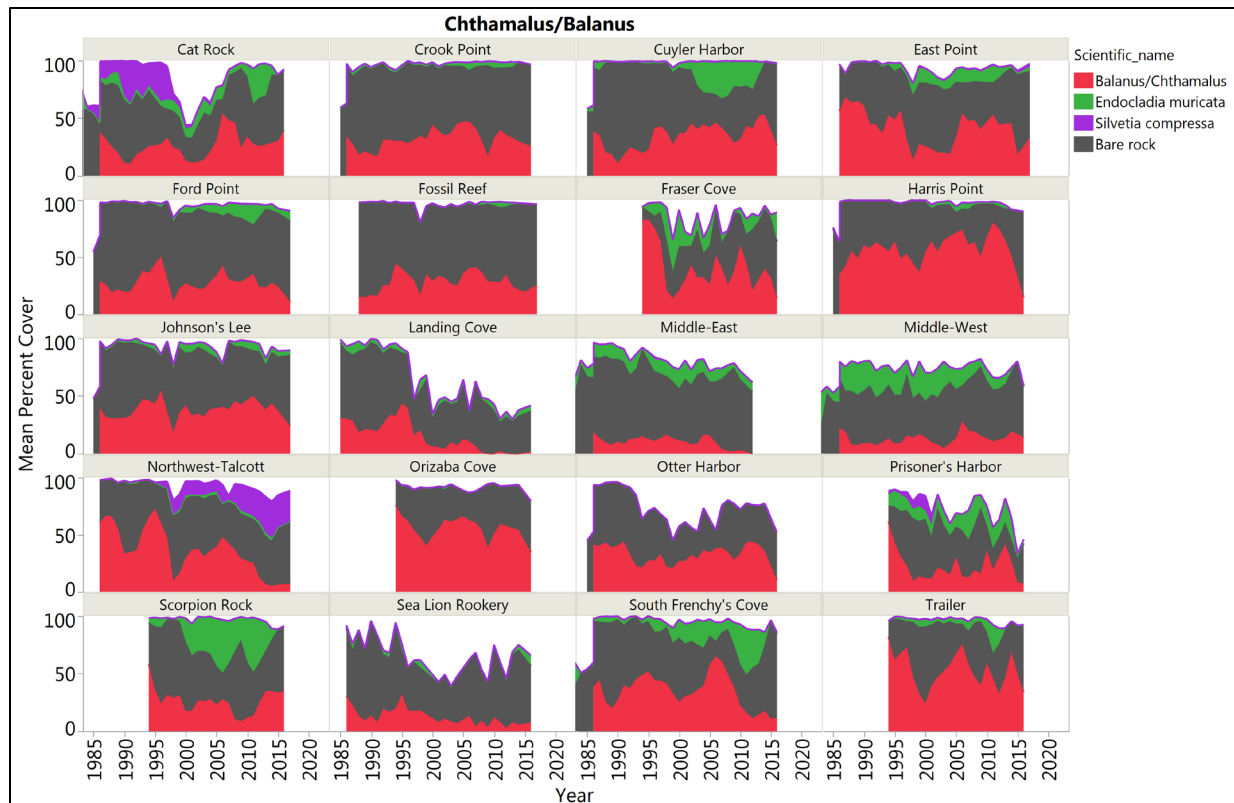


Figure 17. Percent cover of barnacles, *Chthamalus/Balanus*, along with *Endocladia*, *Silvetia compressa* and bare rock in fixed plots within the barnacle (*Chthamalus/Balanus*) zone at each site. Note that barnacle species were not separated. Colored areas represent the mean percent cover for representative and dominant taxa/ substrata from replicated plots (usually five) within the *Chthamalus/Balanus* zone. Note that Anacapa Middle East has not been sampled since 2013.

Goose or leaf barnacle, *Pollicipes polymerus* zone plots have only been established at Fraser Cove, where goose barnacle cover has declined slowly over time from approximately 20% to well below 10% by 2009. *P. polymerus* cover increased markedly since 2009 and was slightly above the long-term mean in 2016–17 (Figure 18). Other dominant species in the *P. polymerus* plots have included *M. californianus* and *T. rubescens* (Figure 19).

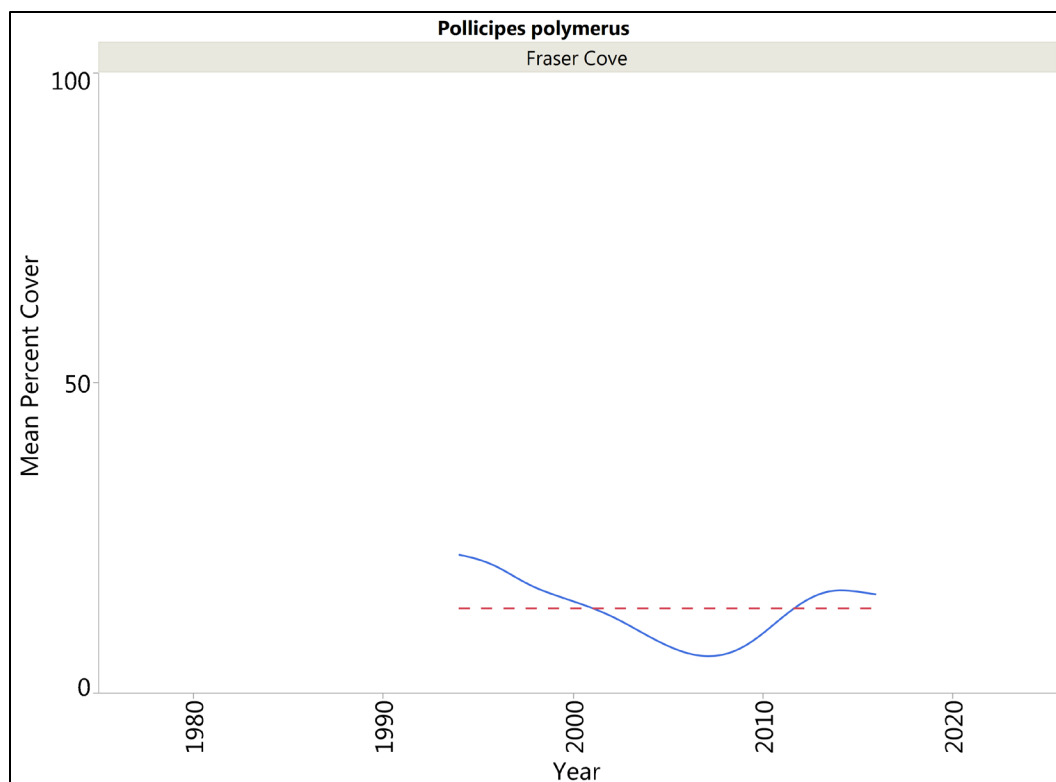


Figure 18. Departure from the long-term mean for *Pollicipes polymerus*. Blue lines represent mean cover of *P. polymerus* within the representative zone pooled across plots at Fraser Cove. Red dashed line represents long-term mean.

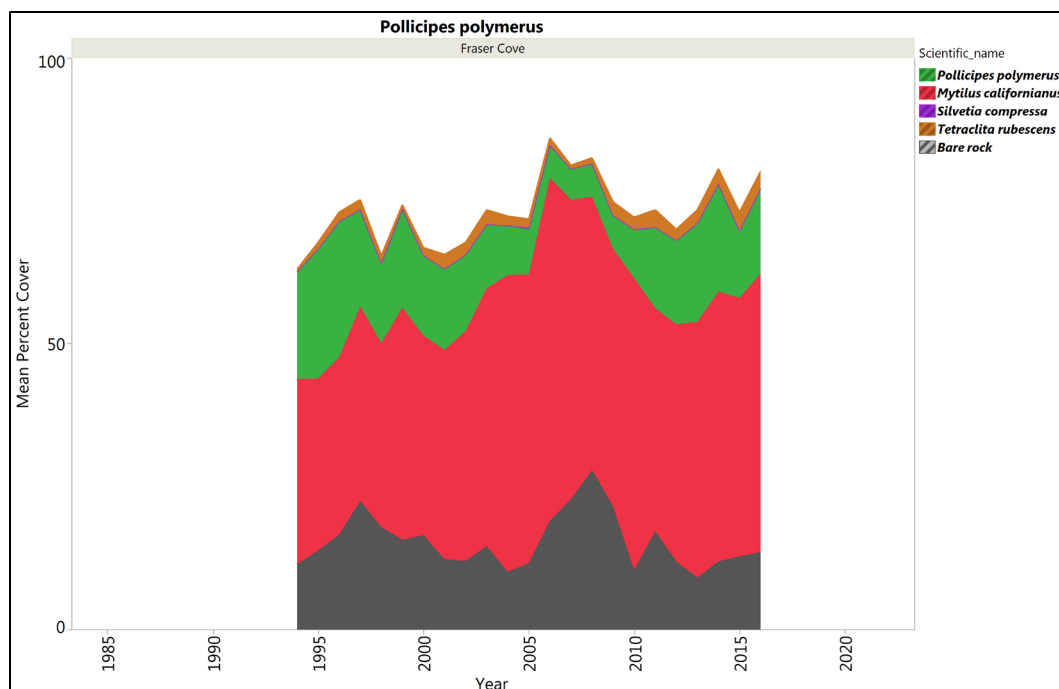


Figure 19. Percent cover of *Pollicipes polymerus* along with other dominant taxa and bare rock in fixed plots within the *Pollicipes* zone at Fraser Cove, Santa Cruz Island. Colored areas represent the mean percent cover for representative and dominant taxa/ substrata from five *Pollicipes* plots.

The thatched barnacle, *Tetracita rubescens* is only monitored at three sites (Harris Point, Orizaba Cove and Scorpion Rock). Thatched barnacles increased above the long-term mean all three locations (Figure 20). Other dominant species in the *T. rubescens* plots have included *M. californianus* (Figure 21).

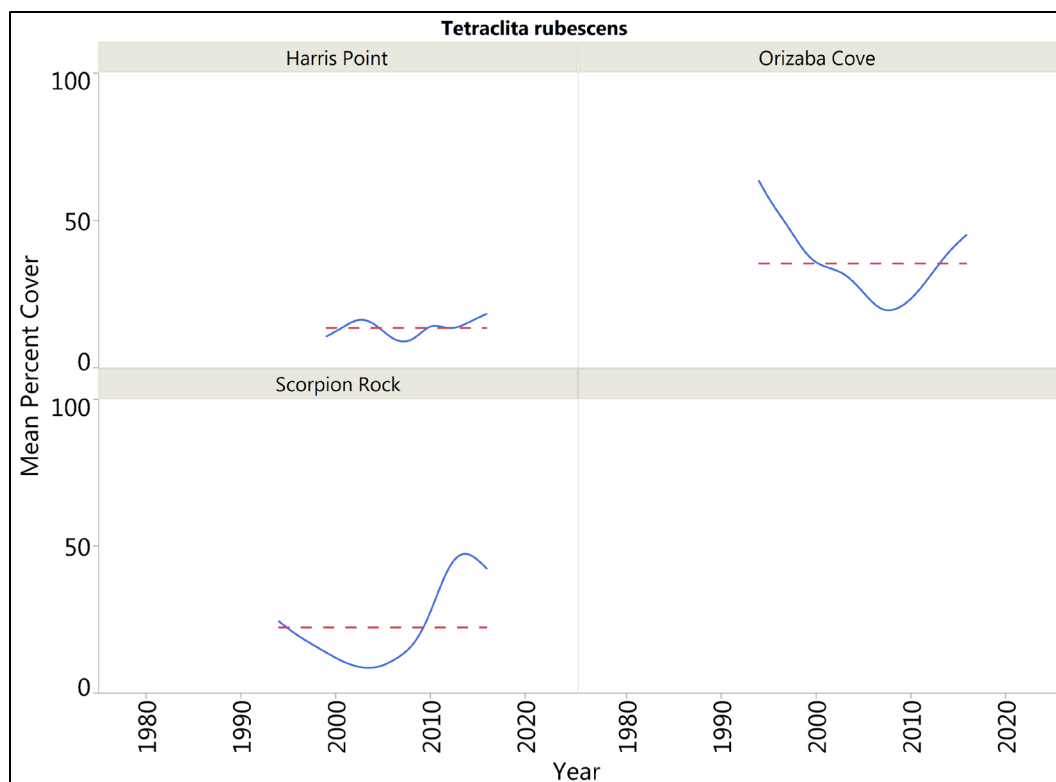


Figure 20. Departure from the long-term mean for *Tetracrita rubescens*. Blue lines represent mean cover of *T. rubescens* within the representative zone pooled across plots at each site. Red dashed line represents long-term mean.

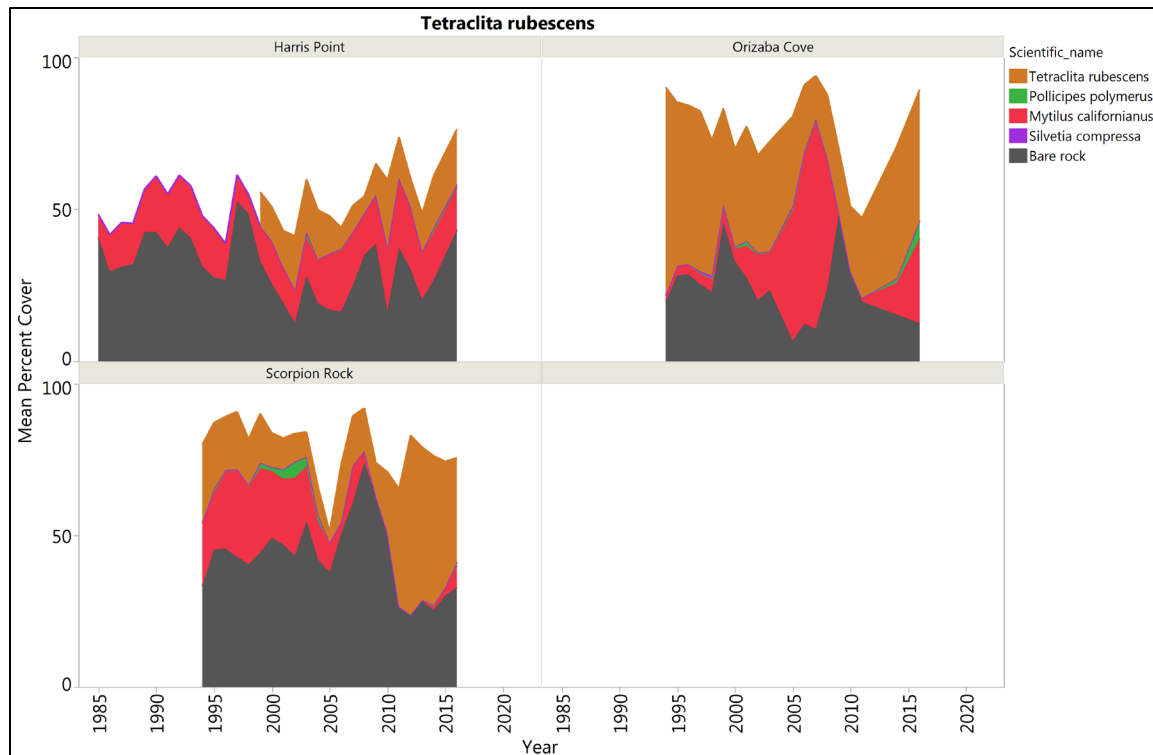


Figure 21. Percent cover of *Tetracita rubescens* along with other dominant taxa and bare rock in fixed plots within the *Tetracita* zone at each site. Colored areas represent the seasonal mean percent cover for representative and dominant taxa/ substrata from five *Tetracita* plots.

Tar is only monitored at Fraser Cove where it is naturally deposited from seeps in the Santa Barbara Channel onto extensive stretches of the upper intertidal on the west end of Santa Cruz Island. There was a slight increase (< 10%) in tar cover in 2016–17 from the long-term mean (approximately 50%) (Figure 22). Dominant species in the tar plots have included *Balanus/ Chthamalus* spp. (Figure 23).

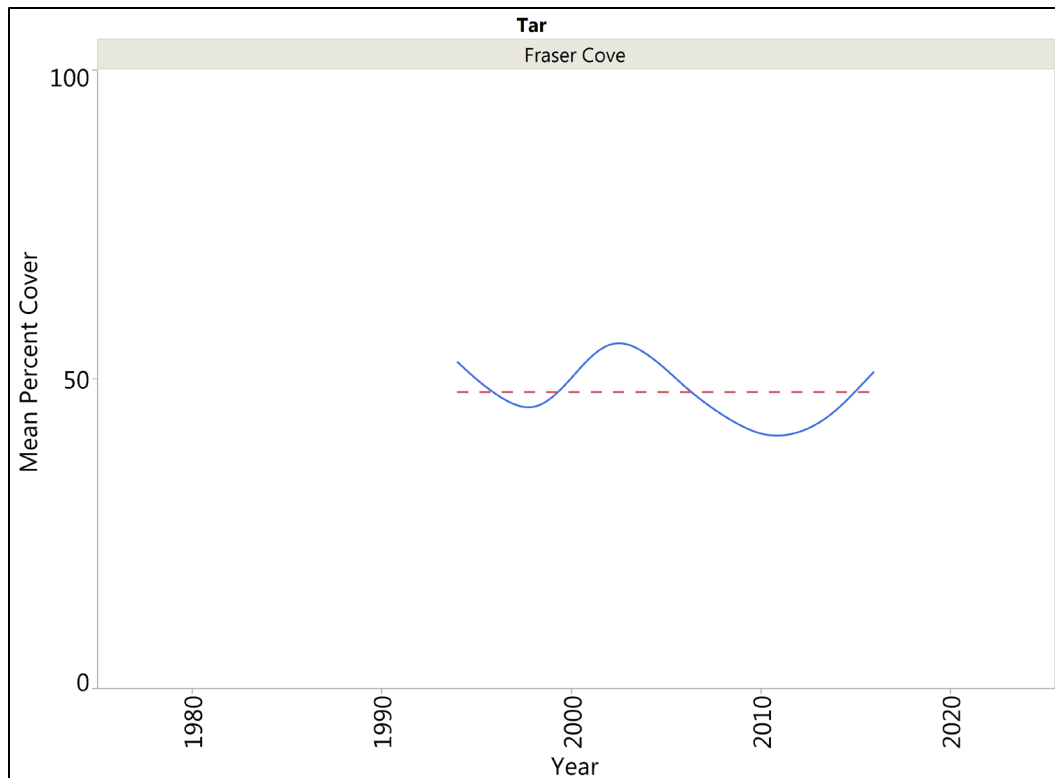


Figure 22. Departure from the long-term mean for tar. Blue lines represent mean cover of tar within the representative zone pooled across plots at Fraser Cove. Red dashed line represents long-term mean.

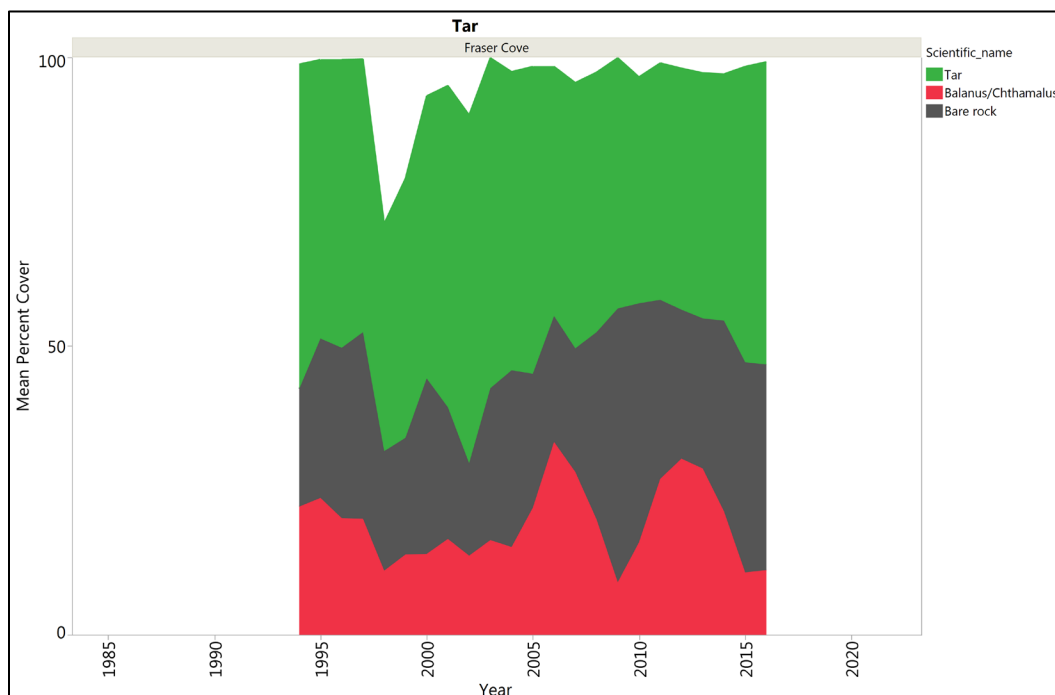


Figure 23. Percent cover of tar along with other dominant taxa and bare rock in fixed plots within the tar zone at Fraser Cove, Santa Cruz Island. Colored areas represent the mean percent cover for representative and dominant taxa/substrata from five tar plots.

Haliotis cracherodii

Following the collapse of the black abalone population in southern California due to Withering Syndrome (WS) in the late 1980s and 1990s, most monitoring sites at CHIS have supported extremely low numbers of abalone relative to historical abundances (Figures 24–25 [density and timed search graphs]). As mentioned in the Methods section, prior to the effects of Withering Syndrome (WS), black abalone were counted and measured in fixed-irregular plots (5 plots per site) at 11 sites. Fixed plots were used when abalone were abundant and often too numerous to count and measure over the entire reef. The fixed plots became inadequate for sampling, however, by the early 1990s as abalone disappeared. Fixed plots have been checked most years for comparison to early samples, but abalone have rarely been encountered in the plots. In 2016–17 fixed plots at most sites were not sampled due to the inability to accurately locate most of the marker bolts that are used to identify the perimeters of the plots. A concerted effort will be made in the near-future to replace the eroded or missing bolts with new ones by consulting historic photographs and bolt-to-bolt location measurements.

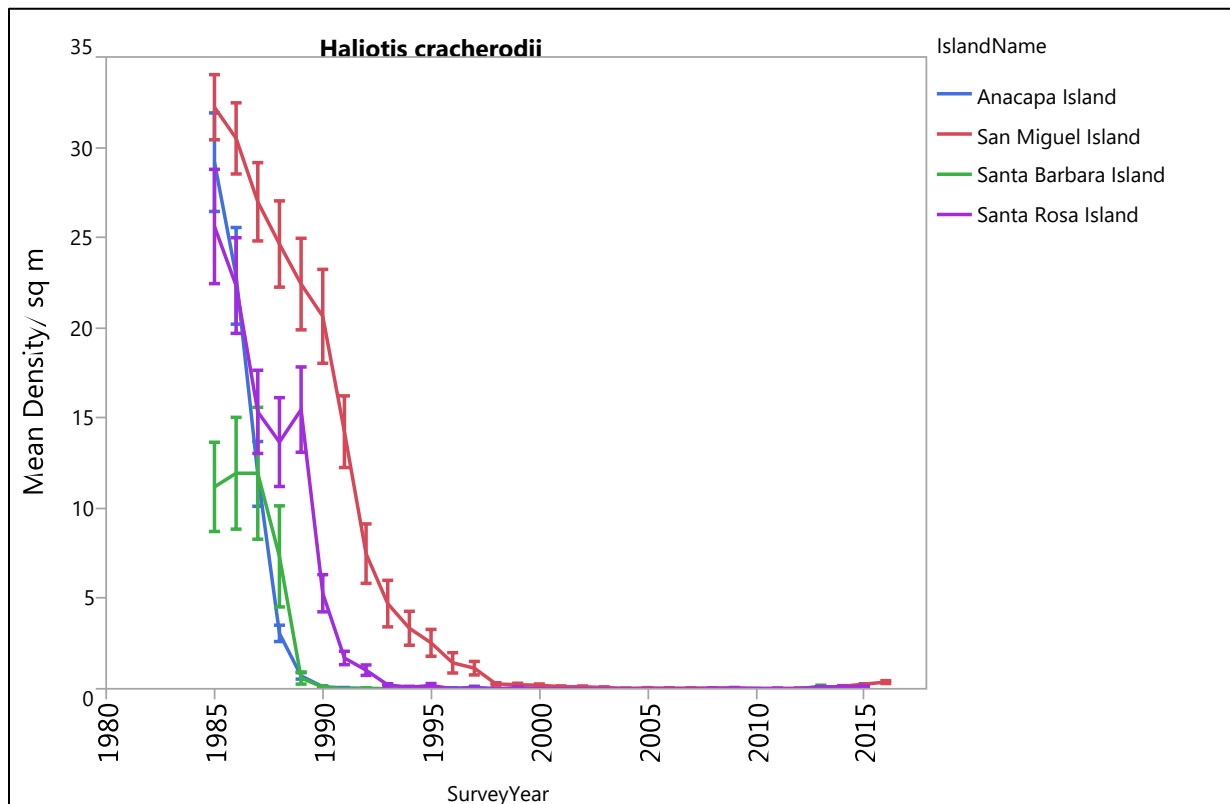


Figure 24. *Haliotis cracherodii* counts from fixed plots at all islands except Santa Cruz from 1985–2015/16. Note that fixed plots were not established at Santa Cruz Island. Standard error bars were constructed using 1 standard error from the mean.

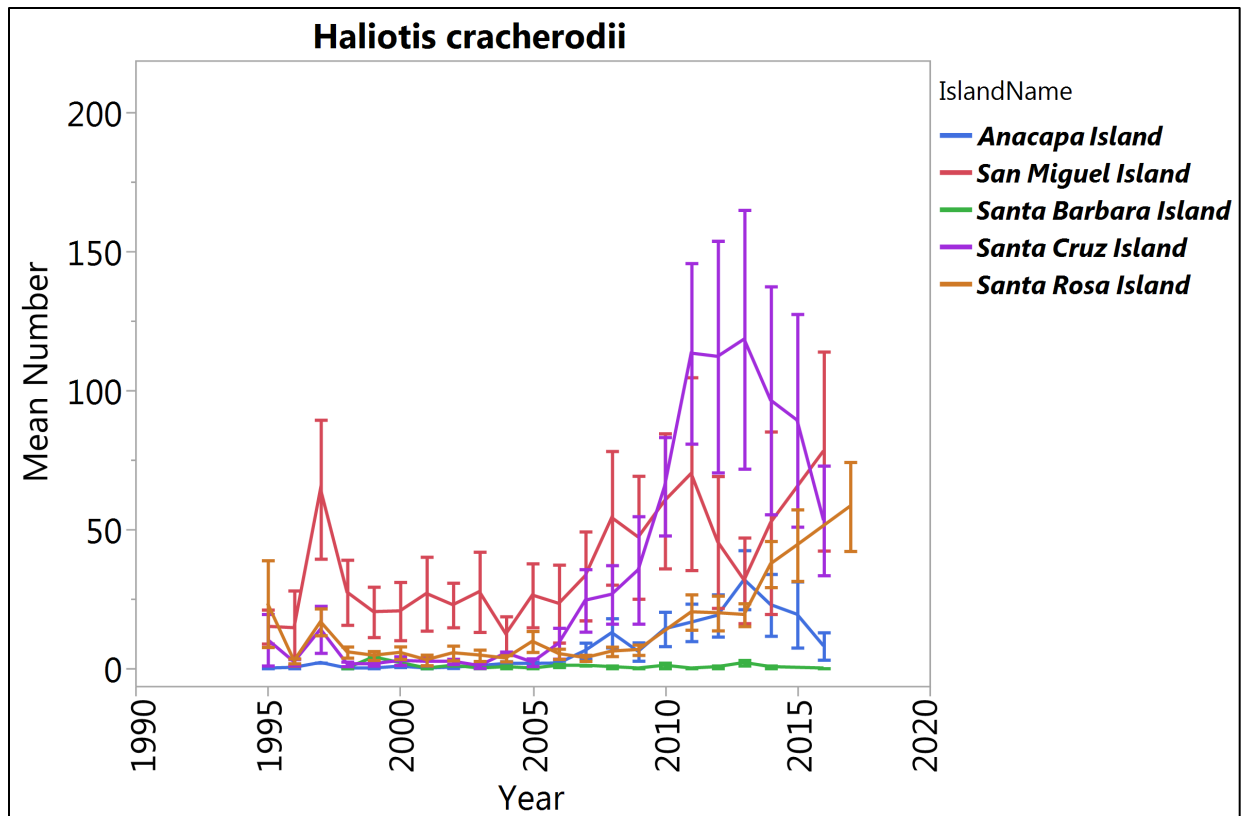


Figure 25. Black abalone, *Haliotis cracherodii*, mean counts at all islands from 1995–2016/17. Count data are generally derived from site-wide searches. Error bars were constructed using 1 standard error from the mean.

During routine timed searches, black abalone were entirely absent from Landing Cove, Sea Lion Rookery and South Frenchy’s Cove. Of the remaining sites where black abalone were seen, fewer than 10 individuals were located at Anacapa Middle West, Fraser Cove, Landing Cove and Prisoner’s Harbor. In contrast, > 100 black abalone were observed at three sites (Otter Harbor, Trailer and Willows Anchorage) (Figure 26). Note that search effort increased at several sites due to the greater number of abalone that occurred at those locations and the greater availability of time; refer to trip reports in Appendix B for details. Searches at all sites except Willows Anchorage were conducted within the confines of the site boundaries as defined by the CHIS Rocky Intertidal Monitoring Program (Richards and Davis 1988) and updated protocol summaries (Richards and Lerma 2000). At Willows, a subset of the entire site was searched both seasons (see corresponding trip reports in Appendix B for details).

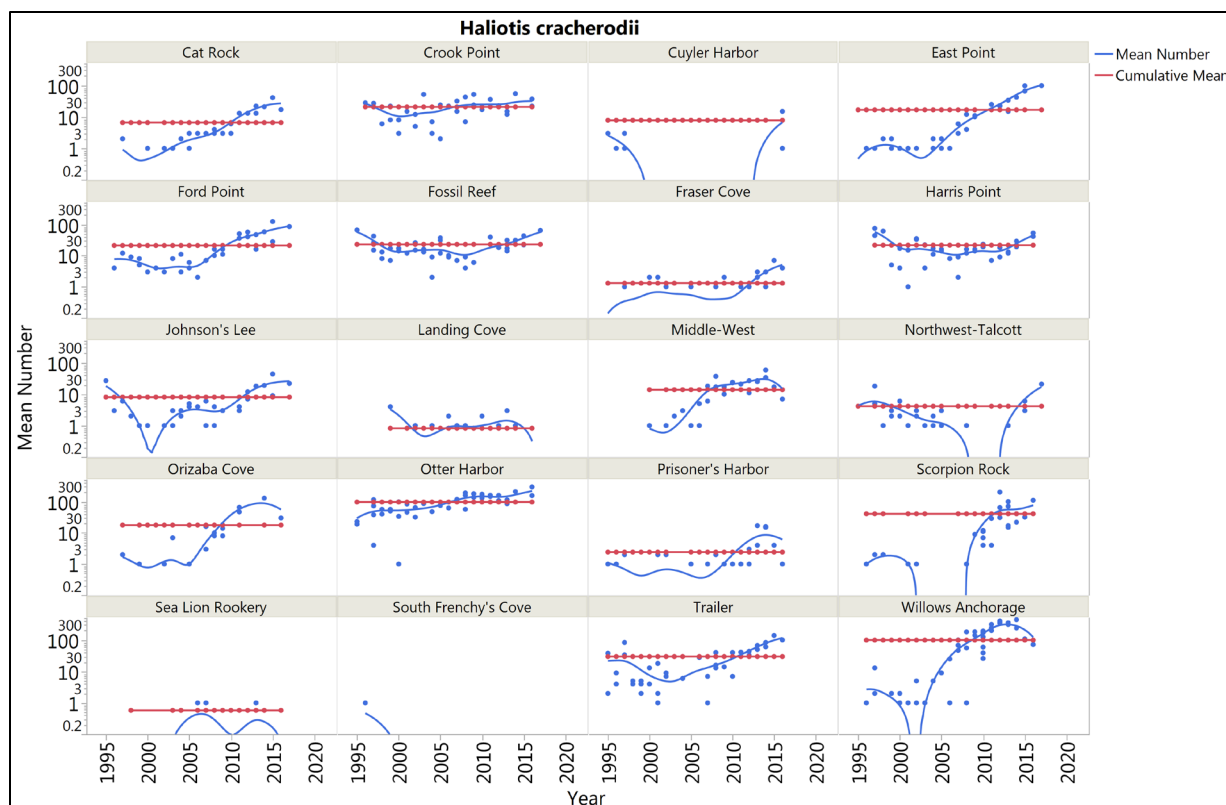


Figure 26. Departure from the long-term mean for *Haliotis cracherodii* at each site. Blue lines represent the trend of the mean number of *H. cracherodii* at each site. Red lines represent cumulative mean. Note that data are displayed on a logarithmic scale.

At most sites, counts of black abalone in 2016–17 were greater than the long-term mean generated from post-1995 count data (Figure 26). In some cases, increases were only slightly above the long-term mean, but substantial increases in abundances were documented in 2016–17 at East Point, Ford Point and Trailer. At most locations where black abalone counts have increased above the long-term mean, abundances began increasing approximately 2007–2009. A decreasing trend and slightly below-average abundance were documented at Anacapa Middle West, Prisoner’s Harbor and Willows Anchorage.

At the island level, mean abundances of *H. cracherodii* in 2016–17 measured above the cumulative mean respective to each island at San Miguel, Santa Cruz and Santa Rosa (Figure 27). Note that only a few black abalone have been observed at Santa Barbara Island in recent years, and the population at that island has yet to exhibit any signs of recovery. At Anacapa Island, the mean number of black abalone observed in 2016–17 was comparable to the cumulative mean.

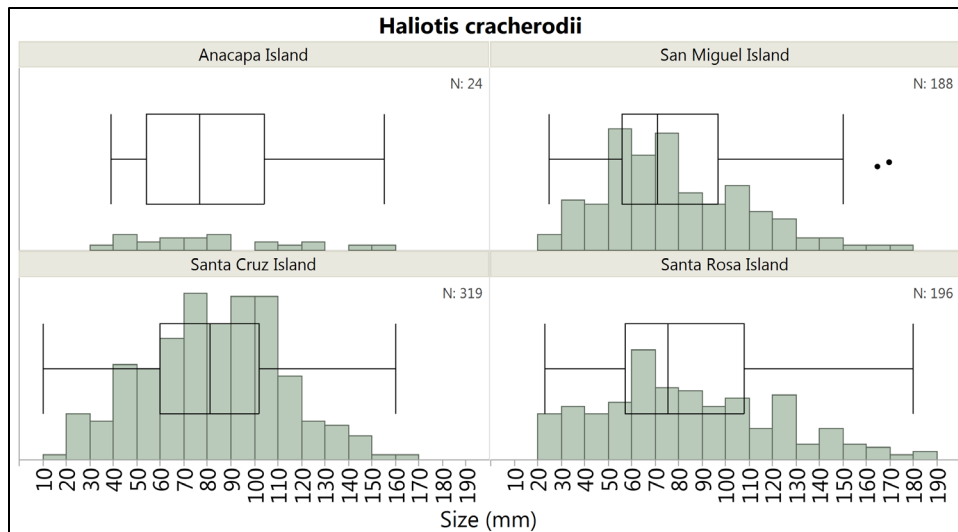


Figure 28. *Haliotis cracherodii* size distributions pooled across sites at each island measured in 2016–17. Box-and-whisker plots indicate the spread and degree of skewness of the size frequency data. The ends of the boxes represent the 25th and 75th quartiles, the vertical line inside the box indicates the median value, the whiskers extend from the ends of the box to the outermost data point that falls within 1.5 of the lower and upper quartiles and dots indicate outlier values.

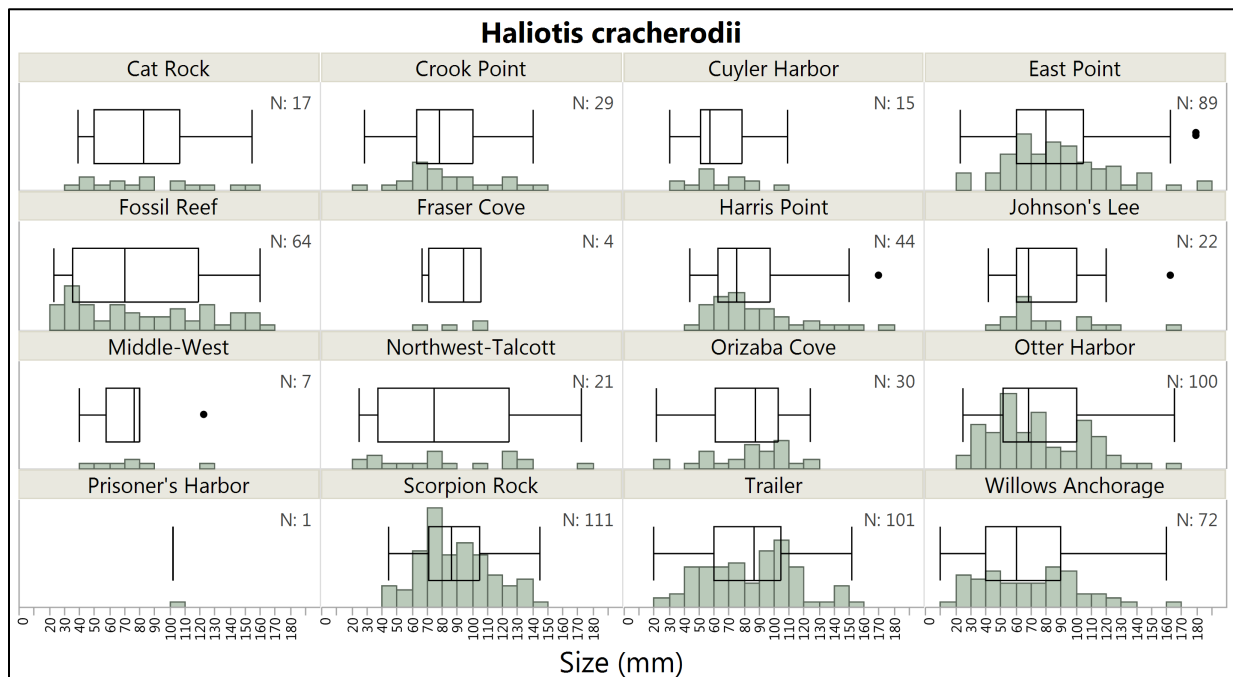


Figure 29. Size frequency distributions of *Haliotis cracherodii* measured at each site in 2016–17. Box-and-whisker plots indicate the spread and degree of skewness of the size frequency data. The ends of the boxes represent the 25th and 75th quartiles, the vertical line inside the box indicates the median value, the whiskers extend from the ends of the box to the outermost data point that falls within 1.5 of the lower and upper quartiles and dots indicate outlier values.

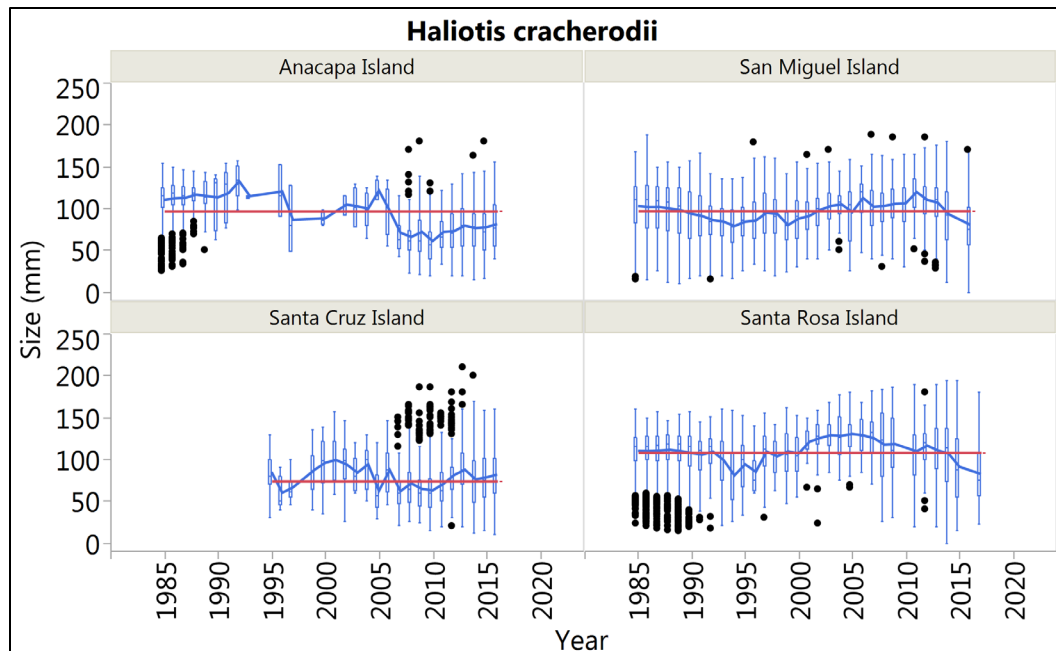


Figure 30. Box plots for annual size frequency distributions of *Haliotis cracherodii* at each island. Blue lines represent mean sizes of *H. cracherodii* at each island pooled across and sites. Red lines represent the cumulative mean.

Shrunken foot, one of the symptoms of Withering Syndrome (WS), was not observed in 2016–17. During the past few years, several abalone that appeared to have shrunken foot were observed. It is unknown whether any of the abalone that appeared shrunken were suffering from WS.

Lottia gigantea

All sites with fixed plots for *L. gigantea* were sampled in 2016–17. The mean density of limpets ranged 3.1–33.5 per plot across all sites that were sampled in 2015–16 (Figures 31–32). Fossil Reef followed closely by Otter Harbor had the greatest density of *L. gigantea* and South Frenchy’s Cove had the least. Mean densities of limpets measured <10 at six sites, 10–20 at four sites and >20 at two sites. Mean densities of *L. gigantea* in 2016–17 were comparable or slightly below the long-term mean at all sites except Fossil Reef, Otter Harbor and Willows Anchorage. At the three latter sites, owl limpets were markedly more abundant than abundances measured in recent past years.

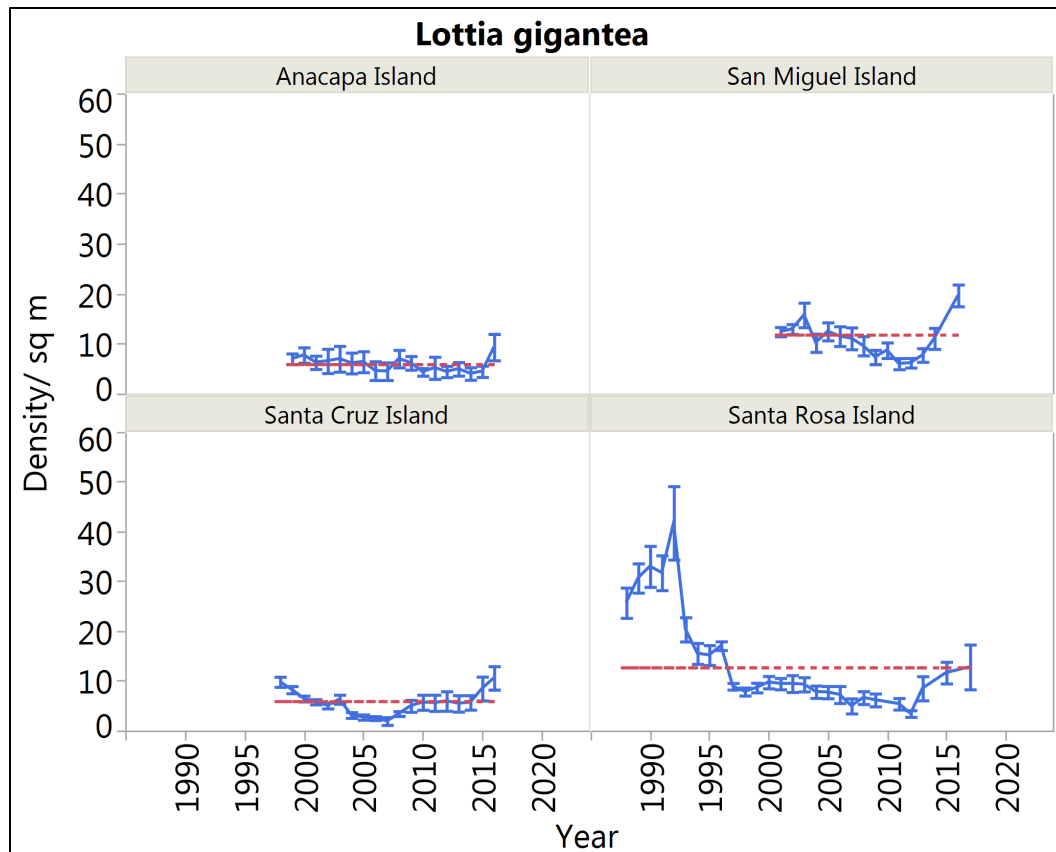


Figure 31. Departure from the long-term mean for *Lottia gigantea* at each island. Blue lines represent mean density of *L. gigantea* at each island pooled across fixed plots and sites. Red dashed lines represent cumulative mean density. Error bars were constructed using 1 standard error from the mean.

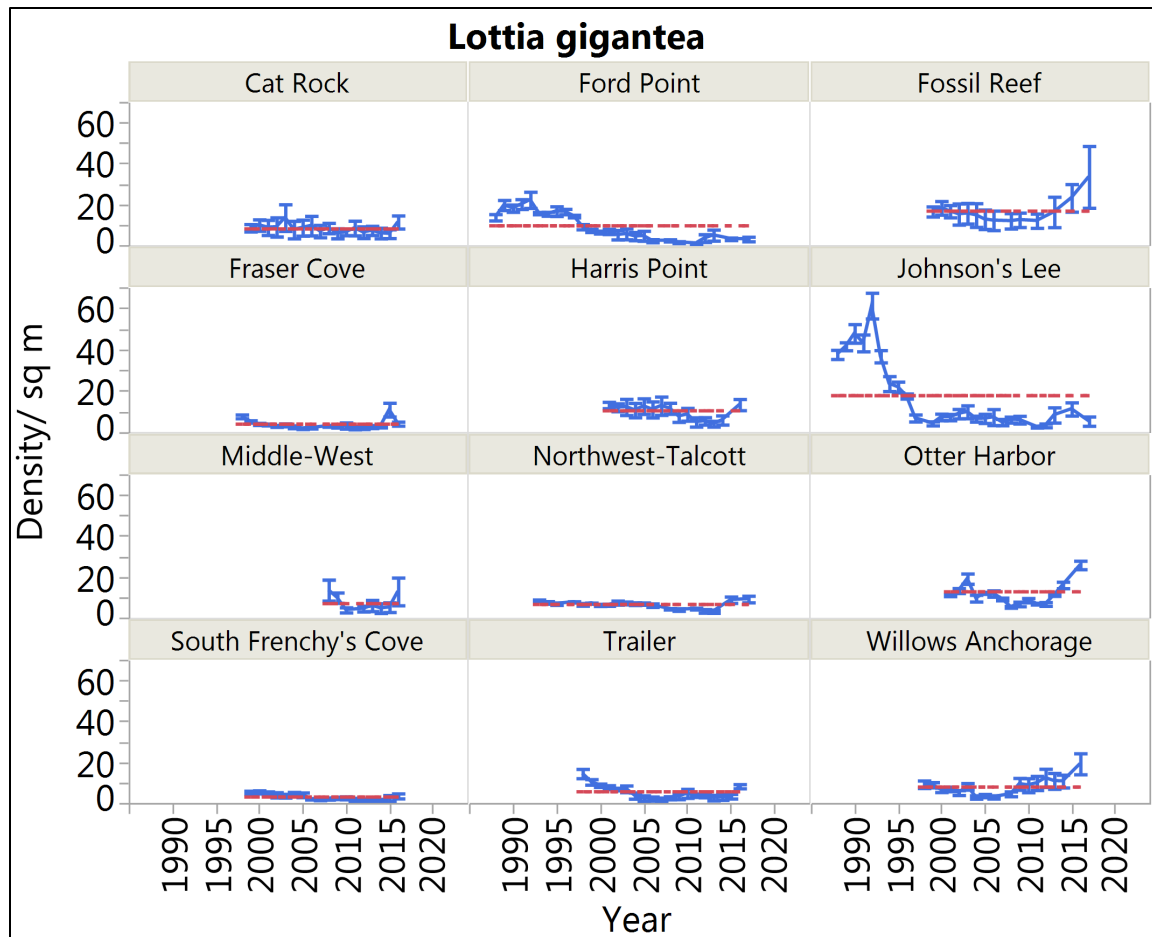


Figure 32. Departure from the long-term mean for *Lottia gigantea* at each site. Blue lines represent mean density of *L. gigantea* at each site pooled across fixed plots. Red dashed lines represent cumulative mean density. Error bars were constructed using 1 standard error from the mean.

The sizes of *L. gigantea* in 2016–17 varied markedly among sites and relatively little among islands. While only minimal temporal changes in mean sizes of limpets were documented within most sites, below-mean sized limpets relative to the most recent five years were measured at six sites (Figures 33–36). Mean sizes ranged 23–46 mm across all sites sampled in 2015–16 with the smallest owl limpets measured at Willows Anchorage followed closely by Anacapa Middle West and the largest at Northwest-Talcott. When pooled across islands, the smallest (mean = 28 mm) limpets occurred at Santa Cruz followed closely by Anacapa (median = 29 mm); limpets at Santa Rosa and San Miguel Islands were approximately equal in size (mean = 32 mm).

The mean sizes of *L. gigantea* in 2016–17 remained comparable at most sites to long-term means generated for each respective site (Figure 34). When pooled across islands, mean sizes of owl limpets were lower relative to historical measurements (Figure 33).

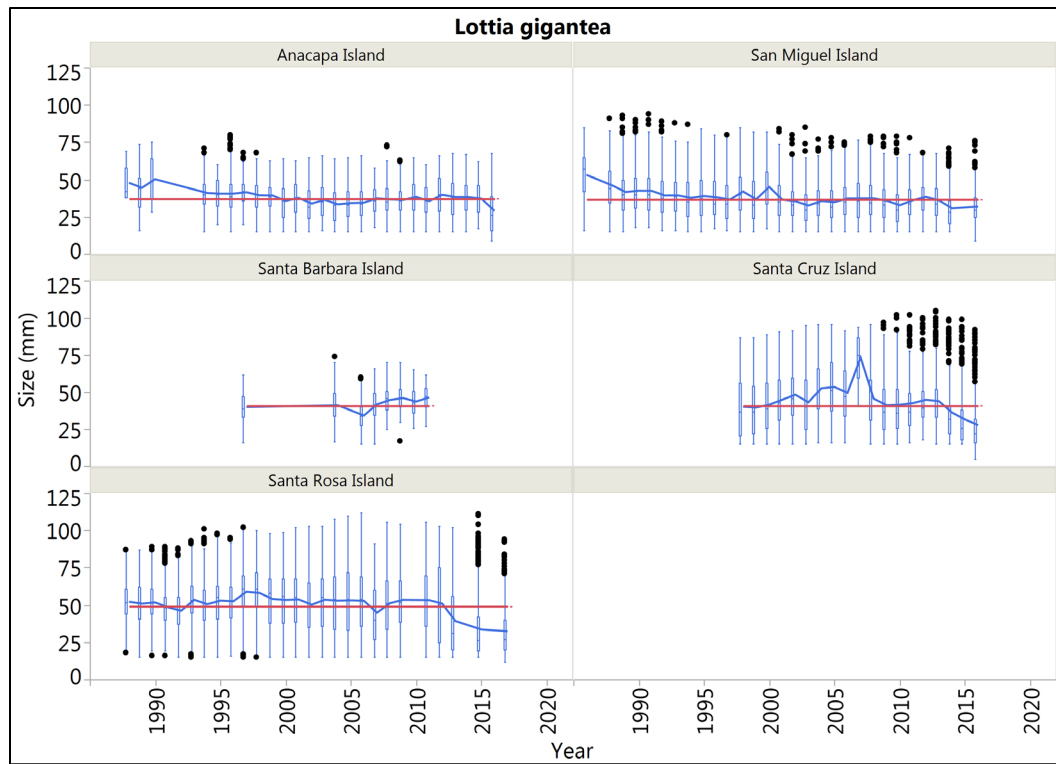


Figure 33. Box plots for annual size frequency distributions of *Lottia gigantea* at each island. Blue lines represent mean sizes of *L. gigantea* at each island pooled across fixed plots and sites. Red lines represent the cumulative mean.

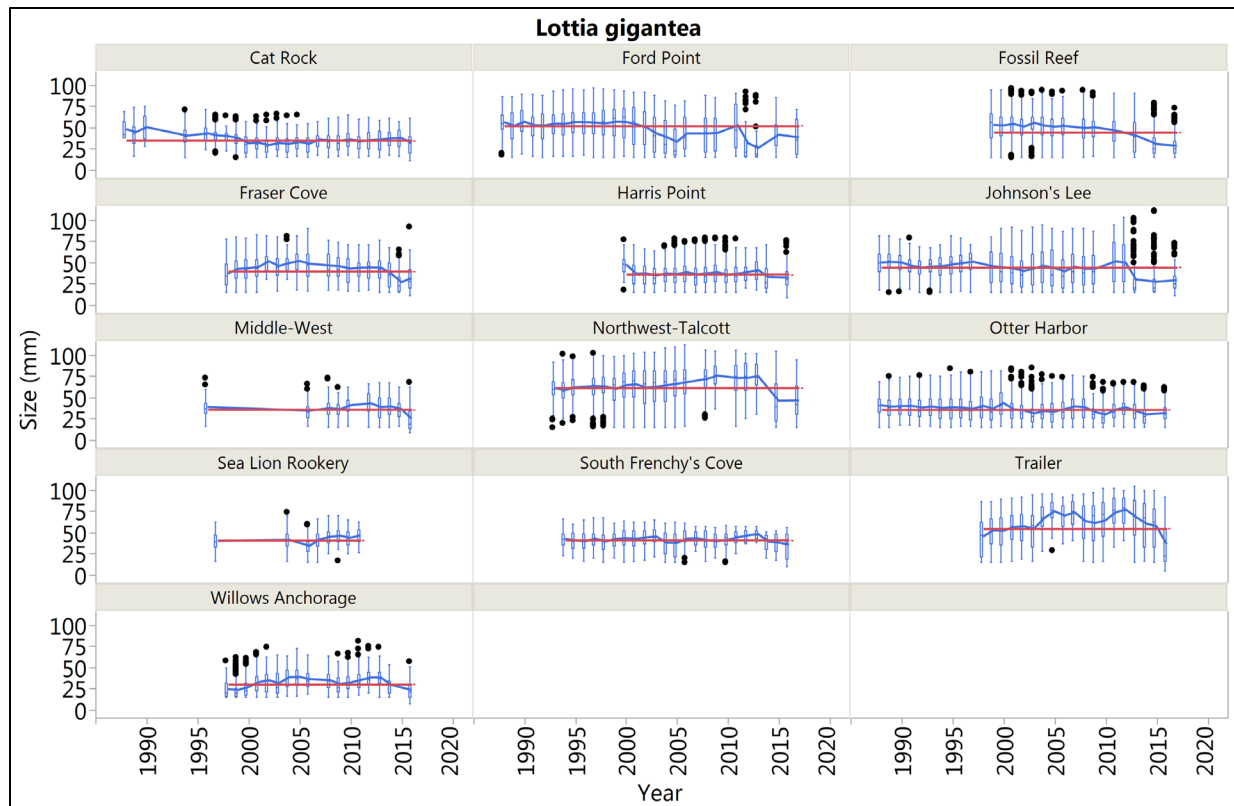


Figure 34. Box plots for annual size frequency distributions of *Lottia gigantea* at each site. Blue lines represent mean sizes of *L. gigantea* at each site pooled across fixed plots. Red lines represent the cumulative mean.

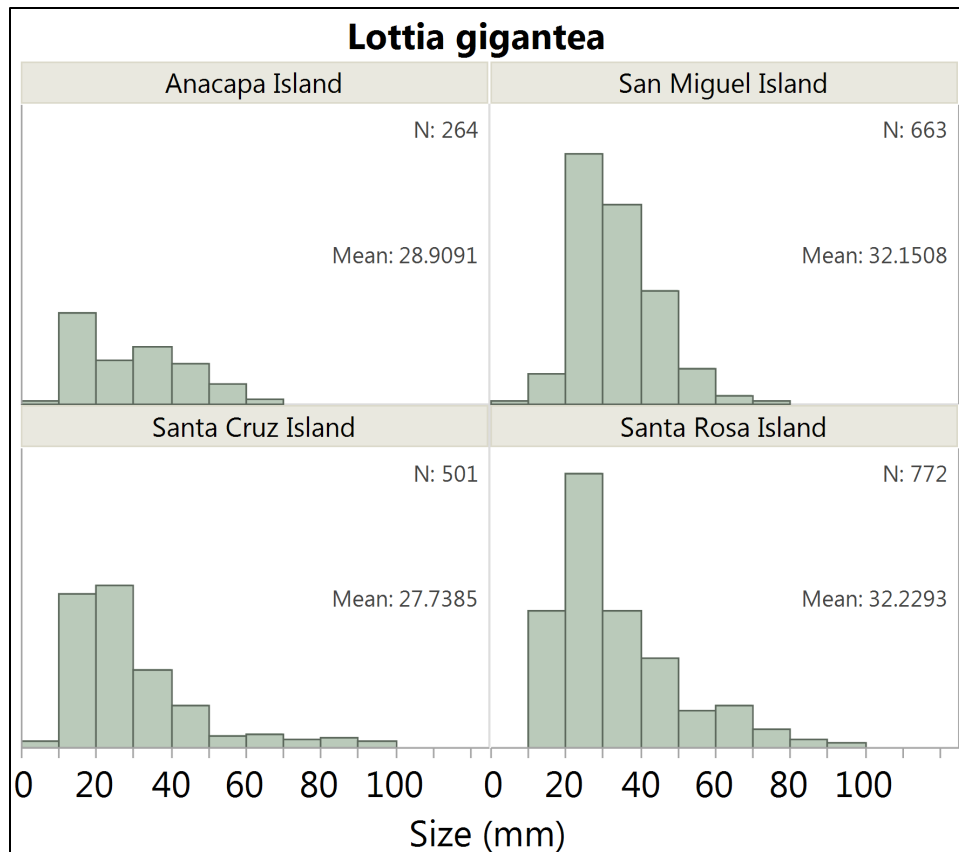


Figure 35. *Lottia gigantea* size distributions at each island measured in 2016–17. Bars indicate the number of individuals within each size bracket. Mean value indicates the mean size of *L. gigantea* at each island.

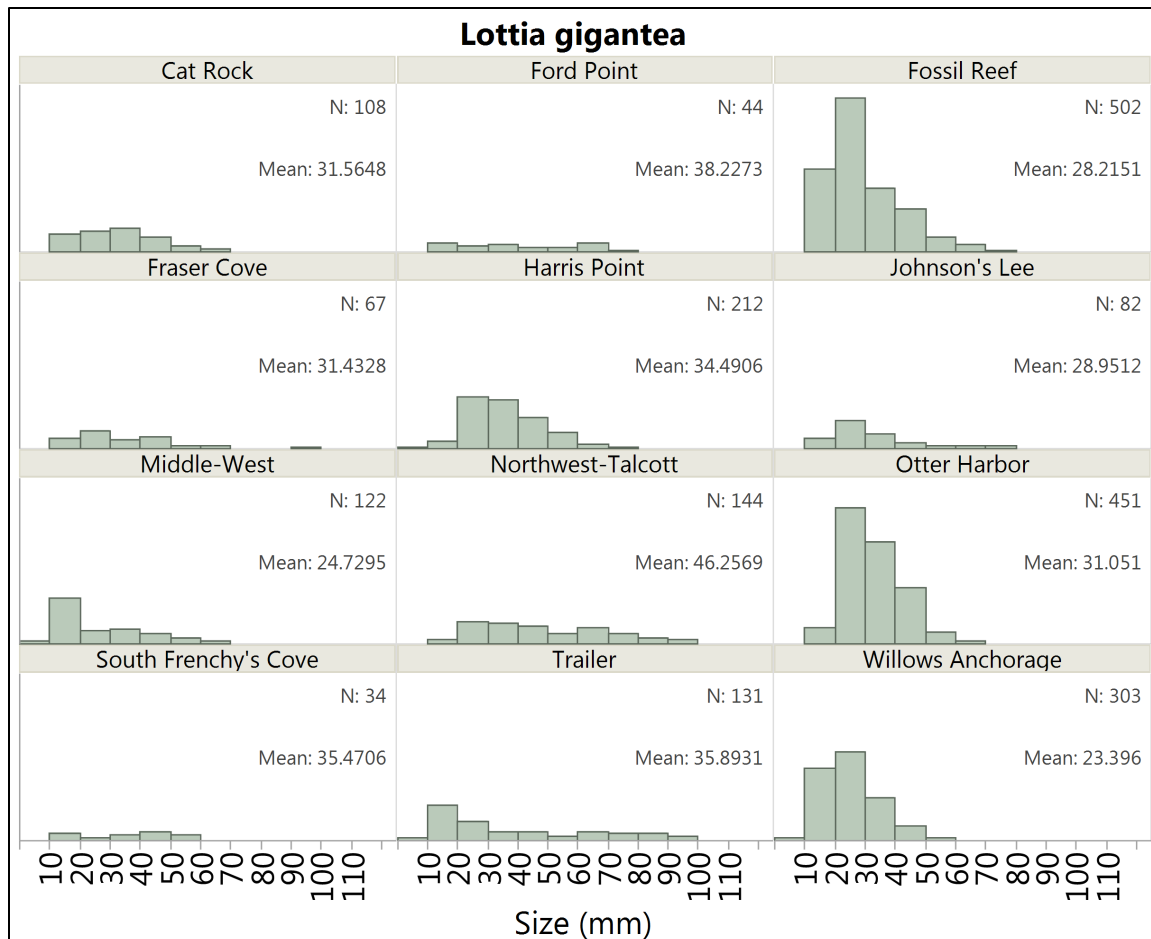


Figure 36. *Lottia gigantea* size distributions at each site measured in 2016–17. Bars indicate the number of individuals within each size bracket. Mean value indicates the mean size of *L. gigantea* at each site.

L. gigantea size distributions pooled across sites for each island are displayed in Figure 35. The size distribution at Anacapa appeared to be mostly flat with a mode centered on 10–20 mm. Distributions for both Santa Rosa and particularly Santa Cruz islands exhibited more positive skewness whereby mean values were slightly higher than the median sizes and modes ranged 10–30 mm. The San Miguel population appeared close to normally-distributed with the mode at 20–30 mm.

Pisaster ochraceus

Temporally, the abundances of *P. ochraceus*, sea stars have fluctuated markedly at most sites, with the exceptions of Cat Rock, Harris Point, Northwest-Talcott, and South Frenchy's Cove which historically have supported low (i.e. < 35 *P. ochraceus*) numbers of sea stars.

Compared with previous years, sea star abundances have plummeted since 2014 including 2016–17 at all sites that were sampled (Figures 37–39). At various times during the past decade, extremely high abundances (~ 500 *P. ochraceus*) have been observed at multiple sites, and most locations have supported >100 sea stars counted during 30-minute site-wide searches. This year, abundances ranged

0–26 individuals per site with all but two sites (Crook Point and Willows Anchorage) having fewer than 15 *P. ochraceus* seen during routine searches.

Beginning in June 2013, a disease event swiftly and significantly impacted *P. ochraceus* (among other species of sea stars) populations along the North American Pacific coast from Alaska to Baja California, Mexico. By the beginning of 2014, *P. ochraceus* abundances had declined by >95% at nearly all CHIS long-term intertidal monitoring sites, in addition to numerous other locations along the west coast. The magnitude and spatial scale of this wasting event were unprecedented by any other die-offs that have been documented in recent decades.

The mortality event, often referred to as sea star wasting syndrome (SSWS) or disease (SSWD), is typically characterized by a suite of symptoms that initially consist of lesions forming in the ectoderm which then leads to fragmentation of the body and death as the illness progresses. The manifestation of symptoms and subsequent death can occur in as little as two days. It's unclear what causes the syndrome although there is evidence that a densovirus (SSaDV) is linked to SSWS (Hewson et al. 2014).

According to Hewson et al. (2014), SSaDV was observed in higher quantities within sick sea stars compared to asymptomatic individuals. When inoculated with the densovirus, outwardly-appearing healthy animals rapidly succumbed to the symptoms of SSWS. However, it should be noted that the densovirus was also detected in museum specimens of sea stars dating back to 1942, and it was observed within other species of echinoderms that were asymptomatic. More research is needed to determine causative agents for the disease.

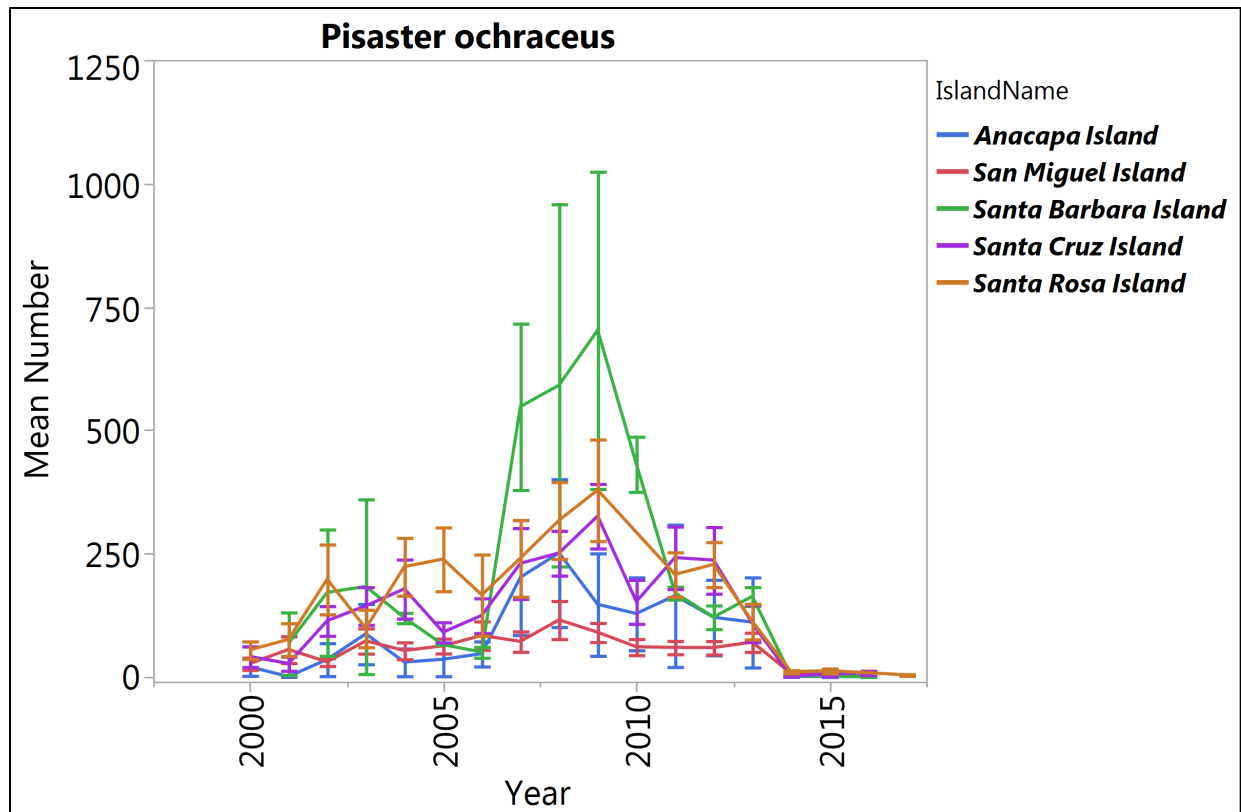


Figure 37. *Pisaster ochraceus* counts pooled across all sites at each island from 1999–2016/17. Count data were obtained from timed-(30 minute) searches.

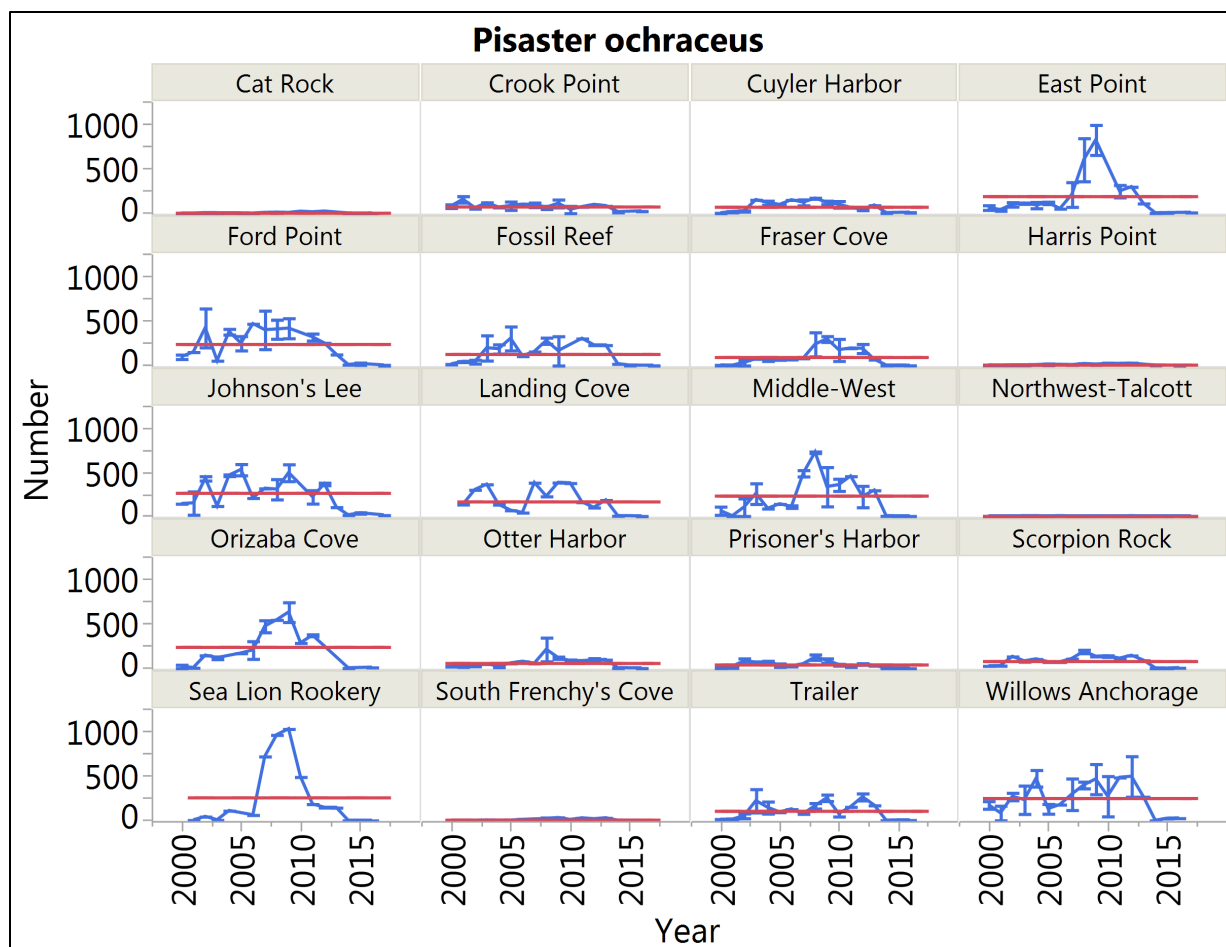


Figure 38. *Pisaster ochraceus* counts at each site from 2000–2016/17. Count data were obtained from timed-(30 minute) searches. Blue lines represent the number of *P. ochraceus* and red dashed lines indicate the long-term mean number of *P. ochraceus* at each site.

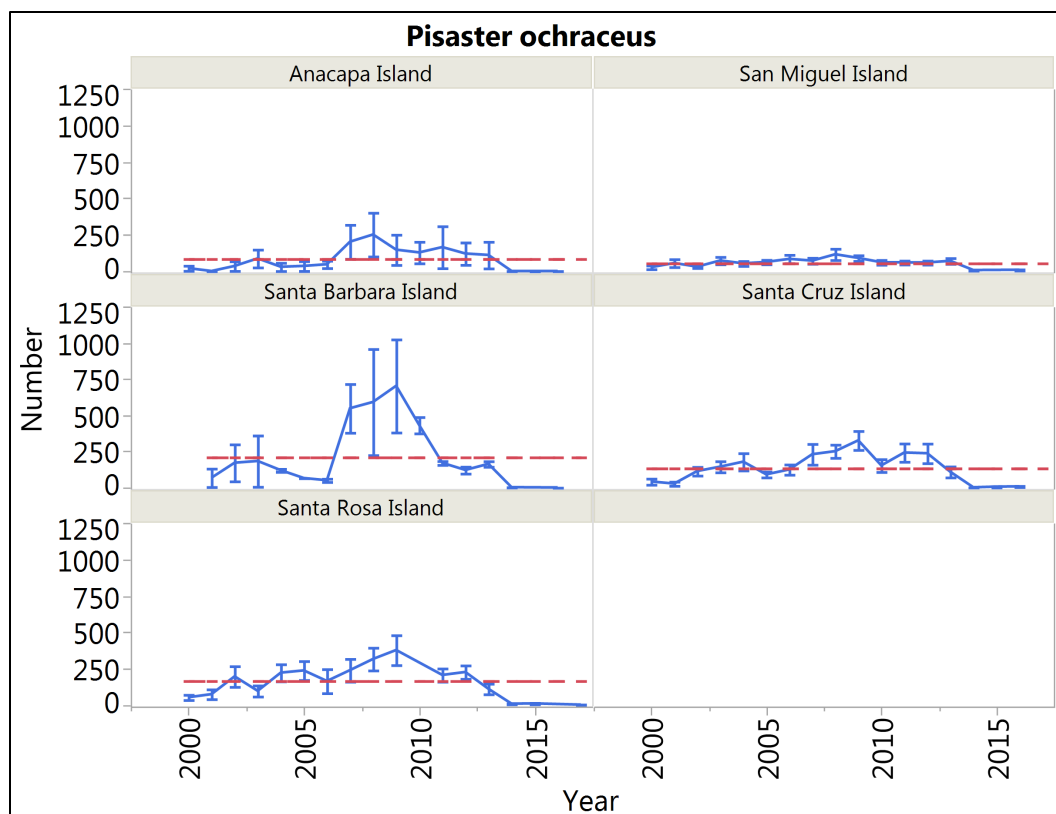


Figure 39. *Pisaster ochraceus* counts at each island from 2000–2016/17. Count data were obtained from timed-(30 minute) searches. Blue lines represent the number of *P. ochraceus* and red dashed lines indicate the long-term mean number of *P. ochraceus* at each site.

Size frequency measurements for *P. ochraceus* were collected at all sites sampled in 2016–17. However, insufficient numbers of sea stars were seen to accurately estimate the size structure of *P. ochraceus* populations. Despite low abundances of sea stars in 2016–17, size frequency data for each island (sites lumped across islands) and site are displayed in Figures 40–43. Even though abundances were low, the presence of small juvenile (e.g., < 50 mm) *P. ochraceus* was documented at many of the monitoring sites.

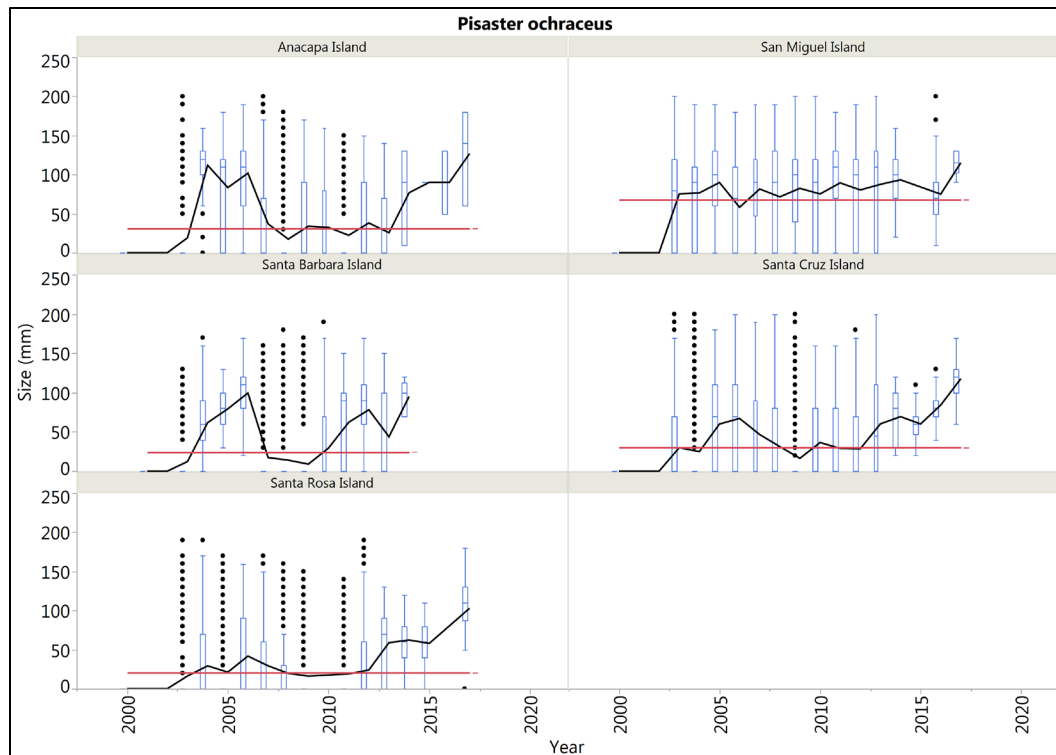


Figure 40. Box plots for annual size frequency distributions of *Pisaster ochraceus* at each island. Black lines represent mean sizes of *P. ochraceus* at each island pooled across sites. Red lines represent the cumulative mean. Note that low abundances of *P. ochraceus* were observed at nearly all sites in 2016–17.

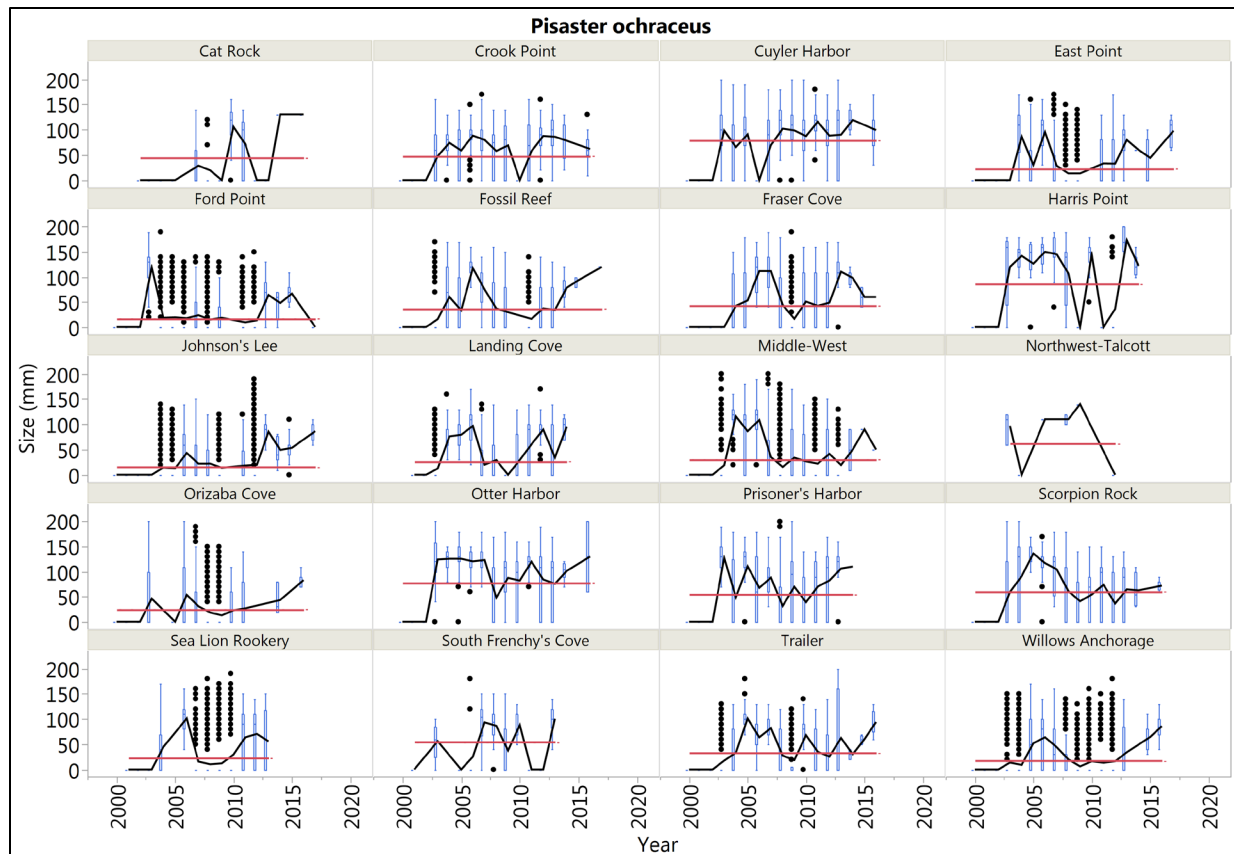


Figure 41. Box plots for annual size frequency distributions of *Pisaster ochraceus* at each site. Black lines represent mean sizes of *P. ochraceus* at each site. Red lines represent the cumulative mean.

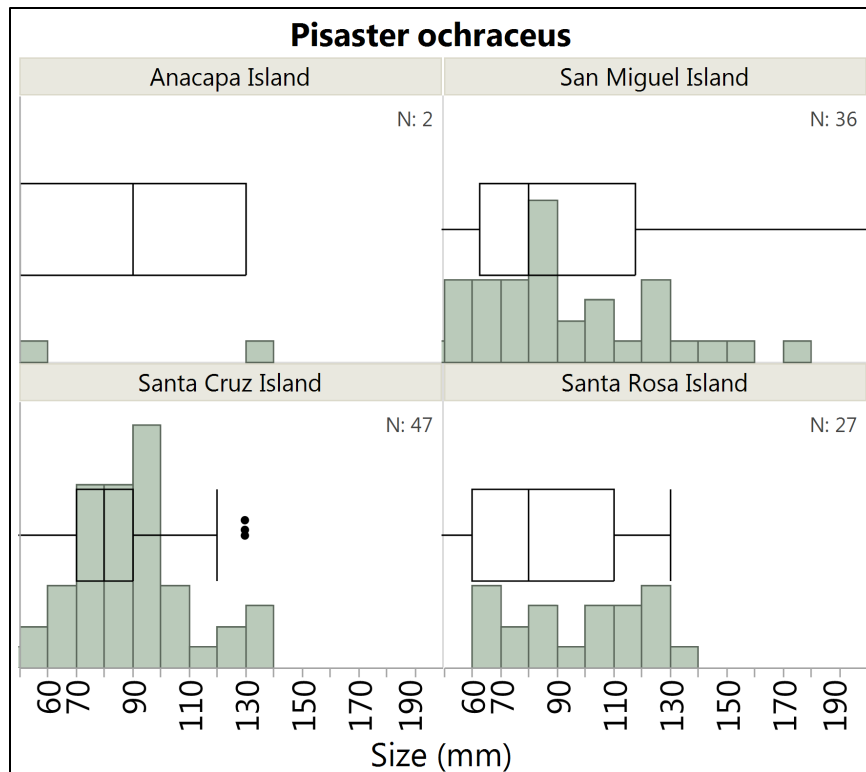


Figure 42. *Pisaster ochraceus* size distributions at each island measured in 2016–17. Box-and-whisker plots indicate the spread and degree of skewness of the size frequency data. The ends of the boxes represent the 25th and 75th quartiles, the vertical line inside the box indicates the median value, the whiskers extend from the ends of the box to the outermost data point that falls within 1.5 of the lower and upper quartiles and dots indicate outlier values.

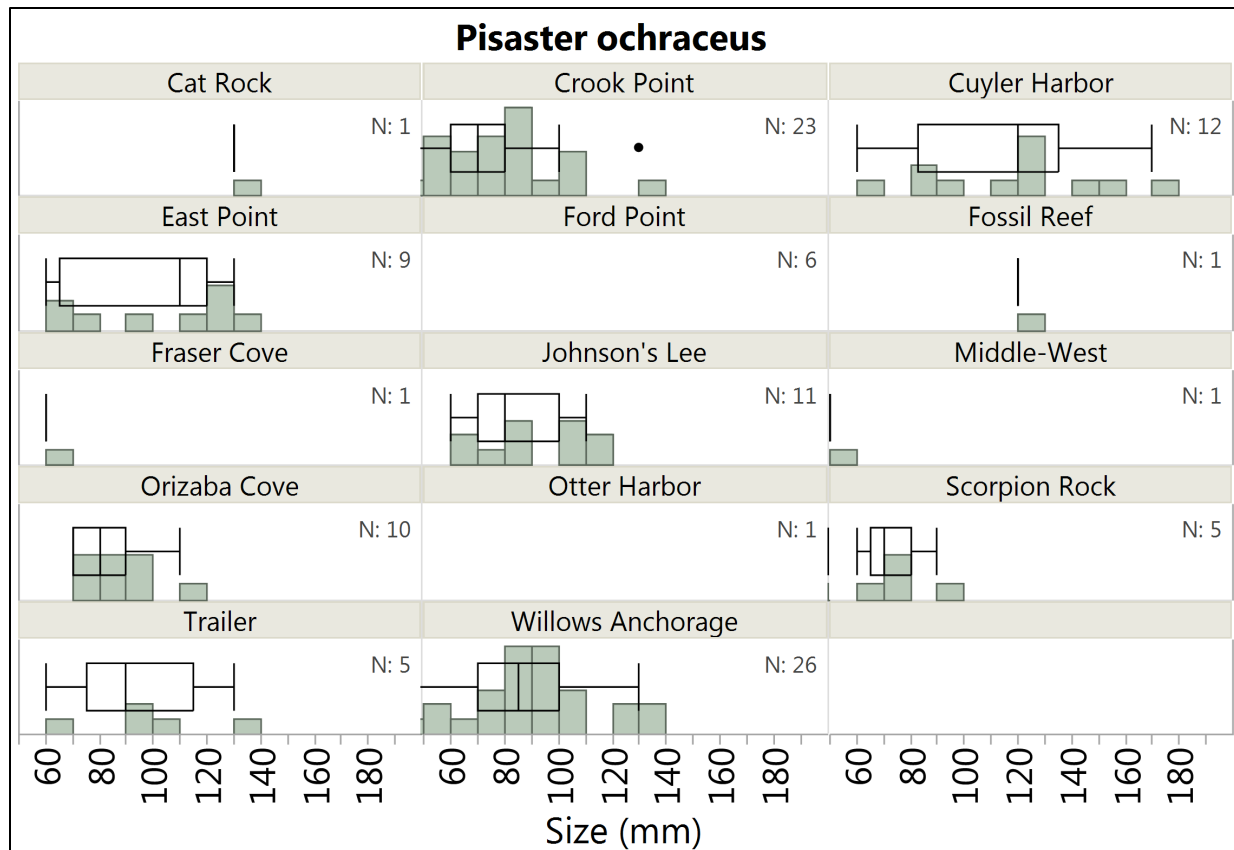


Figure 43. *Pisaster ochraceus* size distributions at each site measured in 2016–17. Box-and-whisker plots indicate the spread and degree of skewness of the size frequency data. The ends of the boxes represent the 25th and 75th quartiles, the vertical line inside the box indicates the median value, the whiskers extend from the ends of the box to the outermost data point that falls within 1.5 of the lower and upper quartiles and dots indicate outlier values. Note that some sites are not displayed because they had zero *P. ochraceus* in 2016–17.

Mytilus californianus

Mytilus californianus shell length and bed depth measurements were obtained at each site annually since 2014 (Figures 44–46). At the island level, in 2016–17, the range and median sizes of mussels remained comparable relative to 2014 measurements at all islands (note that Santa Barbara Island data are not available for earlier years). Median bed depth measurements in 2016–17 also remained comparable to earlier years at all islands.

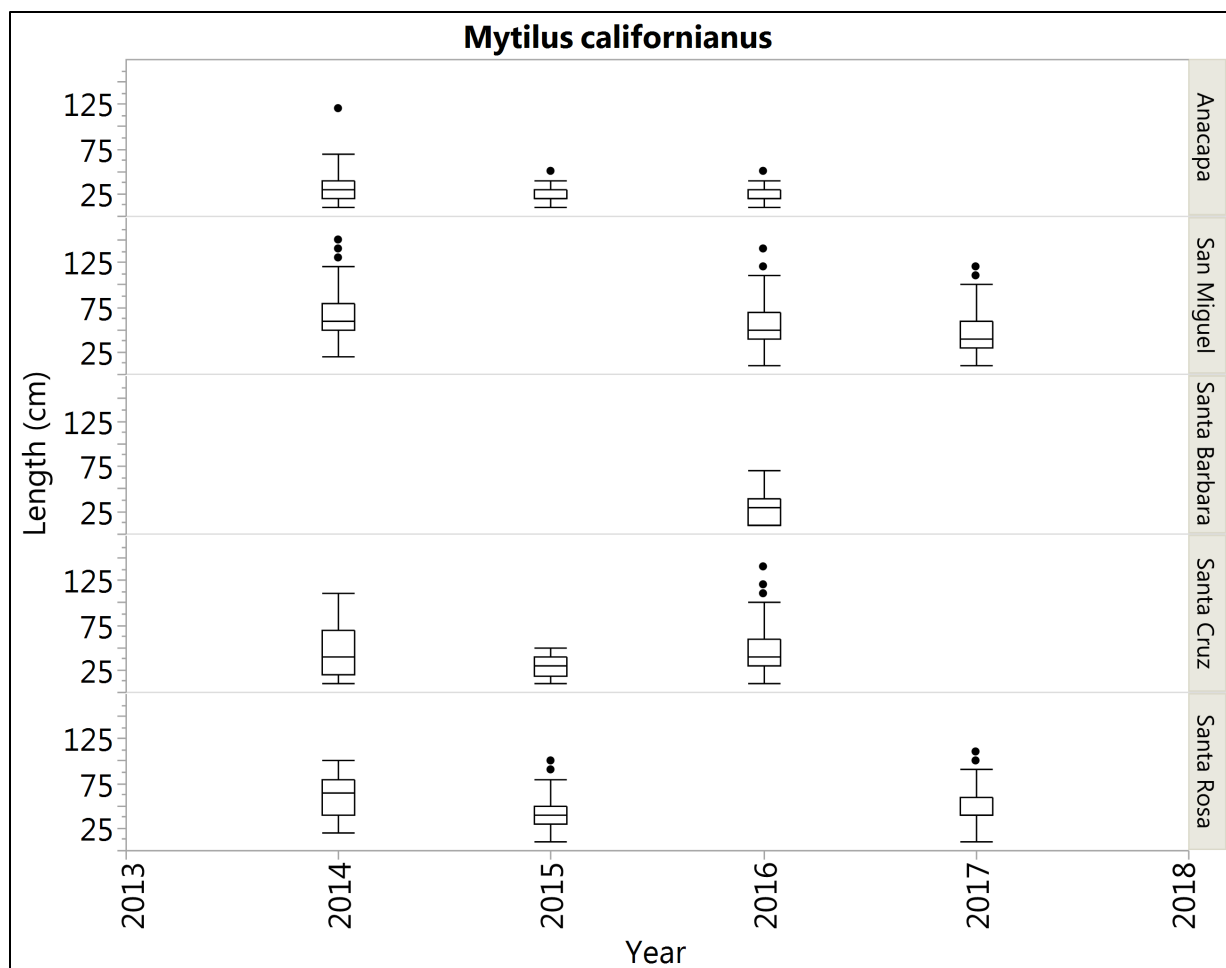


Figure 44. Shell measurements for *Mytilus californianus* summarized across plots and sites for each island.

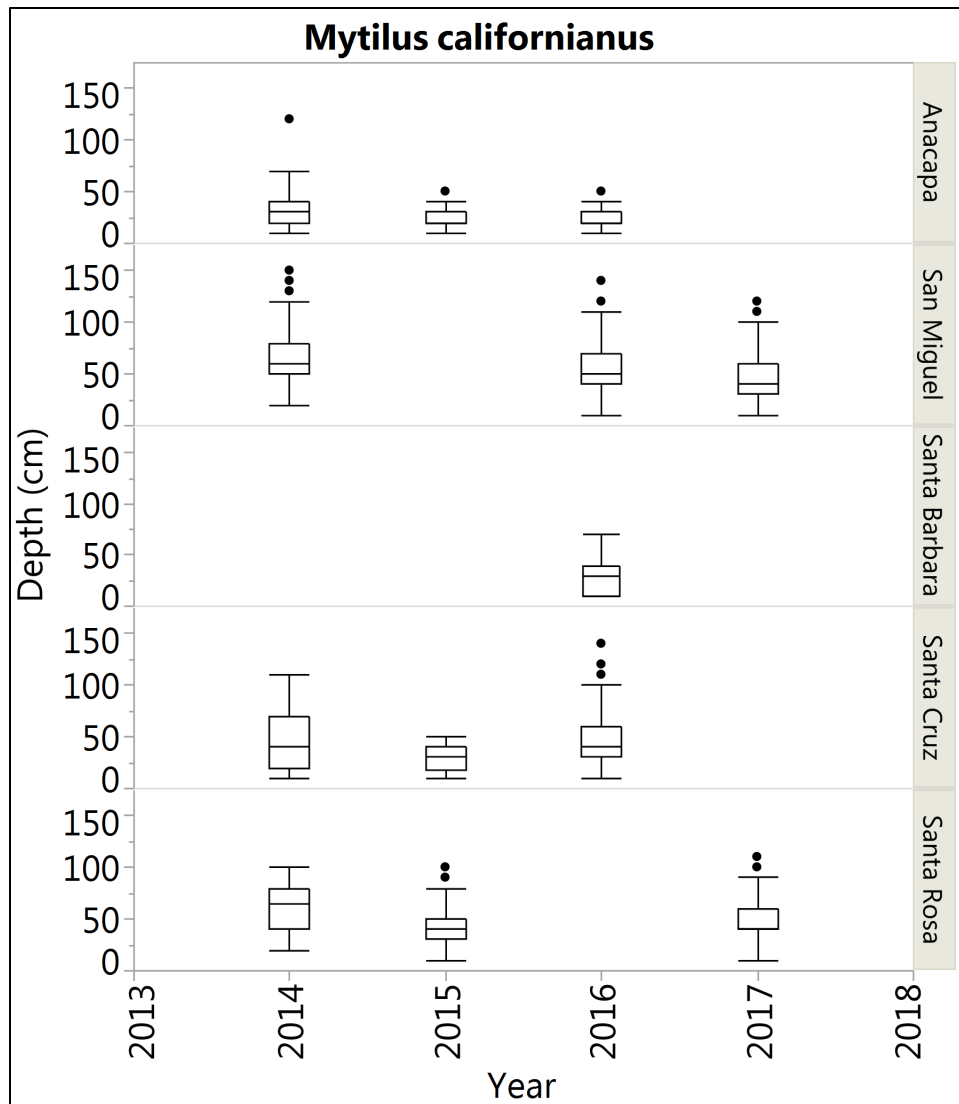


Figure 45. Bed depth measurements for *Mytilus californianus* summarized across plots and sites for each island.

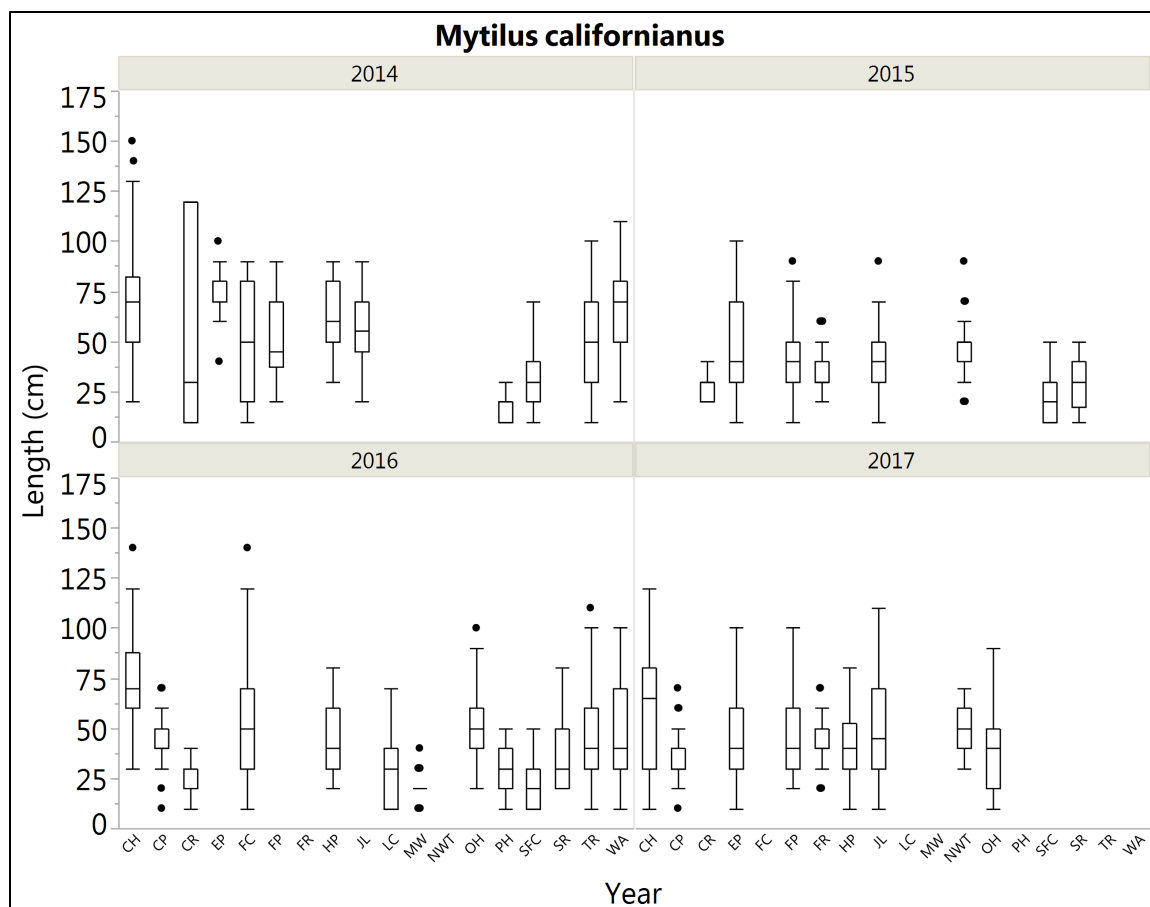


Figure 46. Shell measurements for *Mytilus californianus* summarized across plots for each site.

***Phyllospadix* spp.**

Phyllospadix spp., surfgrass cover has been monitored at two sites (Fraser Cove and Trailer) on Santa Cruz Island since spring 1995, and at two sites (East Point and Northwest-Talcott) on Santa Rosa Island since spring 2002 (Figures 47–50). The four sites were chosen for study based on the relatively high abundance of surfgrass habitat present when the sites were established. *Phyllospadix torreyi* has been the dominant species in most transects but some *P. scouleri* has also been present. In 2016–17, large waves prevented monitoring from occurring at East Point. Additionally, Transect 3 at Northwest-Talcott was not properly located and therefore not sampled.

Strong seasonal patterns have been observed over the years at the two Santa Cruz Island sites, whereby surfgrass overstory cover has routinely declined in spring and increased in fall. In 2016–17, the sites were only sampled in fall precluding any ability to study seasonal differences. Surfgrass cover measured above the long-term mean at all three sites sampled this year (Figure 48).

Santa Rosa sites, East Point and Northwest-Talcott, typically have not displayed a strong seasonal pattern in *Phyllospadix* spp. abundances. Instead, surfgrass on all three transects at East Point and cover on two transects at Northwest-Talcott has remained relatively stable over time. Transect-3 surfgrass at the latter site has fluctuated markedly over the monitoring period declining rapidly

several times by as much as 40% followed by gradual increases in cover. In 2016–17, surfgrass overstory cover at East Point was not assessed due to poor sampling conditions. However, based on qualitative estimates, cover of surfgrass was near 100% on all three transects which is typical of past year abundances at this site. The three transects at East Point are located in an area that receives moderate, consistent wave disturbance from multiple directions and is submerged even during negative tides. Combined, these factors may provide optimal conditions for population subsistence for *Phyllospadix*, but they make it challenging to safely and accurately sample the transects. At Northwest-Talcott, *Phyllospadix* cover was only monitored on two transects. However, cover of surfgrass was approximately 100% on the two transects that were sampled.

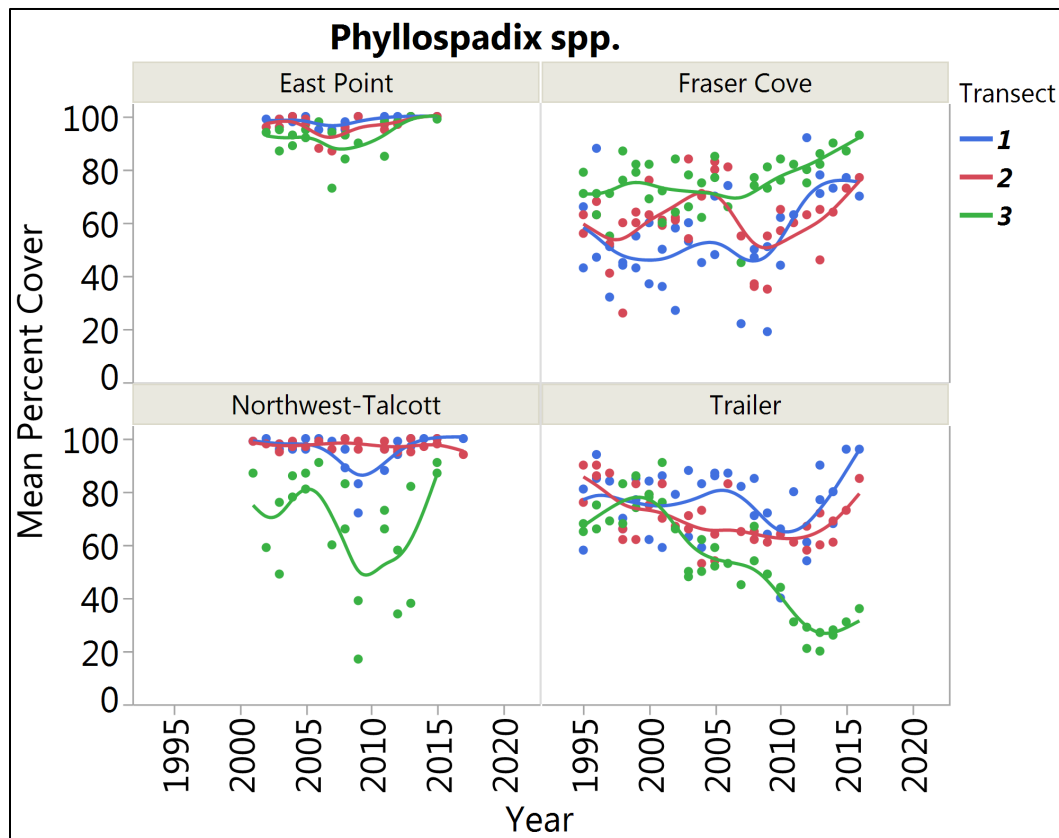


Figure 47. Mean percent cover of *Phyllospadix* spp. at each site. Note that *Phyllospadix* was not monitored at East Point or Transect #3 at Northwest-Talcott in 2016–17.

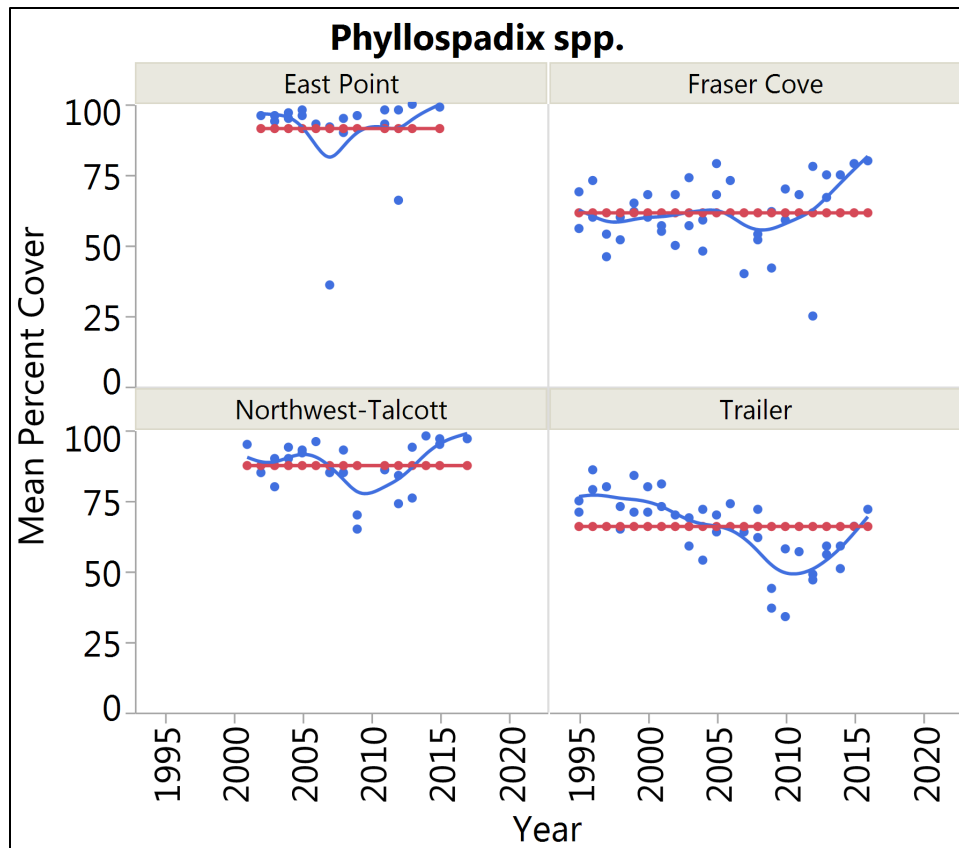


Figure 48. Mean percent cover of *Phyllospadix* spp. pooled across transects at each site. Blue lines represent the mean percent cover of *Phyllospadix* spp. and red dashed lines indicate the long-term mean percent cover of *Phyllospadix* spp. at each site.

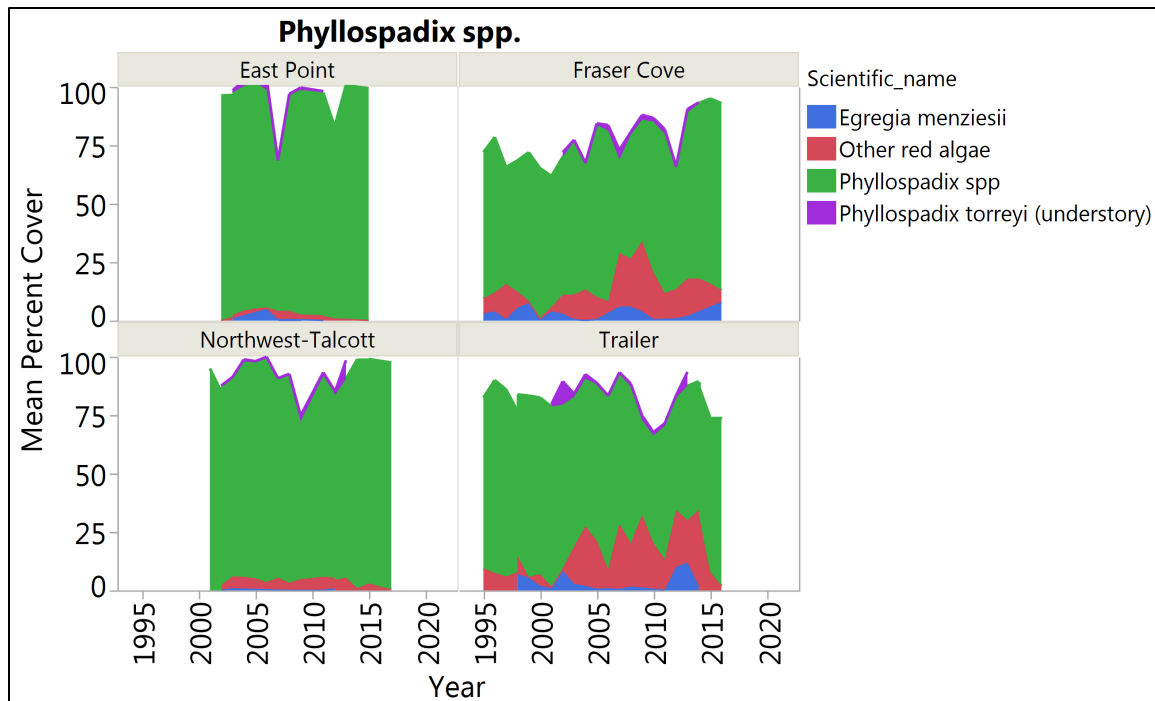


Figure 49. *Phyllospadix* spp. cover at all sites in spring. Colored areas represent the seasonal mean percent cover for *Phyllospadix* spp. and other dominant taxa from 10m point-intercept transects.

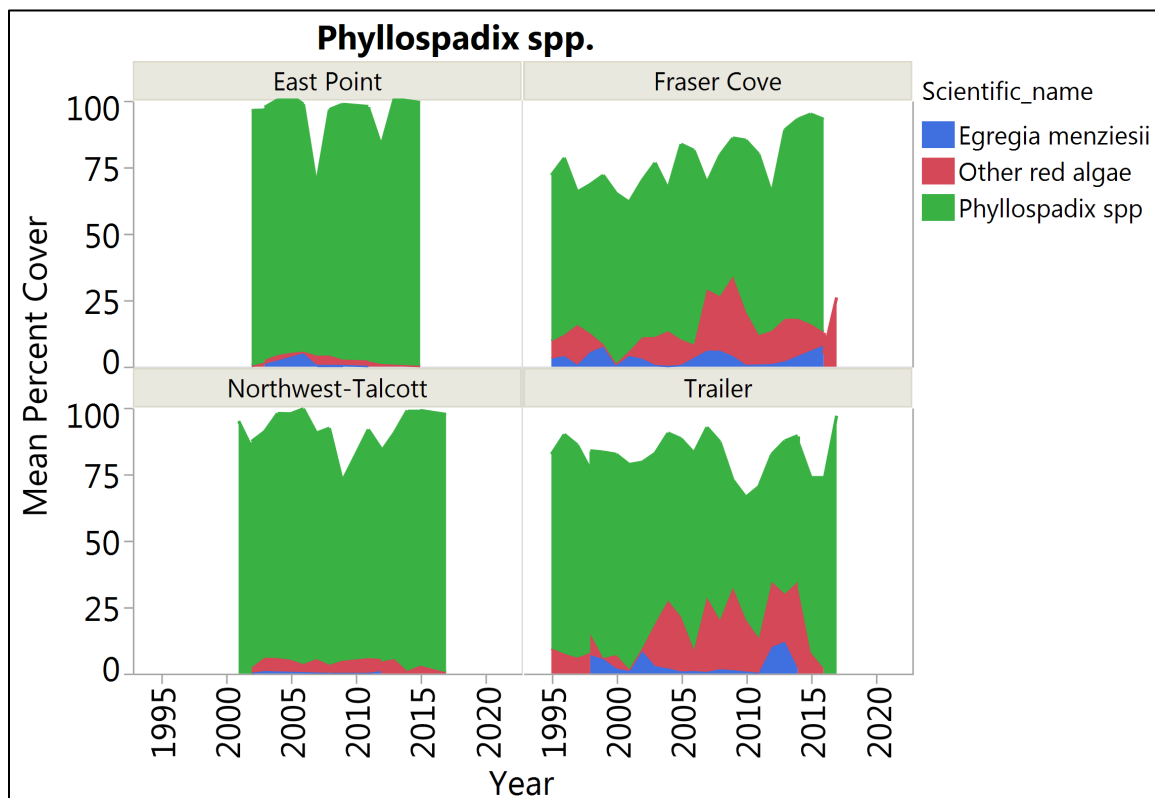


Figure 50. *Phyllospadix* spp. cover at all sites in fall. Colored areas represent the seasonal mean percent cover for *Phyllospadix* spp. and other dominant taxa from 10m point-intercept transects.

Red algae, composed primarily of *Chondracanthus canaliculatus*, *Prionitis lanceolata*, and *Mazzaella affinis*, were present in low abundance on the three transects at both Fraser Cove and Trailer in 2016–17 (Figures 49–50). At the two Santa Rosa Island sites, red algae have historically been much less abundant, particularly at East Point.

The overall condition of surfgrass at the two sites on Santa Cruz appeared to be healthy with only low to medium cover of epiphytic algae (e.g. *Smithora naiadum* and *Melobesia mediocris*) and minimal bleaching observed. At Northwest-Talcott on Santa Rosa, epiphytic green algal cover (*Ulva* sp.) was relatively high, and bleached blades were moderately abundant throughout the two transects that were sampled.

Shorebirds and Pinnipeds

The maximum number of shorebirds and pinnipeds observed at any one time during a visit to the sites in 2016–17 is summarized in Table 2 and Figures 51–52. Overall, the abundances and diversity of shorebirds in 2016–17 at all sites appeared similar to observations made in recent years. Likewise, there were no marked changes to the abundances of pinnipeds observed in 2016–17.

Table 2. Shorebirds and pinnipeds most commonly encountered at monitoring sites in 2016–17 (maximum seen at any one time). Note some sites are not presented since zero birds or mammals were observed at the locations.

Site Name	Black Oyster-catcher	Black Turn-stone	California Sea Lion	Cormorant	Harbor Seal	Northern Elephant Seal	Western Gull
Cat Rock	11	–	–	–	3	–	–
Crook Point	6	3	–	26	–	2	–
Cuyler Harbor	–	–	–	–	–	1	–
East Point	4	–	–	14	–	–	–
Ford Point	2	2	–	–	–	–	–
Fossil Reef	3	–	–	70	–	–	–
Fraser Cove	6	–	–	–	–	–	1
Harris Point	2	–	40	–	5	1	–
Johnson's Lee	2	3	1	–	5	30	–
Landing Cove	2	–	15	–	–	–	–
Middle-West	–	–	–	–	1	–	–
Northwest-Talcott	4	–	–	–	–	–	–
Otter Harbor	3	–	–	–	48	5	–
Prisoner's Harbor	3	–	–	–	–	2	–
Sea Lion Rookery	2	1	30	–	–	–	–

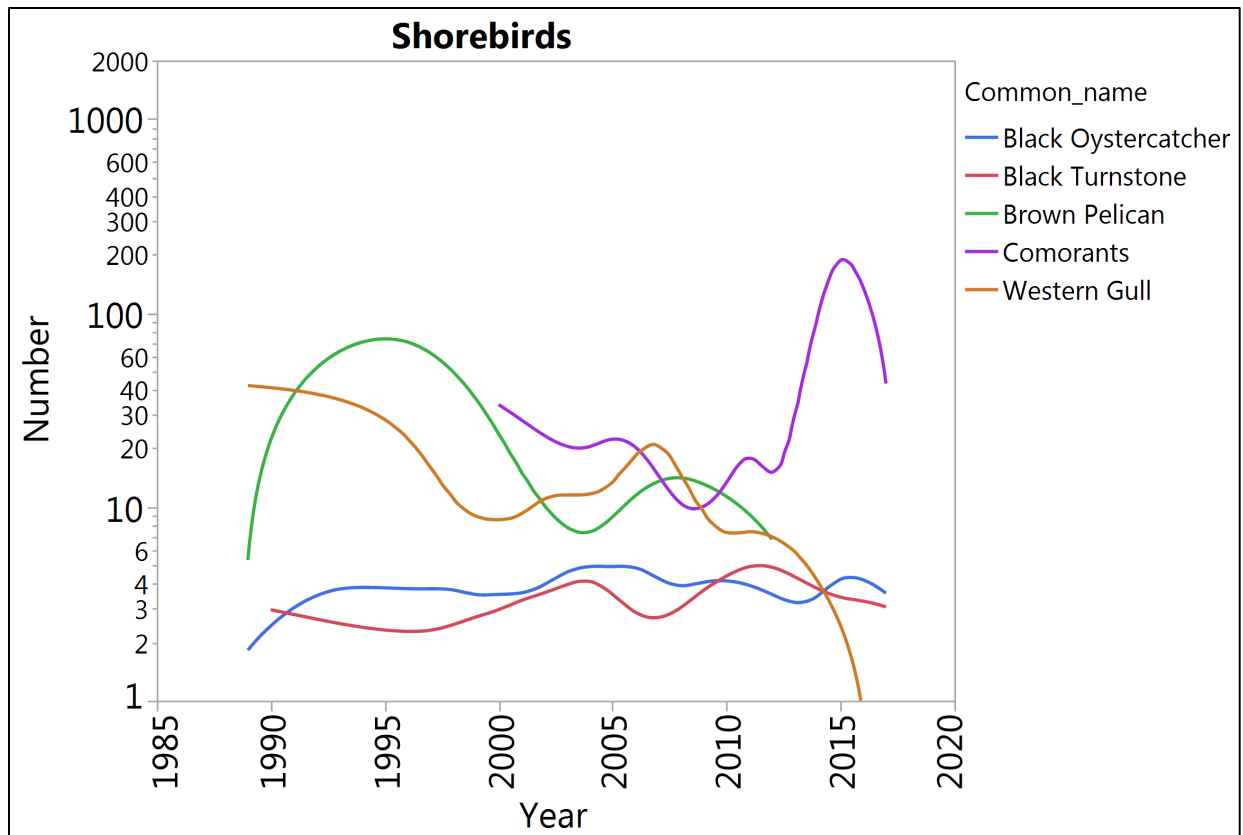


Figure 51. Mean number of shorebirds pooled across sites at each island. Note that data are displayed on a logarithmic scale.

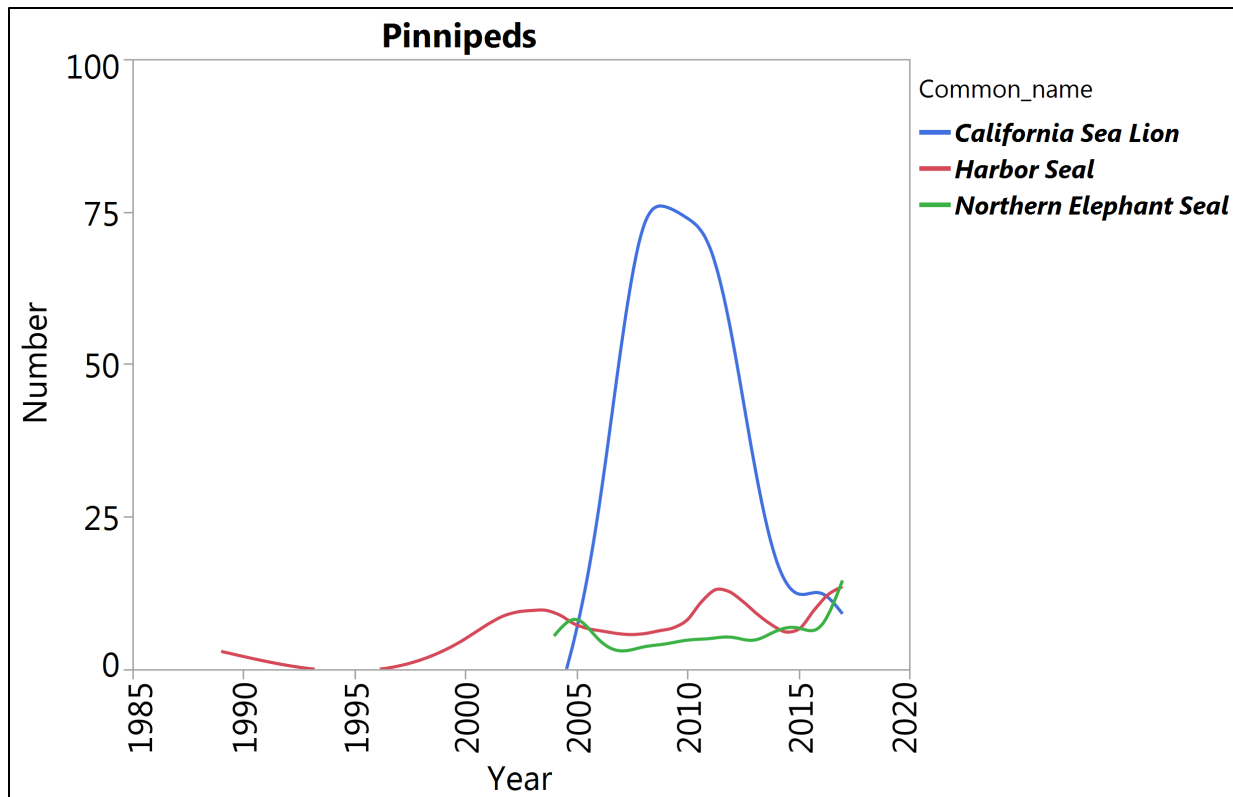


Figure 52. Mean number of pinnipeds pooled across sites at each island.

Black oystercatchers were again the most ubiquitous shorebirds at the rocky intertidal sites. With the exception of two sites (Anacapa Middle West and Cuyler Harbor), at least one black oystercatcher was present at each site. A moderate-sized flock of black oystercatchers was observed at Cat Rock (N=11) and smaller flocks were seen at numerous other sites.

American oystercatchers have gradually become more common at the islands in recent years. However, in 2016–17, American oystercatchers were not sighted at any sites.

Black turnstones were not common in 2016–17 compared with previous years. One to three black turnstones were seen at four sites (Crook Point, Ford Point, Johnson’s Lee and Sea Lion Rookery).

Less common shorebirds such as wandering tattlers and willets are occasionally seen on the reefs while black-bellied plovers and snowy plovers usually inhabit adjacent beaches. Seabirds such as cormorants, gulls, pelicans and occasionally pigeon guillemots, are sometimes observed resting on the reef or hunting in the nearshore zone.

Abundances of gulls often vary widely spatially and temporally. Less than 10 gulls (primarily western gulls) are typically seen at most sites. When large groups of gulls are observed they are normally just resting on the reef, whereas smaller groups and individuals are sometimes witnessed feeding. In 2016–17, gulls were less common than usual since they were only present at

approximately half the sites. At the locations gulls were seen, abundances ranged 1–5 individuals per site.

Cormorant numbers also tend to fluctuate in space and time. When present, they are typically not abundant. However, it is not uncommon to encounter several dozen cormorants at some sites such as East Point and Crook Point (common roosting locations) in fall. This year, 14 cormorants were seen at East Point. At Crook Point, 26 cormorants were observed roosting on the reef. Seventy cormorants were seen at Fossil Reef. Cormorants were not observed at any of the remaining sites.

While not generally considered shorebirds, black phoebes and song sparrows are commonly seen catching flies on the shore while common ravens are primarily scavenging for dead animals washed ashore. Ravens and gulls have both been observed foraging in the mussel beds and other intertidal areas for invertebrates.

Harbor seals, *Phoca vitulina*, were observed at or within the immediate vicinity of five sites (Anacapa Middle West, Cat Rock, Harris Point, Johnson's Lee and Otter Harbor); abundances ranged 1–48. Otter Harbor had the greatest number of seals. Abundances in 2016–17 were comparable to counts obtained in past years.

Northern elephant seals, *Mirounga angustirostris*, usually prefer sandy beaches over rocky shelves to haul out. They are common sights on beaches near Cuyler Harbor, Crook Point, and Fossil Reef in spring where they are typically observed weaned pups that have not yet gone to sea or adults coming ashore to molt. In 2016–17, elephant seals were seen at or nearby Crook Point, Cuyler Harbor, Harris Point, Johnson's Lee, Otter Harbor and Prisoner's Harbor; abundances ranged 1–30 individuals per site. The greatest number of elephant seals was seen at Johnson's Lee. Abundances in 2016–17 were slightly elevated relative to counts obtained in past years.

California sealions, *Zalophus californianus*, were common (approximately 30) at the aptly named, Sea Lion Rookery on Santa Barbara Island as well as the other site (Landing Cove) sampled on the island whereby 15 individuals, mostly juveniles, were observed. Forty sea lions were observed at Harris Point. One sea lion was also seen nearby Johnson's Lee. Relative to past years, abundances this year were low at Santa Barbara Island, mostly due to Sea Lion Rookery, but they were considered average at other locations. The low abundances observed at Santa Barbara may be attributed to temporal differences in sampling. Typically, the two sites are sampled early in the fall season (i.e., October). However, due to weather and logistical constraints, sampling during the 2016–17 season did not occur until late November 2016. The numbers of California sea lions at Santa Barbara Island may typically be lower in November relative to October. It is also possible that the sea lions were simply not on the site at the time we arrived, and instead were out feeding or swimming offshore.

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Appendix A. Program Notes

From an ecological perspective, last year (2015) was a consequential year. One of the strongest El Niño events on record began in April 2015 and lasted through the winter into spring 2016. Additionally, the warm water “Blob” which was first detected in late 2013 persisted and spread throughout 2014 and 2015. The effects of these warm water events rippled through the marine food web. Unusual Mortality Events were declared for California sea lions and Guadalupe fur seals in 2015. Thousands of Cassin’s auklets starved in Oregon. Kelp forests were decimated in northern California resulting in the starvation of urchins and abalone among other herbivorous species. Numerous unusual observations were reported for the northern Channel Islands region including: high densities of pelagic red crabs (*Pleuroncodes planipes*) and *Velella velella* washing up on the beaches nearly all year, basking sharks observed in the Santa Barbara Channel, a tropical fish (*Luvaris imperialis*) was caught at Rincon Point, a live paper nautilus (*Argonauta nodosa*) was seen by the CHIS kelp forest monitoring crew along with several warm-water finfish species and a green sea turtle was seen in Ventura Harbor.

An oil spill occurred on May 19, 2015 immediately north of Refugio State Beach in Santa Barbara County as a result of a corroded underground pipeline that leaked oil down to the ocean. An estimated 142,800 U.S. gallons (3,400 barrels) of crude oil spread along seven miles of shoreline. CHIS marine biologists assisted MARINE scientists by conducting post-spill biological assessments for affected rocky shorelines.

This year (2016–17 field season), fortunately was not quite as exciting although there were several significant storms resulting in damaging surf events and above average amounts of precipitation. Excellent working conditions were experienced at approximately half the sites. Strong northwest swell impacted our ability to thoroughly search nearly half the sites for black abalone and sea stars (see trip reports in Appendix B for details). Surfgrass cover was not assessed at East Point due to moderately-low tides combined with relatively-large sized swell.

Time was not secured on the CINMS NOAA Vessel Shearwater this year to assist with accessing several of the monitoring sites that cannot be accessed via foot. Instead, we used kayaks to access the logistically-challenging sites which are primarily located on Anacapa Island. We were fortunate to experience phenomenal weather conditions which facilitated safe passage to and from each of the sites. Besides the Santa Barbara sites which were accessed with the Sea Ranger II (an NPS vessel), two other locations (Scorpion Rock and Orizaba Cove) require a vessel to access. For Scorpion Rock, we used Islands Packers to get to Santa Cruz Island and then we used kayaks to get to the site. The Sea Ranger II was also used to access Orizaba Rock.

The annual MARINE workshop was held in San Diego, CA at Cabrillo National Monument this year. Stephen Whitaker was the only marine ecologist at CHIS that participated in the workshop since it was not local. Sessions and discussions centered on climate change and ocean acidification, sea star wasting disease, protocol modifications and database management.

One of the benefits of a long-term monitoring program at a network of sites is the capability to recognize and document the colonization and spread of non-native species. The invasive red alga, *Caulacanthus ustulatus*, has been observed at Anacapa Middle East and West sites since 2005. It was first documented in southern California in 1999 and has since exceeded the cover of several native red algal species at mainland sites south of Santa Monica Bay. It was still prevalent throughout Anacapa Middle West and perhaps more abundant relative to past years. In fall 2013, *C. ustulatus* was observed growing at Northwest-Talcott, Santa Rosa Island. Some patches of the alga measured approx. 14 cm across. This was the first time that *Caulacanthus* was observed at any other site beside the two at Middle Anacapa. Last year, *C. ustulatus* appeared to have spread to other locations throughout Northwest-Talcott along with areas east of the site whereby it occupied patches several square meters in area. *Caulacanthus* was also observed for the first time in 2015 at Fossil Reef. The invasive alga was seen within and nearby plot 610 encompassing an area approx. 1–2 sq ft. Unfortunately, the invasive alga is likely here to stay at Northwest-Talcott and Anacapa since removal experiments have proven unsuccessful (Smith et al. 2014).

Another invasive species, the brown alga, *Sargassum horneri*, was observed at Anacapa Middle West in fall 2013 for the first time. It was first observed in southern California in Long Beach Harbor in October 2003. Since then, it has appeared in numerous subtidal locations along the mainland as far south as Baja, CA and around the following islands: San Clemente, Catalina, Santa Barbara, Anacapa, and Santa Cruz. *S. horneri* was documented in the intertidal zone at one of the MARINE monitoring sites at Shaw's Cove in Laguna Beach in fall 2009 (J. Smith personal communication, n.d.). In fall 2015, the invasive species was first observed at San Nicolas Island. This species is not expected to impact the intertidal zone to the same extent it does in the subtidal, but it may occur anywhere from 0 ft MLLW to about 20 m depth and form dense thickets that could shade out other species. Its palatability is unknown at this time but it does not appear to be a preferred food item. In 2016–17, *S. horneri* appeared to have declined in abundance at Anacapa Middle West, but it occupied a significant portion of Sea Lion Rookery.

We received two data requests in 2015. Both requests were for sea star data. One was from Melissa Miner and colleagues to use in a publication on SSWD. The other request was from Alyssa Syverud, an undergraduate student at CSUCI working on an ArcGIS project.

Beachwalk surveys (shorebirds, pinnipeds and carcass counts) were conducted in conjunction with the rocky intertidal monitoring on San Miguel and Santa Rosa Islands making use of the personnel and island time. Western snowy plover surveys on Santa Rosa Island were conducted during spring and winter months overlapping with rocky intertidal monitoring. Sand beach monitoring was conducted during the summer and those data will be reported separately.

Appendix B. Trip Reports

The following are trip reports from the Rocky Intertidal Monitoring 2016–17 field season (October 2016 through April 2017). Reports were prepared by Stephen Whitaker. The reports summarize the work done during each monitoring event, provide a quick summary of the data collected and serve as metadata for the information collected.

Santa Cruz Island, October 29–30, 2016

Prepared by Stephen Whitaker

Purpose:

To monitor the rocky intertidal site Scorpion Rock at Santa Cruz Island.

Personnel:

- Stephen Whitaker, Marine Ecologist, Channel Islands National Park
- Kenan Chan, UCSC Technician, CHIS VIP

Procedure and General Observations:

Island Packers transportation was utilized to access the island. Standard procedures were used for monitoring the rocky intertidal site. Plots and site overviews were photographed with an Olympus Stylus 1030SW digital camera. Photoplots were scored in the field at Site A on 10/29; the five *Hesperophycus* plots at Site B were scored in the field on 10/30. Black abalone were counted and measured during timed site-wide searches at Site A and Site B; sea stars were counted and measured at Site A only. There are no *Lottia gigantea* plots at Scorpion Rock. Motile invertebrates are no longer sampled in photoplots at all sites. The maximum number of shorebirds and pinnipeds observed at each site was recorded. Hobotemp Tidbit temperature loggers are not present at Scorpion Rock. Mussel sizes and mussel bed depth were measured at Site A. Island Packers provided transportation off the island at the end of 10/31.

10/29/2016. Scorpion Rock (Site A).

Low tide 0.27 ft at 1558 hrs. The conditions were excellent with partly cloudy sky, light (<5 kt) wind and minimal (approx. 1') swell. It rained lightly on 10/28. There were no shore birds at Site A upon arrival, but there were approx. 100 gulls in the water nearby. There were numerous (approx. 50) kayakers paddling in the area throughout the day. The site was monitored from 1115 to 1730.

Plots were photographed by Stephen and Kenan. Site panoramas were photographed by Kenan. The 20 photoplots at Site A were scored in the field by Stephen.

A 30-minute search was conducted for black abalone (*Haliotis cracherodii*) presence at Site A by Kenan. N=25 black abalone were observed site-wide at Site A (sizes ranged 14–129 mm, most individuals were located 11–50 cm apart from one another). For reference, last fall, N=35 black abalone were observed site-wide at Site A (sizes ranged 14–129 mm, most individuals were located 11–50 cm apart from one another). In fall 2014, N=41 black abalone were observed site-wide at Site A (sizes ranged 25–108 mm, most individuals were located 11–50 cm apart from one another). In fall 2013, N=17 black abalone were observed site-wide at Site A (sizes ranged 25–105 mm, most

individuals were located 11–50 cm apart from one another). While snorkeling around the site on 10/30, several fresh black abalone shells were located measuring 44, 47, 48, 49, 52 and 64 mm. Additionally, two fresh red abalone shells (51 and 64 mm) were seen during the snorkel survey.

A 30-minute search was conducted for ochre star (*Pisaster ochraceus*) presence at Site A by Kenan. N=5 ochre stars (sizes ranged 64–88 mm) were observed site-wide; all appeared to be healthy. For reference, last fall, N=0 ochre stars were observed site-wide. In fall 2014, N=4 ochre stars were observed site-wide (sizes ranged 30–105 mm); all appeared to be healthy. In spring 2014, zero *P. ochraceus* were seen, and spring 2013, N=162 ochre stars were observed site-wide (sizes ranged 70–150 mm, mode = 100 mm). This year, two *P. giganteus* were observed at the site. Note that on 10/30 Whitaker snorkeled along the shoreline from the site east to the small islet approx. 1 km away and observed approx. 200 *Pisaster ochraceus* and approx. 50 *P. giganteus*.

The field log was completed by Stephen.

No repairs were necessary, but plot 823 was noted as missing etch marks on the head of the upper-left bolt which identify the plot.

The barnacle (*Chthamalus* spp./ *Balanus* spp.) had 35% mean barnacle cover. For reference, last year 33.4% mean barnacle cover was measured. The majority of point contacts in the five plots were bare rock. *Endocladia* plots had 23.2% mean *Endocladia* cover. The majority of point contacts in the five plots were bare rock (mean= 42.6%). For reference, last fall, *Endocladia* plots had had 9.4% mean *Endocladia* cover. Mussel (*Mytilus californianus*) plots had 58.8% mean mussel cover (14% mean cover for *Mytilus* measured last fall). The majority of cover in the five plots was occupied by *Mytilus* and *Tetraclita* (mean=22.8%). The *Tetraclita* plots had 34.4% mean *Tetraclita* cover (41.6% mean *Tetraclita* cover measured last fall). The majority of cover in the five plots was occupied by *Tetraclita*. See below under heading 10/30 for notes on the five *Hesperophycus* plots located on Site B.

Mussels were measured in the five *Mytilus* plots by Stephen. Sizes of mussels ranged 20–80 mm and mussel bed depths ranged 1–5 cm; all plots except plot 1 were monolayers. Last year, mussels measured 10–50 mm and mussel bed depths ranged 1–5 cm; all plots were monolayers.

The site appeared to be in good shape with no obvious disturbances. *Chthamalus/Balanus* and particularly *Tetraclita* were abundant at Site A. Recruitment for all three species was not obvious throughout the site. *Endocladia* appeared to be healthy and fairly abundant. *Mytilus* was more abundant this year relative to recent past years and recruitment of the species was moderate to high. *Anthopleura elegantissima* and *A. sola* were extremely common throughout the reef particularly within the tidepool located at the northern tip of the reef. *Megathura* (N=7) was less common compared with most previous visits. *S. purpuratus* were observed in low to moderate numbers. While snorkeling on 10/30, several *Sargassum horneri* plants were observed in the subtidal near the base of the site. *Mastocarpus* appeared to be slightly more abundant this year relative to recent past visits.

10/30/2016. Scorpion Rock (Site B). Low tide 0.19 ft at 1621 hrs. The conditions were good with cloudy sky, light (5–10 kt) wind and minimal (approx. 1–2') swell. It rained lightly several times

throughout the day including while we were monitoring. There were 2 black oystercatchers and one gull at the site (the small reef at north side of the site) upon arrival. The site was monitored from 1515 to 1745.

The five *Hesperophycus* plots were photographed by Stephen and Kenan. Site panoramas were photographed by Kenan. The photoplots were scored in the field by Stephen.

The *Hesperophycus* plots had 24.4% mean *Hesperophycus* cover. Most of the point contacts within the *Hesperophycus* zone were bare rock (mean= 41.6%). For reference, last fall, 19.4% mean *Hesperophycus* cover was measured in the representative plots, and during fall 2014, ~15% mean *Hesperophycus* cover was measured.

A 30-minute search was conducted for black abalone (*Haliotis cracherodii*) presence across the southern half (middle of site to the south including small raised reef that we typically land on when skiffing) of Site B by Kenan. N= 37 black abalone were observed. Kenan then spent an additional 35 minutes surveying black abalone presence in the area comprising the northern half (middle of the site to the northern end of the boulder field including the small finger reef connected to the Little Scorpion Island) of the site. N= 236 black abalone were observed. Sizes of individuals across the entire area ranged 44–139 mm and most individuals were either touching or within 1–10 cm of one another.

Santa Cruz Island, November 12–16, 2016

(Database event #2016/17-C)

Prepared by Stephen Whitaker

Purpose:

To monitor rocky intertidal sites at Santa Cruz Island.

Personnel:

- Stephen Whitaker, Marine Ecologist, Channel Islands National Park
- Emily Hardison, Technician, UCSC
- Hillary Krumbholz, Technician, UCSC

Procedure and General Observations:

Island Packers transportation was utilized to access the island. Standard procedures were used for monitoring rocky intertidal sites. Plots and site overviews were photographed with an Olympus Stylus 1030SW digital camera. Photoplots were scored in the field at all sampling sites. Sea stars and black abalone were counted during site-wide searches. Surfgrass transects were read at Trailer and Fraser Cove. *Lottia gigantea* were sampled this season at all sites where fixed plots have been established. The maximum number of shorebirds and pinnipeds observed at each site was recorded at all sites. The Hobotemp Tidbit temperature logger was not downloaded at Willows Anchorage. Mussel sizes and mussel bed depth were measured at all sites. Island Packers provided transportation off the island on 11/16.

11/12/2016. Prisoners Harbor.

Low tide -0.25 ft at 1351 hrs. The conditions were workable even though a large, long-period swell out of the N-NW direction was running in the channel. Occasional sets of waves impacted the site, but generally, the swell/surge was only moderate. Light wind (<5 kt) and overcast sky prevailed all day. No measurable precipitation was measured recently. There were three black oystercatchers on the site when we arrived and two elephant seals in the water immediately offshore towards the end of the day. The site was monitored from 1230 to 1645.

Plots were photographed by Hillary. Site panoramas were photographed by Hillary. All photoplots except *Hesperophycus* plot 840 and *Endocladia* plot 832 were scored in the field by Stephen; the others were scored by Hillary and Emily, respectfully. The field log was completed by Stephen.

A 30-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Hillary and Emily. N=1 black abalone was observed site-wide (103 mm – individual was out in the open and foot appeared to be shrunk but the abalone held tightly to the substratum when tested, periostracum was nearly entirely removed). For reference, in fall 2015, N=4 black abalone were observed site-wide, and N=16 individuals were located in fall 2014. However, only four individuals were located in spring 2013, so it is not unusual to find relatively low numbers of abalone here.

A 30-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by Hillary and Emily. Zero *P. ochraceus* were located throughout the entire site. For reference, last fall, zero sea stars were found and only one individual was seen in spring 2014; it appeared to have at least one lesion on its body. In spring 2013, N=31 ochre stars were observed site-wide (sizes ranged 90–140 mm, mode = 100 mm).

No repairs were necessary since nearly all plots have three bolts marking the locations of three corners. The plot(s) that do not have three bolts have two bolts plus epoxy that clearly indicate the location of the plots.

The barnacle (*Chthamalus* spp./ *Balanus* spp.) plots had 7.4% (8.4% mean barnacle cover measured last fall and 32.2% measured in fall 2014) mean barnacle cover. The majority of point contacts in the five plots were bare rock (mean=35%) and *Septifer* (mean=29.6%), although the barnacle plots were quite diverse with many taxa occupying space. *Endocladia* plots had 40% (17.6% measured last fall) mean *Endocladia* cover. The majority of point contacts in the five plots was bare rock (mean=28.4%), but *Chthamalus* spp./ *Balanus* spp. were relatively common (mean=17.6%). The *Silvetia* plots had 0.0% (0.0% measured last fall) mean *Silvetia* cover. Within the *Silvetia* zone, there was a relatively diverse mix of species occupying space including the following most abundant species: *Mazzaella*, *Mytilus*, *Septifer* and *Tetracrita*. The *Hesperophycus* plots had 5% (10.4% measured last fall) mean *Hesperophycus* cover. Most of the point contacts within the *Hesperophycus* zone were bare rock (mean=36.6%), but *Chthamalus* spp./ *Balanus* spp. (mean= 18.6%) and *Endocladia* (mean=30%) were quite common. Mussel (*Mytilus californianus*) plots only had 1.4% (3% measured last fall) mean cover. Mussel cover was only documented in *Mytilus* plots 1, 3 and 4. The majority of cover in the five plots was occupied by articulated corallines (mean= 14%) and *Chondracanthus canaliculatus* (mean= 49.6%).

Mussels were measured in the five original *Mytilus* plots by Stephen. Sizes of mussels ranged 10–50 mm and mussel bed depths ranged 1–3 cm; all plots were monolayers. *Mytilus* plot 4 had zero mussels observed in the plot.

Silvetia appeared to be increasing in abundance near the south end of the reef (entry point) whereby it was occupying an area approx. 5m x 1.5m. Both *Silvetia* and *Hesperophycus* were reproductive and recruitment was low and medium for the two species, respectively. *Mytilus californianus* abundance was low overall and very little recruitment was observed for the species. Very few *M. galloprovincialis* were observed contrary to recent visits. Conversely, *Septifer* abundance appeared to have reached a record-high as relatively large patches were seen, particularly around the barnacle plots. Ephemeral algal species such as *Scytosiphon*, *Endarachne* and *Ulva* were not nearly as common compared to recent visits to the site.

11/13/2016. Willows Anchorage.

Low tide –0.81 ft at 1436 hrs. The conditions were good for sampling. There was a large and powerful swell originating out of the NW, but this south-facing site was sufficiently protected and very little wrap-around swell was experienced. The wind (10–15 kt) and swell (2–3') were light to moderate. The only shorebird seen at the site throughout the day was a wandering tattler west of the *Lottia* plots. A pigeon with leg bands also landed on the site towards the end of the day. No pinnipeds were seen around the site throughout the day. The site was monitored from 1215 to 1730.

Plots were photographed by Hillary. Site panoramas were photographed by Hillary. All of the photoplots were scored in the field by Stephen. The field log was completed by Stephen. The temperature logger was not downloaded or replaced.

A 30-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Hillary and Emily. N=72 black abalone were observed in the area of the site between the first *Hesperophycus* plot and the *Endocladia* plots (sizes ranged 20–130 mm, most individuals were either touching or located 1–10 cm apart from one another). For reference, last January, a search lasting approx. 90 minutes was conducted for black abalone, and N=109 black abalone were observed in the area of the site between the first *Hesperophycus* plot and the *Endocladia* plots (sizes ranged 15–135 mm, most individuals were observed to be touching one another). In fall 2014, N=444 black abalone were observed in the area of the site between the first *Hesperophycus* plot and the *Endocladia* plots (sizes ranged 20–140 mm, most individuals were observed to be touching one another), and N=35 empty, clean shells were located and measured. Three live abalone and one dead individual appeared slightly withered; the dead one which was seen on the beach adjacent to the site was collected and placed in the annex freezer (sample will be sent to Jim Moore). There was obviously a marked decline in the number of black abalone observed this visit relative to last fall. Relative abundances of black abalone during the past 4–5 years have been relatively high (comparable to fall 2014). The reason for the marked decrease in abalone abundance this year is not yet clear.

A 30-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by Hillary and Emily. N=26 *P. ochraceus* were seen across the entire site from H1 to L5 (sizes ranged 40–130 mm,

mode=80–90 mm). All individuals appeared healthy with no lesions observed. For reference, last January, N=23 *P. ochraceus* were seen. In fall 2014 as well as fall 2013, zero sea stars were located.

No repairs were necessary aside from the removal of mussels around some of the bolts marking the locations of *Mytilus* plots, but *Lottia* plot 5 was not located. This plot has been problematic in the past. The bolt was located last January. It may be necessary to install another bolt to make the plot more visible in the future.

The fixed owl limpet plots were sampled by Stephen. Plots 1–5 had N= 97, 63, 91, 39 and 11 *Lottia gigantea*, respectively. Throughout the five plots, sizes ranged 9–57 mm. For reference, last fall, plots 1–5 had N= 65, 72, 98, 44 and 13 *Lottia gigantea*, respectively. Throughout the five plots, sizes ranged <15–58 mm.

Endocladia plots had 42.4% (15.6% measured last January) mean *Endocladia* cover. The majority of cover in the five plots was occupied by *Endocladia*. The *Silvetia* plots only had 12.6% (8.6% measured last January) mean *Silvetia* cover (only plot 949 had *Silvetia* present [63%]). Most point contacts within the *Silvetia* zone were bare rock (mean= 31.8%) and crustose corallines (mean=14.6%). The *Hesperophycus* plots had 0% (0% measured last January) mean *Hesperophycus* cover. Most point contacts within the *Hesperophycus* zone were bare rock (mean=60%). Mussel (*Mytilus californianus*) plots had 82.6% (72.6% measured last January) mean cover. The majority of cover in the five plots was occupied by *Mytilus*.

Mussels were measured in the five original *Mytilus* plots by Emily and Hillary. Sizes of mussels ranged 10–80 mm and mussel bed depths ranged 4–11 cm; all plots were primarily composed of monolayers.

Small mussels carpeted most of the lower intertidal. Black abalone count was down again relative to recent years, but no signs of withering were observed. Seastars are gradually increasing again since the SSWD event in 2014. The scarce amount of rockweed present appeared nonetheless to be healthy but very few thalli were seen. *Endocladia* was common and robust. *Phragmatopoma* still remains dominant in the area of the reef near the beach but appears to be less abundant relative to recent years. Numerous (20–30) *Aplysia* were seen.

11/14/2016. Fraser Cove.

Low tide –1.16 ft at 1522 hrs. The conditions were good despite the moderate-sized (4–5') swell mostly due to the extreme low tide that resulted in infrequent runup of waves during larger sets. The surfgrass transects were easily surveyed and mostly dry. The sky was clear and the breeze was moderate (15–20kt) as white caps were abundant offshore. Black oystercatchers (N=6) and one western gull were seen at the site throughout the day. Two harbor seals were seen in the water at Forney along with approx. 100 gulls and one wandering tattler. The site was monitored from 1220 to 1745. All plots at Fraser and Forney were scored during the same day. There were approx. 8 squid fishing vessels offshore of the Trailer monitoring site all night long (11/14).

Plots were photographed by Hillary. Site panoramas were photographed by Hillary. All 35 photoplots were scored in the field by Stephen.

A 30-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Emily. N=4 black abalone (sizes ranged 67–106mm) were observed site-wide from plot 891 to plot 905. All were 1–10 cm apart from one another. For reference, last fall, N=7 black abalone (sizes ranged 66–139mm) were observed site-wide from plot 891 to plot 905.

A 30-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by Emily. Only one *P. ochraceus* (60 mm) was observed site-wide from plot 891 to plot 905. The individual appeared to be healthy. For reference, last fall, N=2 ochre stars were observed site-wide.

Surfgrass transects were sampled by Stephen. Transects 1–3 had *Phyllospadix* cover = 70, 77 and 93%, respectively. Most of the surfgrass appeared to be in good shape overall with very minimal bleaching and a moderate level fouling from *Melobesia*. For reference, last fall, transects 1–3 had *Phyllospadix* cover = 79, 77 and 87%, respectively.

The fixed owl limpet plots were sampled by Stephen. Plots 1–5 had N= 20, 8, 12, 21 and 6 *Lottia gigantea*, respectively. Throughout the five plots, sizes ranged 12–65 mm. For reference, last fall, plots 1–5 had N= 13, 6, 11, 14 and 10 *Lottia gigantea*, respectively. Throughout the five plots, sizes ranged <15–65 mm.

No repairs were made to plots but it appears that the rock broke loose around the upper-left corner of plot 890 (Hes5) and the bolt is missing. Otherwise, all bolts were cleaned and appear to be in good shape.

The barnacle (*Chthamalus* spp./ *Balanus* spp.) plots had 14% (31.8% measured last fall) mean barnacle cover. The majority of point contacts in the five plots were bare rock. *Endocladia* plots had 58.6% (35.2% measured last fall) mean *Endocladia* cover. The majority of point contacts in the five plots were *Endocladia* followed by bare rock (25%). The *Silvetia* plots had 21.4% (19.4% measured last fall) mean *Silvetia* cover. Most of the point contacts within the *Silvetia* zone were bare rock, however, the *Silvetia* plots were relatively diverse. The *Hesperophycus* plots had 6.8% (7.2% measured last fall) mean *Hesperophycus* cover. Most of the point contacts within the *Hesperophycus* zone were bare rock. Mussel (*Mytilus californianus*) plots had 64% (56.6% measured last fall) mean mussel cover. The majority of cover in the five plots was occupied by *Mytilus californianus*. Pollicipes plots had 15.2% (11.8% measured last fall) mean *Pollicipes* cover. The majority of cover in the five plots was occupied by *Mytilus californianus* (mean= 49.6%). Tar plots had 52.4% (51.2% measured last fall) mean tar cover. Overall, in comparison to data collected for the all the photoplots at this site during the past two years, all target taxa except *Hesperophycus*, *Chthamalus* spp./ *Balanus* spp. and *Endocladia* appear to have remained relatively unchanged. In the case of *Hesperophycus* and *Chthamalus* spp./ *Balanus* spp., abundances have declined whereas *Endocladia* increased markedly.

Mussels were measured in the five *Mytilus* plots by Hillary and Emily. Sizes of mussels ranged 10–100 mm and mussel bed depths ranged 2–11 cm; all plots were essentially monolayers.

The site appeared mostly intact with no obvious signs of disturbance. All focal spp. in photoplots appeared common and robust, particularly *Endocladia* which was noticeably more abundant than I

recall seeing before. The alga was not only abundant forming dense carpets but it was extremely thick and lush. *Mytilus* too was abundant and moderate levels of recruitment were observed. Rockweed species abundances appeared comparable to that of recent years with low-moderate levels of recruitment observed for *Silvetia*. *Porphyra* was common.

11/15/2016. Trailer.

Low tide –1.25 ft at 1730 hrs. The conditions were good given the exceptionally-low tide. However, if not for the low tide, it would have been a very wet day due to the constant influx of waves originating from the northwest from local windswell. All transects, plots and searches were sampled and conducted with high confidence. Swell/surge was moderate (4–5'), and wind was light-moderate (10–15 kt). There were no shorebirds or pinnipeds at the site all day. The site was monitored from 1315 to 1730.

Plots were photographed by Hillary. Site panoramas were photographed by Hillary. All photoplots were scored in the field by Stephen. The field log was completed by Stephen.

A 30-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Hillary and Emily. N=140 black abalone (sizes ranged 20–149 mm, most individuals were located 1–10 cm apart from one another) were observed site-wide from the surge channel at the east end just passed surfgrass transect-3 to the *Lottia* plots at the west end. For reference, last fall, N=144 black abalone were observed site-wide (sizes ranged 19–147 mm, most individuals were located 1–10 cm apart from one another). In fall 2015, N=61 black abalone were observed (sizes ranged 27–141 mm, most individuals were located 1–10 cm apart from one another).

A 30-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by Hillary and Emily. N=5 *P. ochraceus* (presumably healthy) (sizes ranged 60–130 mm) were seen at the site. For reference, last fall, N=4 *P. ochraceus* (appeared healthy) (sizes ranged 50–70 mm) were seen. In fall 2015, only one *P. ochraceus* (appeared healthy) was seen.

Surfgrass transects were sampled by Stephen. Transects 1–3 had *Phyllospadix* cover = 96, 85 and 36%, respectively. *Phyllospadix* was lightly fouled by *Melobeisa* and *Smithora*, and a low percentage of the beds appeared bleached and/or abraded. For reference, last fall, transects 1–3 had *Phyllospadix* cover = 95, 73 and 31%, respectively. In fall 2015, transects 1–3 had *Phyllospadix* cover = 95, 69 and 28%, respectively.

The fixed owl limpet plots were sampled by Stephen. Plots 1–5 had N= 31, 33, 29, 22 and 16 *Lottia gigantea*, respectively. Throughout the five plots, sizes ranged 5–92 mm. For reference, last fall, plots 1–5 had N= 18, 20, 6, 9 and 1 *Lottia gigantea*, respectively.

No repairs were necessary as all plots now have three bolts marking locations of corners.

The barnacle (*Chthamalus* spp./ *Balanus* spp.) had 33.8% (49.6% measured last fall) mean barnacle cover. The majority of point contacts in the five plots were bare rock. The *Silvetia* plots had 52.2% (33.2% measured last fall) mean *Silvetia* cover. Most of the cover within the *Silvetia* zone was dominated by *Silvetia*. The *Hesperophycus* plots had 5.3% (6.3% measured last fall) mean

Hesperophycus cover. Most of the point contacts within the *Hesperophycus* zone were bare rock. Mussel (*Mytilus californianus*) plots had 63% (55.2% measured last fall) mean cover. The majority of cover in the five plots was dominated by *Mytilus* though *Phragmatopoma* (mean= 15.6%) was also particularly dominant.

Mussels were measured in the five original *Mytilus* plots by Hillary and Emily. Sizes of mussels ranged 10–90 mm and mussel bed depths ranged 2–15 cm; all plots appeared to be comprised largely of a monolayer of mussels.

Similar to nearby Fraser Cove, this site appears to be nearly fully intact with all focal species present in relatively high abundance, all of which appeared to be robust and healthy. Both rockweed species appear to be functioning spectacularly-well with moderate percentages of recruits observed for both species. *Mytilus* is also doing quite well again as it gradually takes back territory occupied by *Phragmatopoma*. Black abalone were common and size distribution was wide-ranging. However, only five *P. ochraceus* were observed throughout the site. *Phyllospadix* appeared lush and abundant. No obvious signs of disturbance were observed anywhere throughout the site.

Santa Barbara Island, November 29–30, 2016

(Database event #2016-17-D)

Prepared by Stephen Whitaker

Personnel:

- Stephen Whitaker, Marine Ecologist, Channel Islands National Park
- Emily Hardison, Technician, UCSC
- Hillary Krumbholz, Technician, UCSC
- Kenan Chan, VIP

Procedure and General Observations:

Standard procedures were used for monitoring rocky intertidal sites. All plots (except for the red turf algal plots at Landing Cove) and site overviews were photographed with an Olympus 1030 digital camera. All photoplots were scored in the field. Counts were not made of motile invertebrates inside the photoplots. Searches were conducted to count seastars and black abalone at both sites. The maximum number of shorebirds and pinnipeds observed at each site was recorded. We came out to the island on the Sea Ranger II in combination with a specially-scheduled Kelp Forest Monitoring trip to swap wave sensors (similar to the last trip here in January 2015).

29 November 2016. Landing Cove.

Low tide –0.24 ft at 1528 hrs. Note that we were unable to sample the Santa Barbara sites last fall. A combination of poor conditions (high swell), boat or captain availability and the damaged/closed pier have made it challenging to sample the sites at Santa Barbara Island. Unfortunately, the conditions during this trip were bordering on poor for sampling due to the relatively large swell (for SBI). The swell/surge was high due to a combination of west ground swell wrapping around the island and wind swell from the east blowing across the channel; it is always difficult to estimate swell at SBI

since the waves come inshore from deep water and roll in as surge rather than break as a standing wave. SBI is unique in the sense that it receives swell from all angles, and its small size results in swell wrapping around the entire island regardless of originating direction. Wind was <5 kt.

There were 2 black oystercatchers and 2 western gulls on the reef south of the pier. Within the cove, approx. 15 sea lions (mostly juveniles) were observed. We were onsite from 1345–1730 hrs.

Hillary and Emily worked together to photograph the plots on the south side of the site. It was challenging just photographing the plots due to the constant and frequent sets of waves impacting the entire site nearly up to the cliff.

Stephen managed to score all the plots south of the pier despite the poor conditions. North of the pier, only the *Silvetia* plots were photographed and scored. The red algal turf plots were not exposed long enough to facilitate sampling them. Regardless, the red algal turf assemblage is only sampled at Landing Cove, and the decision was recently made during our second program review to stop monitoring the plots since they are considered “orphan plots” and are not replicated at other sites.

Hillary and Kenan searched for sea stars throughout the reef located south of the pier. Zero *Pisaster ochraceus* were seen throughout the site. The poor conditions hampered our ability to thoroughly search the entire site resulting in moderate confidence in our population estimate. For reference, in January 2015, N=3 *Pisaster ochraceus* were seen throughout the site. Sizes were estimated to be 100–120mm. The visit prior, in October 2013, Dan Richards counted N=182 sea stars throughout the reef located south of the pier.

A thirty-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Kenan and Hillary. Zero black abalone were seen. For reference, in January 2015, one black abalone (126mm) was observed hanging onto the edge of the reef near plot 315. Surprisingly, no other abalone were seen at the site. During the past several years, we usually saw 1–2 individuals in the crevice near the sea star transect, but we have not encountered them the last couple years. The poor conditions may have hampered our ability somewhat to thoroughly search the entire site.

Most of the photo plots were located with relative ease with the exception of 326. Numerous plots were missing corner markers: LL bolts were added to 328 and 329, 3 bolts added to 19, UL and LR bolts added to 310–312 and 314, UL and UR added to 313. Note that 326 should be orientated so that bolts are in UL and LR. The only plots that still require bolts are 310–314 which all need at least one bolt and 326 which needs a bolt in the UR corner.

After completely monitoring the south side of the site, the entire crew crossed the chasm to the 10 remaining plots on the north side of the cove. Stephen scored the five *Silvetia* plots while Hillary and Emily photographed the plots then assisted Kenan with the task of installing bolts. The red algal turf plots were not scored or photographed.

Barnacle plots were again nearly depleted of *Balanus/Chthamalus* cover (mean= 1.6%) (0% measured in January 2015) and appear to be transitioning to a community more representative of the mid to lower intertidal zone. In the barnacle plots, *Tetraclita* cover ranged 5–30% (mean=20.4%),

Mytilus mean cover was 18% and non-coralline crust averaged 6.4% among other less abundant taxa. *Silvetia* plots were devoid of *Silvetia* except for plots 310 and 311 (cover = 1–2%) (only 6% measured in plot 314 in January 2015, all other plots = 0%). The *Silvetia* plots were instead dominated by *Mazzaella* (mean=14.4%), *Chondracanthus* (mean=12.8%) and non-coralline crust (mean=7%). Mussel cover in *Mytilus* plots ranged 60–97% and averaged 78.2% (58.2% measured in January 2015). Red turf plots were not sampled this year and likely will not be sampled in the future since they have been dropped from the sampling program.

Mussels were measured in the five *Mytilus* plots by Emily and Hillary. Sizes of mussels ranged 10–70 mm and mussel bed depths ranged 2–7 cm; all plots were monolayers.

Mytilus cover was markedly higher than seen during recent past years. Nearly all mussels were small (e.g. 10–40 mm); recruitment for the species appeared to be minimal. *Endocladia* was present in relatively low abundance but appeared to be robust overall. *Egregia*, *Eisenia* and *Halidrys* appeared to be less abundant in the vicinity of the *Pisaster* transect. *Chthamalus* and *Balanus* were fairly rare throughout the site. *Strongylocentrotus purpuratus* was quite common and appeared to be healthy with no individuals exhibiting symptoms of disease such as lesions. No black abalone or sea stars were seen anywhere throughout the site. *Silvetia* occurred in low abundance on the west reef (it is nonexistent on the east reef) as there were only 44 thalli counted all of which were very small but mostly reproductive. Several of the *Silvetia* thalli appeared to be new recruits.

30 November 2016. Sea Lion Rookery.

Low tide –0.25 at 1601 hrs. We experienced decent conditions despite the frequent wetting of the site as a result of long-period sets of waves. Still, we were able to complete all monitoring with a high degree of confidence in our ability to accurately estimate species presence and abundance. Wind was light (<5kt). We attempted to skiff into the site, but the waves were too large to safely access the site. We decided to get dropped off at the pier and hike to the site instead.

Upon arrival, approximately 300 or more sea lions (mostly mothers and pups with two large males present) were seen in the vicinity of the monitoring site. In addition, there was 1 black turnstone, 1 gull and 2 black oystercatchers at the site. We were on site from 1245–1630 hrs.

Hillary and Emily photographed the plots. Most of the plots were located with relative ease since a significant amount of time was dedicated to installing at least one bolt into nearly all plots last year. However, it again took an exorbitant amount of time to identify the correct orientation for several of the *Mytilus* plots since many were missing bolts or had extra bolts that were likely installed during periods of high mussel cover. Unlike past years whereby the *Mytilus* plots had nearly 100% mussel cover, this year (similar to January 2015), the *Mytilus* plots were nearly devoid of mussels likely due to a wave disturbance event. Site panoramas were photographed by Hillary.

Stephen scored all plots in the field. As in past years, many of the plots appeared to be heavily disturbed as a result of trampling from the sea lions and were composed largely of turf algae (*Gelidium*, *Chondracanthus*, *Mazzaella*, *Ulva*). Other than *Mytilus*, there were no distinct biotic zones throughout the site. As usual the site was dominated by *Ulva*.

Stephen and Hillary searched for *Pisaster ochraceus* and abalone for 30 minutes throughout the site but found zero individuals for both taxa. For reference, in January 2015, there were no abalone or sea stars (besides one *P. giganteus*) seen at the site either. In fall 2013, N=144 *P. ochraceus* and zero abalone were observed. In fall 2012, N=143 *P. ochraceus* were counted and N=0 black abalone were seen.

The field log was completed by Stephen. Numerous bolts were installed by Kenan, Hillary and Emily. Photolog has all the details on which bolts were added. All plots should now have three bolts including all the *Mytilus* plots, but it still would be a good idea to bring the plot maintenance gear along during the next visit in case there is a need to install additional bolts.

Barnacle plots only averaged 7.6% (5.8% measured in January 2015) *Balanus/Chthamalus* cover. The majority of point contacts in the five plots were bare rock and *Ulva* (mean=27.2%). *Endocladia* plots had 16.2% (17% measured in January 2015) mean *Endocladia* cover along with 15.6% *Ulva* and 23% *Mazzaella* among other less common taxa. Rockweed plots averaged 35.4% (27% measured in January 2015) *Silvetia* and 11.8% *Mazzaella* along with scarce amounts of several other taxa. Mussel (*Mytilus californianus*) plots had 0% (39.4% measured in January 2015) mean cover. The majority of cover in the five plots was occupied by articulated corallines (mean=38%) and *Halidrys* (mean=41.6%).

Zebra surf perch were seen in the tidepool next to the barnacle and *Endocladia* plots. *Sargassum horneri* now extends from the *Mytilus* plots inshore to the *Endocladia* plots and occupies much of the reef (approx. 25 sq m). *Silvetia* was not very abundant, but appeared to be in decent condition and a moderate level of recruitment was observed (receptacles were present on most of the thalli). High cover of ephemeral algal species (mostly *Ulva* and filamentous red algae) were seen throughout the site presumably due to increased nutrient load from sea lion fecal matter. The mid to upper intertidal zone was scoured from sea lions as well. *Mytilus* was largely absent from the site and zero mussels were seen in the *Mytilus* plots.

Santa Cruz Island, December 1, 2016

(Database event #2016-17 D)

Prepared by Stephen Whitaker

Purpose:

To monitor rocky intertidal sites at Santa Cruz Island.

Personnel:

- Stephen Whitaker, Marine Ecologist, Channel Islands National Park
- Emily Hardison, Technician, UCSC
- Hillary Krumbholz, Technician, UCSC
- Kenan Chan, VIP

Procedure and General Observations:

The Sea Ranger II was utilized to access the island as a collaborative trip with the kelp forest monitoring program. Prior to monitoring Orizaba Cove, we sampled both Santa Barbara Island sites on the same trip. Standard procedures were used for monitoring the rocky intertidal site. Plots and site overviews were photographed with an Olympus Stylus 1030SW digital camera. Photoplots were scored in the field (with the exception of one *Mytilus* plot which was scored subsequently in the office). Sea stars and black abalone were counted during site-wide searches. The maximum number of shorebirds and pinnipeds observed at each site was recorded at all sites. There is no Hobotemp Tidbit temperature logger at this site. Mussel sizes and mussel bed depth were measured.

12/1/2016. Orizaba Cove.

Low tide -0.18 ft at 1637 hrs. The conditions were not optimal for sampling due to the powerful ground swell out of the northwest. The large swell compromised our ability to adequately search the site for black abalone and sea stars but we have high confidence that the fixed plots were sampled adequately. The wind was light. One wandering tattler and no other shorebirds were seen at the site throughout the day. No pinnipeds were observed. The site was monitored from 1330 to 1645.

Plots were photographed by Hillary and Emily. Site panoramas were photographed by Hillary and Emily. All of the photoplots (except *Mytilus* 862) were scored in the field by Stephen. The field log was completed by Stephen.

A site-wide search lasting approximately 30 minutes was conducted for black abalone (*Haliotis cracherodii*) presence by Hillary, Kenan and Emily. N=30 black abalone were observed in the area of the site from plot Hes 1 to Myt 5 (sizes ranged 21–124 mm, most individuals were observed to be 1–5m apart from one another). For reference, the last time this site was monitored in fall 2014, 130 individuals were found and measured throughout the entire site (sizes ranged 12–124 mm, most individuals were observed to be 1–5m apart from one another).

A 30-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by Kenan. N=10 *P. ochraceus* were seen at the site; all appeared to be healthy (sizes ranged 70–110 mm). During the previous survey of this site (November 2014), N=3 *P. ochraceus* were seen at the site; all appeared to be healthy (sizes ranged 20–80 mm).

No plot repairs were necessary but *Mytilus* plots 2–5 had 1–3 bolts that were not located because they were overgrown with mussels. A metal detector should be used during the next visit to locate all bolts.

Mussels were measured in the five *Mytilus* plots by Hillary and Emily. Sizes of mussels ranged 20–80 mm and mussel bed depths ranged 3–9 cm; all plots were multilayers. The mussel beds were the thickest Whitaker has observed at this site for over five years.

The barnacle (*Chthamalus* spp./ *Balanus* spp.) plots had 34.8% mean barnacle cover (54.2% mean barnacle cover was measured in fall 2014); barnacle species were the most dominant taxa but the majority of point contacts were bare rock. The *Silvetia* plots only had 6.6% mean *Silvetia* cover (only two plots had *Silvetia* present) (8.4% mean *Silvetia* cover was measured in fall 2014). Most cover

within the *Silvetia* zone was occupied by non-coralline crust, *Tetraclita*, *Mytilus* and *Mazzaella*. The *Hesperophycus* plots had 23% mean *Hesperophycus* cover (18.4% mean *Hesperophycus* cover was measured in fall 2014); the plots were relatively diverse with measurable amounts of numerous other species including *Endocladia*, *Chthamalus* spp./ *Balanus* spp., *Mazzaella*, *Mastocarpus* and *Silvetia*. Mussel (*Mytilus californianus*) plots had 96.4% mean cover (67.4% mean *Mytilus* cover was measured in fall 2014). The majority of cover in the five plots was occupied by *Mytilus*. *Tetraclita* plots had 43.4% mean cover of the representative species which was also the most common species encountered (43.4% mean *Tetraclita* cover was measured in fall 2014).

Mytilus cover was very high on the outer reef and surge channels in the middle of the site. *Mytilus* recruitment was highest in the surge channel. *Tetraclita* was highly abundant along with other barnacle spp. (*Balanus* and *Chthamalus*). *Silvetia* and *Hesperophycus* were not particularly abundant but both spp. appeared to be healthy; recruitment was not observed for either spp. but time was limited for making ancillary observations. *Mazzaella affinis* had two morphologies (narrow and wide blade). The black abalone count resulted in markedly fewer abalone this year relative to the last visit to this site in November 2014 but conditions were not optimal for searching for black abalone.

Anacapa Island, December 11–13, 2016

Prepared by Stephen Whitaker

Purpose:

To monitor rocky intertidal sites at Anacapa Island.

Personnel:

- Stephen Whitaker, Marine Ecologist, Channel Islands National Park
- Emily Hardison, Technician, UCSC
- Hillary Krumbholz, Technician, UCSC
- Kenan Chan, VIP

Procedure and General Observations:

We were unable to utilize the R/V Shearwater to access the island this fall. Instead, we stayed on the island and used kayaks to get to our monitoring sites. Standard procedures were used for monitoring all three rocky intertidal sites. Photographs of plots were taken at all sites, and all plots were scored in the field at each site. Plots and site overviews were photographed with an Olympus Stylus 1030SW digital camera. Timed-searches for black abalone and sea stars were conducted. *Lottia gigantea* were sampled this season at all three sites. Motile invertebrates are no longer sampled at any sites. The maximum number of shorebirds and pinnipeds observed was recorded. The Hobotemp Tidbit temperature logger was replaced at South Frenchy's Cove and Middle West. In addition, a temperature logger was placed above the upper intertidal zone at Middle West and South Frenchy's Cove to obtain air temp data. Mussel sizes and mussel bed depths were measured at all three sites.

12/11/2016. Middle West.

Low tide -0.7 ft at 1327 hrs. The conditions were perfect for sampling. The sky was overcast, wind was light (<5 kt) and swell/surge was minimal (< 1'). No shorebirds and one harbor seal (in water)

were observed at the site. One wandering tattler was observed flying over the site. The site was monitored from 1015 to 1530.

Plots were photographed by Hillary and Emily. Site panoramas were photographed by Hillary. Photoplots were scored in the field by Stephen.

A 40-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Kenan. N=7 black abalone were observed site-wide. Most individuals were located 1–5 m apart. Sizes ranged 40–123 mm. Markedly fewer abalone were seen this year compared to last fall in which N=17 black abalone were observed site-wide, and even fewer than was observed in fall 2014 (N=34). Black abalone were not counted and measured at Harbor Seal Arch due to lack of time.

A 40-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by Kenan. N=1 ochre star (50 mm) was observed site-wide. The individual appeared to be healthy and free of lesions. Last fall, N=1 ochre star (90 mm) was observed site-wide.

The field log was completed by Stephen.

Lottia gigantea were measured within the fixed plots by Kenan, Emily and Hillary (and plots were then checked for accuracy by Stephen). Abundances in plots 1–3 were N=82, 11 and 29, respectively. Sizes ranged 9–68 mm. For reference, last fall, abundances in plots 1–3 were N=31, 7 and 11, respectively. Sizes ranged <15–60 mm.

No plot repairs were necessary during this visit. A temperature logger was placed above the upper intertidal zone inshore of *Lottia* plot 2 (9.2m) and 14m inshore from L3.

Mussels were measured in the five original *Mytilus* plots by Hillary and Emily. Sizes of mussels ranged 10–40 mm and mussel bed depths ranged 1–6 cm; all plots were monolayers. The mussel beds were noted as being fairly empty with the majority of mussels being very small and clustered in little patches. For reference, last fall, the mussel measurement protocol was attempted in the five *Mytilus* plots, but there were zero mussels in all plots.

The barnacle (*Chthamalus* spp./ *Balanus* spp.) had 14.2% mean barnacle cover. For reference, last fall, mean barnacle cover was 17%. The majority of point contacts in the five plots were bare rock, though the plots were relatively diverse for the barnacle zone. *Caulacanthus* comprised 7.8% of the plots and was seen in plots 448–451. Last fall, *Caulacanthus* comprised 3% and 5% of plots 448 and 450, respectively. *Endocladia* plots had 2.6% mean *Endocladia* cover (last fall, mean *Endocladia* cover = 1%). The majority of point contacts in the five plots were bare rock. However, the *Endocladia* plots were fairly diverse with moderate amounts of articulated corallines, *Mazzaella* and non-coralline crust. *Caulacanthus* was measured in all five plots this season and ranged 2–19%. Last fall, the invasive alga comprised 3% of plots 457 and 458 and 1% of plot 460. The rockweed plots had 0% mean *Silvetia* cover. In fact, similar to observations in recent years, no *Silvetia* was seen throughout the entire site. Rather, most of the space within the rockweed plots was bare rock. *Mazzaella*, *Chondracanthus*, articulated corallines, non-coralline crust and *Tetracilita* all occurred in moderate abundance within the *Silvetia* plots. *Caulacanthus* comprised 2% of plot 455. Last fall, the

invasive occupied 4% and 1% of plot 454 and 455, respectively. Mussel (*Mytilus californianus*) plots had 8.2% (0% measured last fall) mussels. The majority of cover in the five plots was occupied by *Mazzaella*, *Gelidium*, *Chondracanthus*, *Tetraclita* and articulated corallines.

The site condition overall appeared similar to that of previous visits. Two *Centrostephanus* were seen in the lower intertidal zone. Red crabs were observed offshore while kayaking and the gulls were feeding on them. *Mytilus* recruits from last year were still intact, but very few newly recruited individuals were seen. *Chthamalus/Balanus* were present throughout the upper intertidal in low abundances and very few recruits were observed for either species. *Tetraclita* was relatively abundant with a medium level of recruitment seen. No rockweeds were present. *Caulacanthus* appears to have become more widespread. *Sargassum horneri* is still present in several locations throughout the lower intertidal, but the invasive alga does not appear to be more abundant than observed at this site last year. We collected samples of *Chondracanthus canaliculatus* and *Endocladia* for Todd Braje and colleagues at the Smithsonian.

12/12/2016. Cat Rock.

Low tide -1.2 ft at 1413 hrs. The conditions were phenomenal for sampling since the swell/surge was negligible (approx. 1') and wind was light (5-10 kt). Sky was partly cloudy. As a result, we were able to conduct searches for black abalone and sea stars and score all plots with ease and high confidence. Eleven black oystercatchers (one appeared to possibly be an American/ black hybrid) and 3 gulls were observed at the site along with three adult harbor seals in the water upon arrival. The site was monitored from 1030 to 1500. We decided to paddle to the site by crossing to the backside of the island between East and Middle Anacapa. The trip took approx. two hours. The return trip took 1.5hr since we crossed back over to the frontside between West and Middle Anacapa.

Note that last season we reduced the number of plots at Cat Rock from 9/zone to 5/zone. Rationale for dropping plots was based on the results of a power analysis done by Dr. Pete Raimondi which indicated that minimal loss in power to detect change would occur if we reduced the number of photoplots to the number of plots monitored at all other sites. Each of the zones at Cat Rock consist of 3 plots that were trampled once, 3 that were scraped and three controls. In most cases, we will continue to monitor all the control plots for each zone. Two other plots were chosen randomly among the six remaining plots for each zone. From this point forward, the following plots will be photographed and monitored:

- CHT (1-5) = 32, 36, 39, 33, 35
- END (1-5) = 53, 19, 54, 14, 467=17
- SIL (1-5) = 4, 8, 10, 5, 6
- MYT (1-5) = 203, 473, 472, 468, 470

Plots and site panoramas were photographed by Hillary and Emily. All 20 photoplots were scored in the field by Stephen.

A 42-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Kenan. N=17 black abalone were observed site-wide (from *Lottia* plot #3 on the west end of the site to the

abalone plots at the east end). Most individuals were located 1–10 cm apart. Sizes ranged 42–155 mm. The abalone plots were not officially sampled due to lack of time, but it appeared unlikely that any abalone were residing within any of the plots. For reference, last fall N=41 black abalone were observed site-wide.

A 42-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by Kenan, Hillary and Emily. N=1 ochre star (130 mm) was observed site-wide (from *Lottia* plot #3 on the west end of the site to the abalone plots at the east end). Last fall, N=0 *P. ochraceus* was seen at this site.

The field log was completed by Stephen.

Lottia gigantea were measured within the fixed plots by Hillary and Emily. Abundances ranged N=16–48 in the three plots. Sizes ranged 11–61 mm. For reference, last fall, abundances ranged N=6–29 in the three plots. Sizes ranged 17–57 mm.

No plot repairs were necessary this visit.

Mussels were measured in the five *Mytilus* plots by Emily. Sizes of mussels ranged 10–40 mm and mussel bed depths ranged 2–4 cm; all plots were monolayers.

Note that the mean abundances for sessile target species reported below were calculated using the subset (N=5) of photoplots in each target assemblage/zone. The barnacle (*Chthamalus* spp./ *Balanus* spp.) plots had 39.6% mean barnacle cover which was close to the same (30.4%) as measured in fall 2015. The majority of point contacts in the five plots were bare rock. *Endocladia* plots had 19.2% mean *Endocladia* cover (in fall 2015, mean *Endocladia* cover = 7.4%). The majority of space in the five plots was bare rock, but the plots were fairly diverse with moderate levels of cover for *Tetraclita*, *Mytilus*, non-coralline crust and other less common taxa. The rockweed plots had 2.4% mean *Silvetia* cover and 14.8% *Hesperophycus* cover. Most of the space within the rockweed zone was bare rock. For reference, 1.2% mean *Silvetia* cover and 15.8% *Hesperophycus* cover was measured last fall. Mussel (*Mytilus californianus*) plots had 33.6% mean cover. The majority of cover in the five plots was occupied by *Mytilus*. For reference, last fall, mean mussel cover was 36.8%.

This site conceivably has the highest diversity of both algae and invertebrates than all the other CHIS sites. Light bleaching was observed for the articulated corallines and *Plocamium*. At least four *Aplysia californica* of varying sizes found on the site. Additionally, at least three *A. vaccaria* were found on the site, two of which were observed to be laying eggs. At least four *Megathura* found on the site. Both species of rockweeds appeared to be lush and relatively abundant compared to their condition during past visits; a low level of recruitment was observed for both rockweed species. *Chthamalus* was markedly more abundant than *Balanus*. *Mytilus* was common but nearly all mussels were small (10–40 mm) and newly-recruited individuals were not common. Black abalone abundance was markedly lower than what was measured last fall. Only one *P. ochraceus* was seen throughout the entire site.

12/13/2016. South Frenchy's Cove.

Low tide –1.53 ft at 1516 hrs. The conditions were perfect! There was practically no swell or wind the entire day, the sky was mostly clear and tide was extremely low. The entire site was easily accessible due to a combination of premium conditions and extremely-high sand cover (see pictures on U: drive). No shorebirds or pinnipeds were observed at the site at any time during the day. The site was monitored from 1100 to 1530.

Plots were photographed by Hillary. Site panoramas were photographed by Hillary. All the photoplots were scored in the field by Stephen.

A 45-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Hillary. N=0 black abalone were observed site-wide (from sand channel to sand channel on both sides of the site). Note that black abalone have not been seen at this site for numerous years.

A 45-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by Hillary. N=0 ochre stars were observed site-wide (from sand channel to sand channel on both sides of the site). Note that ochre sea stars have not been seen at this site for numerous years.

The field log was completed by Stephen.

Lottia gigantea were measured within the fixed plots by Hillary and Emily. Abundances ranged N=7–19 in the three plots. Sizes ranged 10–56 mm. For reference, last fall, abundances ranged N=2–17 in the three plots. Sizes ranged 18–51 mm.

Numerous plot repairs were conducted in 2014. No repairs were necessary this year.

The barnacle (*Chthamalus* spp./ *Balanus* spp.) plots had 11.8% mean barnacle cover. For reference, last fall, mean barnacle cover was 10.8%. The majority of point contacts in the five plots were bare rock. *Endocladia* plots had 33.6% mean *Endocladia* cover (in fall 2015, mean *Endocladia* cover = 14.2%). The majority of point contacts in the five plots was bare rock. The rockweed plots had 55.4% mean *Silvetia* cover, up from 46.2% last fall. Most of the cover within the rockweed zone was dominated by *Silvetia*. Mussel (*Mytilus californianus*) plots had 59.2% mean cover. The majority of cover in the five plots was occupied by *Mytilus*. For reference, last fall, mean mussel cover was 36.6%.

Mussels were measured in the five *Mytilus* plots by Emily. Sizes of mussels ranged 10–50 mm and mussel bed depths ranged 1–4 cm; all plots were monolayers. Last fall, sizes of mussels ranged 10–50 mm and mussel bed depths ranged 1–4 cm; all plots were monolayers.

Sand level at the site was the highest that Whitaker has observed in the eight years he has been monitoring the site. *Jania crassa* is still dominant in many of the tidepools. At least 150 Cancer crabs (possibly *C. antennarius*) were seen around the base of the reefs buried in the sand. Numerous *Tegula galena* were seen around the access point (west end of Middle Anacapa). *Silvetia* appears to be robust and reproductive with a considerable amount of small recruits. *Hesperophycus* was not very abundant but appeared to be healthy and reproductive. *Endocladia* was lush and relatively

abundant. Sand covered a high proportion of the inner, middle and outer reefs. Large patches of *Ulva* were observed covering all three reefs. *Chondracanthus canaliculatus* was extremely dominant and lush. *Mytilus* was not particularly abundant and very few new recruits were seen. Approx 10 southern kelp crabs were found at the lower reef located furthest offshore. *Aplydium* and *Sphaciospongia* were relatively abundant at the bases of the reefs. Zebra perch were seen in the tidepool in the center of the outer reef.

San Miguel Island, February 5–12, 2017

(Database event #2016-17-E)

Prepared by Stephen Whitaker

Purpose:

To monitor rocky intertidal sites at San Miguel Island.

Personnel:

- Stephen Whitaker, Marine Ecologist, Channel Islands National Park
- Hillary Krumbholz, Biological Technician, UCSC
- Emily Hardison, Biological Technician, UCSC

Procedure and General Observations:

Channel Islands Aviation transportation was utilized to access the island. Standard procedures were used for monitoring rocky intertidal sites. Plots and site overviews were photographed with an Olympus Stylus 1030SW digital camera. Photoplots were scored in the field at all four sampling sites. Sea stars and black abalone were counted and sized during timed (typically 30 min) site-wide searches at all four sampling sites. *Lottia gigantea* were sampled this season at the two sampling sites (Otter Harbor and Harris Point) that have fixed plots. Motile invertebrates are no longer sampled at any of the four sampling sites. The maximum number of shorebirds and pinnipeds observed at each site was recorded at all sites. Hobotemp Tidbit temperature loggers were downloaded at Otter Harbor and Crook Point and were replaced with fresh loggers. Additional temperature loggers were placed at all sites above the upper intertidal zone to record ambient air temperature. Mussel sizes and mussel bed depth were measured at all four sampling sites. Channel Islands Aviation provided transportation off the island on Sunday, February 12th.

2/6/2017. Harris Point.

Low tide –0.4 ft at 1301 hrs. The conditions were only mediocre due to the surge generated from the moderately-sized swell out of the northwest. Still, we were able to safely sample all plots including those for *Lottia gigantea* and conduct site searches for black abalone and sea stars with a relatively high level of confidence. The sky was overcast and foggy all day and wind was light. Two black oystercatchers, 40 juvenile sea lions, 5 adult harbor seals and 1 bull elephant seal were at the site upon arrival. No pups were present. The site was monitored from 1200 to 1645.

Plots were photographed by Emily and Hillary. Site panoramas were photographed by Emily and Hillary. All 25 photoplots at the site were scored in the field by Stephen. The field log was completed by Stephen.

No repairs were made during this visit, but several plots require the addition of a third bolt—see photolog for details. A total of 17 bolts still needs to be deployed. However, all plots were easy to locate. Several of the barnacle plots were mislabeled with the incorrectly numbered bolt; all misidentified plots currently have an epoxy patch that correctly identifies them. The mislabeled barnacle plots were later fixed on 2/11.

A Hobotemp Tidbit temperature logger was deployed at 1635 above the staging area to record ambient air temperature.

A 45-minute search (note that search time includes time spent measuring) was conducted for black abalone (*Haliotis cracherodii*) presence by Emily and Hillary. N=44 black abalone were observed site-wide (from R2 at the west end within the boulder field to the crack east of plot 430) (sizes ranged 52–150 mm, most individuals were spaced 1–10 cm more apart from one another). All five fixed plots were sampled; all had N=0 except plot 443 with N=3 black abalone. For reference, last February, N=25 black abalone were seen at the site; sizes ranged 18–168 mm, most were spaced 1–10 cm apart from one another.

A thirty-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by Emily and Hillary. N=0 ochre stars were observed site-wide (from R2 at the west end within the boulder field to the crack east of plot 430). For reference, last February, zero sea stars were observed.

Owl limpets (*Lottia gigantea*) were counted and measured in the fixed plots by Stephen (plots 1–4) and Emily (plot 5). Plots 1–5 had N= 14, 27, 64, 76 and 31 owl limpets, respectively. Sizes of *L. gigantea* lumped across the five plots ranged 9–76 mm. For reference, last February plots 1–5 had N= 12, 28, 74, 76 and 21 owl limpets, respectively. Sizes of *L. gigantea* lumped across the five plots ranged 13–75 mm.

Mussel lengths ranged 10–80 mm and bed depths ranged 10–60 mm in *Mytilus* plots 1–5. All plots appeared to be comprised of monolayers of *Mytilus*. Measurements were taken by Hillary and Emily.

The barnacle (*Chthamalus* spp./ *Balanus* spp.) plots had 10.6% mean barnacle cover. The majority of point contacts in the five plots were bare rock. Last February, there was 19% mean barnacle cover. *Endocladia* plots had 46% mean *Endocladia* cover. The majority of point contacts in the five plots were occupied by *Endocladia*. Last February, there was 15.2% mean *Endocladia* cover. The rockweed plots only had 0.2% mean *Hesperophycus* cover. Plot 424 was the only plot with any *Hesperophycus* cover (1%). Most of the point contacts within the rockweed zone were bare rock. Last February, 0% *Hesperophycus* cover was measured. Mussel (*Mytilus californianus*) plots had 29.6% mean cover. The majority of point contacts in the five plots were bare rock. Last February, there was 25% mean mussel cover. The *Tetraclita* zone had 20.4% mean *Tetraclita* cover. The majority of point contacts in the five plots were bare rock. Last February, 16% mean *Tetraclita* cover was measured in the five representative plots.

No obvious signs of major disturbance were observed for the site. As observed at many other sites this season, *Endocladia* appeared especially lush and abundant. *Mytilus* was quite common and healthy in appearance but no recruitment was observed for the species. Articulated corallines were bleached in a small percentage (approx. 25%) of the site. *Hesperophycus* still occupies part of the area within the sea star transect channel. The condition of the rockweed was mixed with most thalli appearing healthy while others (approx. 25%) extremely tattered. Red crabs were observed in the gull scat. Owl limpet abundances appeared higher than counts in the fixed plots from previous years. *Balanus* and *Chthamalus* were common but not overly abundant and recruitment for either species was not readily observed. There was an extremely high number of *Pachygrapsus* observed throughout the site.

2/7/2017. Otter Harbor.

Low tide -0.88 ft at 1349 hrs. The conditions were excellent for sampling with minimal swell and wind. The sky was foggy all day long with periods of light drizzle. One quarter of an inch of rain fell last night and early this morning. There were 5 western gulls, 6 marbled godwits and 3 black oystercatchers along with 48 harbor seals and 5 elephant seals at the site upon arrival. Unfortunately, the charismatic harbor seal that we have encountered at the site during the past several visits was not present. No harbor seal pups were observed at the site. All but one of the elephant seals was seen in the surge channel east of the site. The site was monitored from 1145 to 1700.

Plots were photographed by Hillary and Emily. Site panoramas were photographed by Hillary and Emily. All photoplots were scored in the field by Stephen. The field log was completed by Stephen.

No plot repairs were conducted during this visit since all plots now have three bolts indicating the locations of the corners. All plots were easily located.

A 60-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Hillary. The search encompassed the area from R2 to the east end of the site near the surge channel. Abalone were counted first, then a subset was measured afterwards. N=311 black abalone were observed site-wide (sizes ranged 26–165 mm, most individuals were either touching or were located 1–10 cm apart from one another). Numerous (approx. 25%) black abalone were small (20–40 mm), most of which were located on the east end of the site near the surge channel and tucked deep within rock crevices near *Lottia* plot 1. All five abalone fixed plots were sampled; plots 1–5 had N=0, 1, 1, 0, 10 black abalone, respectively. N=10 empty and clean black abalone shells were located at the site; sizes ranged 23–76 mm. For reference, last February, N=129 black abalone were observed site-wide (sizes ranged 32–140 mm, most individuals were either touching or were located 1–10 cm apart from one another).

A 60-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by Emily. N=1 ochre stars were observed site-wide from R2 to the east end near the surge channel (size = 200 mm). Last February, N=2 *P. ochraceus* (sizes were 60 and 130 mm) were observed site-wide.

Owl limpets (*Lottia gigantea*) were counted and measured in the fixed plots by Stephen (plots 1–4) and Hillary (plot 5). Plots 1–5 had N= 95, 103, 112, 87 and 54 owl limpets, respectively. Sizes of *L. gigantea* lumped across the five plots ranged 15–62 mm. For reference, last February plots 1–5 had

N= 57, 77, 65, 63 and 98 owl limpets, respectively. Sizes of *L. gigantea* lumped across the five plots ranged <15–64 mm.

Mussel lengths ranged 10–90 mm and bed depths ranged 10–70 mm in *Mytilus* plots 1–5. All plots appeared to be comprised of monolayers of *Mytilus*. Measurements were taken by Hillary and Emily.

The barnacle (*Chthamalus* spp./ *Balanus* spp.) had 8.4% mean barnacle cover. The majority of point contacts in the five plots were bare rock. Plot 374 which has been dominated by red algae comprised primarily of *Chondracanthus* and *Mazzaella* for many years, was instead comprised solely of crustose forming algal species as if the majority of the area comprising the plot and surge channel had been scoured clean. Last February, 12% mean barnacle cover was measured in the barnacle plots. *Endocladia* plots had 47% mean *Endocladia* cover. The majority of point contacts in the five plots were bare rock. Last February, 21.6% mean *Endocladia* cover was measured in the representative plots. The rockweed plots had 0.2% mean *Silvetia* cover (1% measured in plot 356) and 0.2% mean *Hesperophycus* cover (1% measured in plot 358). Most of the point contacts within the rockweed zone were bare rock or *Endocladia* (mean=18.8%). Last February, 0.2% mean *Silvetia* cover was measured in the representative plots. Mussel (*Mytilus californianus*) plots had 54.4% mean cover. The majority of cover in the five plots was occupied by mussels. Last February, 55.4% mean *Mytilus* cover was measured in the representative plots.

The wall that plot 374 is located on appears to have been scoured from the base to a point approximately half way up whereby all the foliose algae (i.e., *Mazzealla*, *Chondracanthus*, etc.) have been removed. Left remaining are crustose algal species including *Ralfsia*, *Lithothamnion*, etc. *Spheciospongia* was observed in various locations within the supra lower intertidal zone. *Endocladia* appeared to be lush and abundant. *Mytilus* was also highly abundant but no obvious signs of recruitment were observed for the species. *Silvetia* was relatively rare, but the thalli that were present appeared to be robust and reproductive. *Hesperophycus* (Harris Point variety) was perhaps more common than *Silvetia* and appeared to be healthy. *Balanus* were rare particularly compared to *Chthamalus* abundances which were quite high. *Porphyra*, along with *Ulva*, covered most of the upper reef. A fair amount of bleaching was observed for many algal species particularly those located in the low (< 0' MLLW) portions of the site.

2/8/2017. Crook Point.

Low tide –1.19 ft at 1431 hrs. The conditions were less than ideal due to the constant wetting of the outer reef as a result of the relatively-large long-period swell out of the northwest. Even though the site faces predominantly towards the south, apparently it is still subject to west swells as they wrap around the island. Unfortunately, the large and frequent sets of waves significantly compromised our ability to adequately search for and measure black abalone and sea stars, but we were able to confidently sample all the fixed plots. The wind was light and the sky was mostly overcast all day. There were 26 cormorants, 4 gulls, 6 black oystercatchers and 3 black turnstones at the site upon arrival. One immature male elephant seal was seen near the bluff at the entry to the site and an adult male showed up before we left. Approximately 300 grebes were seen offshore between the site and Wyckoff Reef drifting and feeding in a large group. The site was monitored from 1150 to 1630. There was three urchin commercial fishing vessels nearby offshore the entire day.

Plots were photographed by Hillary and Emily. Site panoramas were photographed by Hillary and Emily. All photoplots were scored in the field by Stephen. The field log was completed by Stephen.

No plot repairs were necessary during this visit.

The temperature logger #2264333 located in the mid intertidal nearby the abalone plots was replaced with logger #10999078 at 1504. An additional temperature logger #10999076 was deployed on 2/10 above the site near the staging area in a rock depression with a small grapefruit-sized red rock covering it. A GPS point was taken to mark the location.

A 30-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Emily and Hillary. N= 57 black abalone (sizes ranged 28–140 mm) were observed site-wide from the east end excluding the offshore reef to the west end in line with plot 388. As mentioned, the large swell may have impacted our ability to confidently locate abalone particularly on the south side of the reef. Abalone were counted first and then a subset was measured afterwards. Plots 1–4 were sampled but plot 5 was too impacted by swell to safely and accurately sample. Plots 1–4 had N=3, 1, 2, and 1 black abalone, respectively. Last February, N= 42 black abalone (sizes ranged 32–153 mm) were observed site-wide.

A thirty-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by Hillary and Emily. N=23 ochre stars were observed site-wide (from the east end excluding the offshore reef to the west end in line with plot 388) (sizes ranged 40–130 mm, mode = 80 mm). All sea stars appeared to be healthy with no visible lesions. Note that conditions were not optimal for conducting sea star or black abalone searches. Last February, N= 15 *P. ochraceus* (sizes ranged 10–100 mm) were observed site-wide.

Mussel lengths ranged 10–70 mm and bed depths ranged 20–60 mm in *Mytilus* plots 1–5. All plots appeared to be comprised of monolayers of *Mytilus*. Measurements were taken by Hillary and Emily.

The barnacle (*Chthamalus* spp./ *Balanus* spp.) plots had 23% mean barnacle cover. The majority of the point contacts in the five plots were bare rock. Last February, 28.8% mean barnacle cover was measured. *Endocladia* plots had 19.8% mean *Endocladia* cover. The majority of the point contacts in the five plots were bare rock. *Endocladia* plot 389 had 54% mussels present. Last February, 22.8% mean *Endocladia* cover was measured. The rockweed plots had 0% *Hesperophycus* and *Silvetia* cover (the same was documented last February). Most of the cover within the rockweed zone was dominated by mussels (mean=29.6%). Mussel (*Mytilus californianus*) plots had 76.6% mean cover. The majority of cover in the five plots was occupied by mussels. Last February, 80.2% mean *Mytilus* cover was measured.

The condition of the site appeared to be comparable to that of recent visits with no obvious signs of disturbance. *Mytilus* is the dominant species at this site with markedly lower abundances of other species dispersed within outcroppings of higher elevations. Despite the high abundance of mussels, very little if any recruitment was observed. Rockweeds were not common. *Silvetia* was particularly rare. *Hesperophycus* (Harris Point variety) was slightly more common and appeared healthy with several small (presumably newly-recruited) individuals seen. *Balanus* was rare relative to

Chthamalus abundances. *Endocladia* was not nearly as common here as observed at most other sites sampled this season, but the alga appeared robust. *Ulva* and *Porphyra*, among other less common ephemeral algae (i.e. *Scytosiphon*, diatoms, etc.) were widely distributed throughout the upper intertidal zone. *Pisaster ochraceus* abundance was the highest recorded at all sites sampled this season. Interestingly, this is the site that we first observed signs of recovery following the wasting event in 2014. Black abalone abundance this year was comparable to abundances measured in recent past years.

2/9/2017. Cuyler Harbor.

Low tide -1.3 ft at 1511 hrs. The conditions were excellent with light swell and wind coupled with the extreme low tide. Sand level on the beach appeared comparable to levels seen in recent years, but there was a deep cut formed in the upper beach west and east of the surge channel resulting in a 6' wall and much of the sand in the channel had been removed. We accessed the site via the wind tunnel from the Cardwell trail, and then came back to housing on the beach. There were no shorebirds at the site upon arrival. One large elephant seal bull was observed swimming near the base of the site after we arrived. The site was monitored from 1230 to 1615.

Plots were photographed by Hillary and Emily. Site panoramas were photographed by Hillary and Emily. All photoplots were scored in the field by Stephen. The field log was completed by Stephen.

No plot repairs were necessary during this visit.

A temperature logger was deployed at 1600 above the site near the staging area in a sandstone outcrop (the largest one seen as you look backwards at the site).

A 30-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Emily. N=15 black abalone (sizes ranged 30–109 mm) were observed site-wide. The majority was observed under the large rock where R1 is located. This is the second consecutive year that black abalone have been observed at this site in perhaps 20 or more years. Last February, N= 1 black abalone (86 mm) was observed site-wide.

A 30-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by Hillary. N=12 ochre stars were observed site-wide (sizes ranged 60–170 mm, mode = 120 mm). Two sea stars appeared to have lesions. These were noted and photographed to obtain a second opinion. Last February, N= 6 *P. ochraceus* (sizes ranged 30–150 mm) were observed site-wide; all appeared to be healthy.

Mussel lengths ranged 10–120 mm and bed depths ranged 20–90 mm in *Mytilus* plots 1–5. All plots appeared to be comprised of monolayers of *Mytilus*. Measurements were taken by Hillary and Emily.

The barnacle (*Chthamalus* spp./ *Balanus* spp.) plots had 22.8% mean barnacle cover. The majority of the point contacts in the five plots were bare rock. Last February, 30.2% mean barnacle cover was measured. *Endocladia* plots had 25.8% mean *Endocladia* cover. The majority of the point contacts in the five plots were bare rock, but all five plots were relatively diverse. Last February, 15.6% mean *Endocladia* cover was measured. The rockweed plots had 0% *Hesperophycus* and *Silvetia* cover (the

same was documented last February). Most of the point contacts within the rockweed were bare rock. Mussel (*Mytilus californianus*) plots had 73.8% mean cover. The majority of cover in the five plots was occupied by mussels. Last February, 61.2% mean *Mytilus* cover was measured.

The condition of the site appeared to be comparable to that of recent visits with no obvious signs of disturbance. Several *Cancer* sp. and one *Pugettia* were observed near the lower intertidal zone. Two *P. ochraceus* appeared to have lesions; photos were taken to assist with confirmation. Both rockweed species appeared to be robust and reproductive; several small *Silvetia* thalli were observed. *Balanus* was much more abundant than *Chthamalus*, contrary to trends observed at nearly all other monitoring sites. Very few empty tests for either barnacle species were seen. All sizes of *Mytilus* were observed including presumably newly-recruited individuals. *Endocladia* was common but not overly abundant as has been observed at most other sites. After more than two decades, black abalone were finally seen again here.

Santa Rosa Island, April 18–25, 2017

Prepared by Stephen Whitaker

Purpose:

To monitor rocky intertidal sites at Santa Rosa Island.

Personnel:

- Stephen Whitaker, Marine Ecologist, Channel Islands National Park
- Josh Sprague, Marine Ecologist, Channel Islands National Park

Procedure and General Observations:

Park transportation was utilized to access the island. Standard procedures were used for monitoring rocky intertidal sites. Plots and site overviews were photographed with an Olympus Stylus 1030SW digital camera. Photoplots were scored in the field at all sites (the only exception was plot 514 at Johnson's Lee). Sea stars and black abalone were counted during 30-minute site-wide searches at all five sites. Surfgrass transects were read at Northwest-Talcott, but all three transects at East Point could not be safely and accurately sampled due to large swell and poor low tide conditions. *Lottia gigantea* were sampled this season at all of the monitoring sites that have fixed plots. Motile invertebrates are no longer sampled at any of the monitoring sites. The maximum number of shorebirds and pinnipeds observed at each site was recorded. The Hobotemp Tidbit temperature loggers were exchanged at Northwest-Talcott, Johnson's Lee and Fossil Reef, and loggers were placed above the upper intertidal at Johnson's Lee and East Point. Mussel sizes and mussel bed depths were measured at all monitoring sites.

4/19/2017. East Point.

Low tide 0.66 ft at 1144 hrs. The conditions were surprisingly good considering the positive low tide and moderate-sized swell and surge. Still, we were not able to sample the surfgrass transects, but all other protocols were completed and the abalone and sea star searches were not compromised. The swell was moderate-sized (2–4') and the wind was blowing 20–25 kt. There were 4 black oystercatchers at the site at various times throughout the day. Additionally, there were 14 cormorants

and 1 gull at the site upon arrival. One elephant seal was observed in the water near the site. The site was monitored from 0945 to 1500. We walked to the site from Water Canyon and then searched for snowy plovers on all the beaches between East Point and Southeast Anchorage. Approximately 0.25" of precipitation dropped on 4/18.

Temperature logger #10021200 was deployed at 1430 above the staging area.

Plots were photographed by Josh. Site panoramas were photographed by Josh. All 25 photoplots were scored in the field by Stephen.

A 30-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Josh. N=99 black abalone were observed site-wide from the sand channel on the north side of the site to plot 594 on the south end (N=89 measured; sizes ranged approx. 23–180 mm, most individuals were close enough to touch one another). The fixed abalone transect was not sampled. Note that a flashlight was used during the abalone search. For reference, during the last visit (November 2015), N=98 black abalone were observed site-wide from the sand channel on the north side of the site to plot 594 on the south end excluding the outer reefs (sizes ranged approx. 24–177 mm, most individuals were 1–10 cm apart from one another).

A thirty-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by Josh. N=9 ochre stars were observed site-wide from the sand channel on the north side of the site to plot 594 on the south end; sizes ranged 60–130 mm and all individuals appeared to be free of lesions. For reference, during the last visit (November 2015), N=4 ochre stars were observed site-wide (sizes ranged 30–80 mm). All four individuals appeared to be healthy.

Surfgrass transects were not sampled due to the relatively-high low tide combined with moderately-high waves.

The field log was completed by Stephen.

No repairs were necessary during this visit since all plots were easy to locate and nearly all have three bolts.

The barnacle (*Chthamalus* spp./ *Balanus* spp.) had 33.2% mean barnacle cover; in November 2015, there was 16% mean barnacle cover. The majority of point contacts in the five plots were bare rock. *Endocladia* plots had 64.8% mean *Endocladia* cover; in November 2015, there was 28.2% mean *Endocladia* cover. The majority of cover in the five plots was occupied by *Endocladia*. The *Silvetia* plots had 32.2% mean *Silvetia* cover; in November 2015, there was 27.6% mean *Silvetia* cover. Most of the point contacts within the *Silvetia* zone were bare rock. The *Hesperophycus* plots had 8% mean *Hesperophycus* cover; in November 2015, there was 36.2% mean *Hesperophycus* cover. Most of the cover within the *Hesperophycus* zone was dominated by *Endocladia* (mean = 33.6%). Mussel (*Mytilus californianus*) plots had 58.8% mean cover; in November 2015, there was 44.6% mean *Mytilus* cover. Unlike previous years whereby only two plots (593 and 594) had mussels present, mussels have been present in all five plots during the last couple years. The majority of cover in the five plots was occupied by *Mytilus*.

Mussels were measured in the five original *Mytilus* plots by Stephen. Sizes of mussels ranged 10–100 mm and mussel bed depths ranged 3–10 cm; plots 1,2, and 5 were monolayers. In November 2015, mussels ranged 10–90 mm and mussel bed depths ranged 3–6 cm; all plots were monolayers.

Phyllospadix appeared to be reduced in abundance and heavily fouled with *Smithora*. *Silvetia* was abundant and appeared to be robust and healthy but very few new recruits were seen. *Hesperophycus* abundance was low; thalli appeared to be healthy and low to moderate recruitment was observed. *Mytilus* was abundant with high numbers of small recruits attached to the upper surface of the bed. *Phragmatopoma* appeared to be significantly less abundant than it has been in previous years. *Chthamalus* recruitment was high. *Balanus* was rare. *Ulva* and *Cladophora* were highly abundant throughout the site.

4/20/2017. Johnson's Lee.

Low tide 0.45 ft at 1235 hrs. The conditions were not optimal given the long-period moderate-sized south swell that impacted the site incessantly. Additionally, very high wind made for challenging conditions to monitor all plots and conduct site searches. There were 2 black oystercatchers, 3 black turnstones, 1 California sea lion, 5 harbor seals and 30 elephant seals at the site upon arrival. Two of the harbor seals were a mother/pup pair. The site was monitored from 1100 to 1600. The site was revisited on 4/24 to complete monitoring of several of the plots and conduct site searches for black abalone and sea stars.

Temperature logger #2012089 was deployed at 1540 above the staging area. Logger #10443596 was replaced by #2264349 at 1530.

Plots were photographed by Josh. Site panoramas were photographed by Josh. All photoplots except one *Mytilus* plot (514) were scored in the field by Stephen on 4/20.

A thirty-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Josh.

N=21 black abalone were observed site-wide from R1 at the west end to the tip of the reef at the east end not including any of the offshore reefs (sizes ranged 42–163 mm, most individuals were spaced 1–10 cm apart from one another). The black abalone plots were not searched. Note that the search on 4/20 was not ideal for locating black abalone, so the search was repeated on 4/24 (results reported above) when conditions were slightly more conducive to searching in the lower intertidal. Still, the conditions on 4/24 were not optimal and the searches were compromised by the large swell. For reference, during the last visit (November 2015), N=45 black abalone were observed site-wide (sizes ranged 24–174 mm, most individuals were spaced 11–50 cm apart from one another).

A thirty-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by Josh on 4/24. N=22 ochre stars were observed site-wide (see area searched during black abalone search) (N=11 individuals measured, sizes ranged 60–110 mm). For reference, during the last visit (November 2015), N=44 ochre stars were observed site-wide (sizes ranged approx. 20–110 mm, all individuals appeared to be healthy and free of lesions).

Owl limpets (*Lottia gigantea*) were counted and measured in the fixed plots by Stephen and Josh. Plots 1–5 had N= 9, 4, 5, 29 and 39 owl limpets, respectively. Sizes throughout all five plots ranged 12–73 mm. For reference, during the last visit (November 2015), plots 1–5 had N= 8, 48, 23, 94 and 70 *L. gigantea*, respectively. Sizes of owl limpets in all the plots combined ranged <15–111 mm.

Bolts (UL and LR) were placed in plot 518. Epoxy was placed in UL of 505 and epoxy was placed around bolt on 513. All abalone plots still require new bolts.

The barnacle (*Chthamalus* spp./ *Balanus* spp.) had 23.8% mean barnacle cover; in November 2015, there was 31% mean barnacle cover. The majority of point contacts in the five plots were bare rock. *Endocladia* plots had 22.4% mean *Endocladia* cover; in November 2015, there was 21% mean *Endocladia* cover. The majority of point contacts in the five plots were bare rock. Mussel (*Mytilus californianus*) plots had 42% mean cover overall including the four new plots. Without the additional plots the original five plots had 21.8% mean mussel cover; in November 2015, there was 41.4% mean mussel cover overall including the four new plots and 38.9% excluding the four new mussel plots. The majority of cover in the five plots was occupied by *Mytilus*. The splash plots were devoid of biota aside from *Littorina*; plots 1–5 had N=1, 85, 9, 63 and 0 littorine snails, respectively. Splash plots 1–5 also had 0, 0, 10, 4 and 2 *Chthamalus*, respectively.

Mussels were measured in the five original *Mytilus* plots by Stephen. Sizes of mussels ranged 10–110 mm and mussel bed depths ranged 2–8 cm; all plots were monolayers. In November 2015, sizes of mussels ranged 10–70 mm and mussel bed depths ranged 1–7 cm; all plots were monolayers.

The site appeared similar to previous visits with no major disturbances observed. *Mytilus* was relatively abundant and recruits were present in moderate abundance. *Phragmatopoma* appeared to have declined in abundance. *Chthamalus* was common; *Balanus* was relatively rare. Rockweeds were absent. *Endocladia* was abundant and appeared to be robust. *Porphyra* and *Ulva* dominated the surge channel near the center of the site. A lobster trap (likely the same one observed here last spring) was seen in the upper intertidal near the center of the site.

4/21/2017. Northwest-Talcott.

Low tide 0.25 ft at 1316 hrs. The conditions were good despite the moderately-low tide. *Mytilus* plots were wet all day, but we managed to score them, measure mussels and sample surfgrass transects. Black abalone and sea star searches were not compromised. Wind and swell were considered moderate. There were 4 gulls and 4 black oystercatchers at the site upon arrival. Five harbor seals (no pups) were also observed near the access point prior to descending the cliff. The site was monitored from 1100 to 1600.

Plots were photographed by Josh. Site panoramas were photographed by Josh. All photoplots were scored in the field by Stephen.

A thirty-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Josh. N=14 black abalone were seen (an extended search resulted in a total of N=21 throughout the site; sizes ranged 25–172 mm, most individuals were spaced 11–50 cm to one another). The fixed abalone plots were not sampled. For reference, during the last visit (November 2015), N=8 black abalone

were observed site-wide (sizes ranged approx. 59–188 mm, most individuals were 1–10 cm to one another). Note that the abundance of black abalone at this site increased markedly this visit relative to previous years (less than three abalone have been seen at this site each year since 2000).

A thirty-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by Josh. Zero sea stars were observed. Likewise in November 2015, zero sea stars were seen. Low abundances of sea stars are not unusual for this site even before the widespread population crash in early 2014.

Surfgrass transects were sampled by Stephen. Transects 1–2 had *Phyllospadix* cover = 100 and 94%, respectively. Transect #3 was not sampled because it was not located. *Phyllospadix* on both transects was heavily fouled with epiphytic algae (appeared to be *Ulva intestinalis*) and was lightly bleached/browned. For reference, during the last visit (November 2015), transects 1–3 had 100, 100 and 90% cover, respectively.

The *Lottia gigantea* plots were sampled by Josh. Plots 1–5 had N= 30, 40, 43, 18 and 17 *L. gigantea*, respectively. Sizes of owl limpets in all the plots combined ranged <15–94 mm. For reference, in November 2015, plots 1–5 had N= 37, 32, 64, 24 and 28 *L. gigantea*, respectively. Sizes of owl limpets in all the plots combined ranged <15–96 mm.

The field log was completed by Stephen.

No repairs were completed during this visit. However, some plots could still use the addition of bolts in corners to aid in locating them. All plots were however located with relative ease. The following plots still require the addition of at least one bolt: 555–556, 559, 560–563, 566–567, 569. Splash plots (particularly 4–5) need maintenance in addition to the abalone plots. Special attention should be placed in locating the SG-3 transect. Note that images indicating the positions of Splash plot #5 and SG-3 will be necessary to consult when relocating during the next visit.

The barnacle (*Chthamalus* spp./ *Balanus* spp.) had 7.2% mean barnacle cover; in November 2015, there was 6.4% mean barnacle cover. The majority of point contacts in the five plots were bare rock, but *Silvetia compressa* occupied 26.8% cover. *Endocladia* plots had 22.6% mean *Endocladia* cover; in November 2015, there was 6% mean *Endocladia* cover. The majority of point contacts in the five plots were bare rock. The rockweed plots had 58.4% mean *Silvetia* cover; in November 2015, there was 65.4% mean *Silvetia* cover. Most of the cover within the rockweed zone was dominated by *Silvetia*. Mussel (*Mytilus californianus*) plots had 51.8% mean cover; in November 2015, there was 38.6% mean *Mytilus* cover. The majority of cover in the five plots was occupied by *Mytilus*, but all the plots were fairly diverse with coralline crusts, *Phragmatopoma*, *Pollicipes* and articulated corallines ranking as the next most abundant taxa. The splash plots were devoid of biota aside from *Littorina*; plots 1–4 had N=13, 10, 40, 75 littorine snails, respectively. Splash plots 1–4 also had 18, 38, 3, 2 *Chthamalus*, respectively. Splash plot #5 was not located.

Mussels were measured in the five *Mytilus* plots by Stephen. Sizes of mussels ranged 30–70 mm and mussel bed depths ranged 3–7 cm; all plots were monolayers. In November 2015, sizes of mussels ranged 20–90 mm and mussel bed depths ranged 2–6 cm; all plots were monolayers.

The invasive alga, *Caulacanthus ustulatus*, was first seen in November 2013 occupying small areas throughout the site from plots 555–559. Some patches of the alga measured approx. 14 cm across. This was the first time that *Caulacanthus* has been observed at any site besides the two sites at Middle Anacapa. Unfortunately, the invasive alga is likely here to stay at Northwest-Talcott and Anacapa since removal experiments have proven unsuccessful (J. Smith, per com). *Caulacanthus* has been seen each year since and was present again during this visit. The invasive appears to have increased slightly in abundance since we first observed it in 2013.

Veleva (living) were seen on the beach. *Chthamalus* abundance was low and distribution was patchy. Very few *Balanus* were seen. *Silvetia* was abundant and appeared to be healthy; very few recruits were seen. *Endocladia* was also abundant. *Caulacanthus* was observed growing alongside *Endocladia* with the appearance of competing for space. *Mytilus* was common on the outer reef; very little recruitment was observed. Black abalone sharply increased from N=8 in Dec 2015 to N=21 which was by far the greatest number of abalone seen here in many years.

4/22/2017. Fossil Reef.

Low tide 0.1 ft at 1326 hrs. The conditions were only satisfactory due to moderate-sized (3–5') swell and powerful wind that blew steadily at +30 kt all day. There were 3 gulls, approx. 70 cormorant and 3 black oystercatchers along with 1 elephant seal at the site upon arrival. No harbor seals were seen at the site at any time during the day. The site was monitored from 1015 to 1630.

Logger #2264337 was replaced by #2264348 at 1355.

Plots were photographed by Josh. Site panoramas were photographed by Stephen. All 20 photoplots were scored in the field by Stephen.

A thirty-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Josh. N=64 black abalone were observed site-wide from the east end of the western reef including the monitoring reef and the flat area with large boulders back to the west side of the eastern reef (sizes ranged 25–160 mm, most individuals were 1–10cm apart). A flashlight was not used during the abalone search. The fixed abalone plots were not sampled. For reference, during the last survey in November 2015, N=43 black abalone (sizes ranged 26–146 mm, most individuals were observed touching one-another) were observed site-wide.

A thirty-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by Josh.

N=1 ochre star (120mm – observed to be healthy) was observed site-wide from the west side of the abalone plots, east to the cobble beach, placing the reef with the monitoring plots in the center. For reference, in February 2015, N=2 ochre stars (80mm and 100mm – observed to be healthy) were observed site-wide from the west side of the abalone plots, east to the cobble beach, placing the reef with the monitoring plots in the center.

The *Lottia gigantea* plots were sampled by Josh. Plots 1–5 had N= 1, 6, 112, 151 and 254 *L. gigantea*, respectively. Sizes of owl limpets in all the plots combined ranged <15–73 mm. In

February 2015, plots 1–5 had N= 4, 3, 86, 123 and 155 *L. gigantea*, respectively; sizes of owl limpets in all the plots combined ranged <15–76 mm.

The field log was completed by Stephen. No plot repairs were made during this visit, but a total of N=17 bolts still need to be installed. The temperature logger #2264337 was exchanged by #2264348 at 1355.

The barnacle (*Chthamalus* spp./ *Balanus* spp.) had 25.8% mean barnacle cover. The majority of point contacts in the five plots were bare rock. For reference, in November 2015, there was 18.6% mean barnacle cover. *Endocladia* plots had 29.4% mean *Endocladia* cover. The majority of point contacts in the five plots was bare rock, but *Silvetia* (mean= 31.2%) and *Balanus/ Chthamalus* (mean= 8.8%) were also relatively abundant. In November 2015, *Endocladia* plots had 22.6% mean *Endocladia* cover. The rockweed plots had 62.6% mean *Silvetia* cover. Most of the cover within the rockweed zone was dominated by *Silvetia*. In November 2015, the rockweed plots had 73.8% mean *Silvetia* cover. Mussel (*Mytilus californianus*) plots had 35.6% mean cover. The majority of cover in the five plots was occupied by *Mytilus* followed closely by *Phragmatopoma* (mean= 35.2%). In November 2015, mussel plots had 13% mean *Mytilus* cover.

Mussels were measured in the five original *Mytilus* plots by Stephen. Sizes of mussels ranged 20–70 mm and mussel bed depths ranged 4–7 cm; all plots were monolayers. In November 2015, Mussels were measured in the five original *Mytilus* plots by Stephen. Sizes of mussels ranged 20–60 mm and mussel bed depths ranged 2–6 cm; all plots were monolayers.

As observed in recent past years, *Silvetia* was highly abundant and appeared to be healthy and robust; little recruitment was observed however. A small patch of *Silvetia compressa deliquescens* was observed in the upper intertidal near the staging area. *Endocladia* was also highly abundant and appeared to be robust. *Chthamalus* was abundant. In relation to *Chthamalus*, *Balanus* was considerably less abundant. *Tegula funebris* abundance was in the 10s of 1000s. *Mytilus* continued to steadily increase in abundance with minor levels of recruitment observed overall for the species.

4/23/2017. Ford Point.

Low tide 0.1 ft at 1645 hrs. The conditions were not conducive to sampling the intertidal due to strong and steady wind blowing +30 kt combined with large and powerful long-period ground swell originating out of the southwest. All plots were sampled without experiencing any disturbances, but the searches for black abalone and sea stars were significantly compromised. There were 2 black oystercatchers, 2 gulls and 2 black turnstone at the site at various times throughout the day. There were no pinnipeds seen at the site or in the water nearby the site at any time during our visit. The site was monitored from 1215 to 1645. Note that we were required to walk to the site from Johnson's Lee due to the closure of East Point and Wreck Roads. Hiking time took 1.5–2 hrs and was considerably challenging due to the tall grass and shrubs combined with difficult crossings at the drainages. Stephen took the coastal route both to and from the site and found it to be difficult. Josh returned along Wreck road to Johnson's Lee and found it to be less difficult than travelling off trail despite the drastic elevation changes.

Plots were photographed by Josh. Site panoramas were photographed by Josh. All 15 photoplots were scored in the field by Stephen.

A thirty-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Josh. (N=85) black abalone were observed site-wide (from the area in the vicinity of abalone plot 535 to the east end of the site near 534) (sizes of black abalone were not recorded due to the danger imposed by frequent and powerful waves). The conditions were not ideal for finding or measuring black abalone given the relatively large swell. For reference, during the last visit (November 2015), (N=124) black abalone were observed site-wide (sizes ranged 28–183 mm, most individuals were located 1–10 cm apart from one another). The black abalone plots were not sampled. A flashlight was not used during the abalone search.

A thirty-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by Josh. N= 6 ochre stars were observed site-wide (from the area in the vicinity of abalone plot 535 to east end of the site near 534) (sizes of ochre stars were not recorded due to the danger imposed by frequent and powerful waves). All observed *P. ochraceus* appeared to be healthy. For reference, during the last visit (November 2015), N=32 sea stars were observed (sizes ranged 40–110 mm). All observed *P. ochraceus* appeared to be healthy.

The field log was completed by Stephen.

No plot repairs were necessary as all plots had three bolts indicating the location of corners. However, we were unable to locate the old 600 *Lottia* plot. It will be necessary to consult photos from past visits and interdistance plot measurements during the next visit to locate the fixed owl limpet plot.

The barnacle (*Chthamalus* spp./ *Balanus* spp.) had 11% mean barnacle cover. The majority of point contacts in the five plots were bare rock. For reference, in November 2015, there was 23.2% mean barnacle cover. *Endocladia* plots had 29% mean *Endocladia* cover. The majority of point contacts in the five plots were bare rock. In November 2015, *Endocladia* plots had 8.6% mean *Endocladia* cover. Mussel (*Mytilus californianus*) plots had 58.4% mean cover. The majority of cover in the five plots was occupied by *Mytilus*. In November 2015, mussel plots had 48.8% mean *Mytilus* cover. The splash plots were devoid of biota aside from littorine snails (abundances in plots 1–5 = 1, 77, 75, 34, 67, respectively), *Chthamalus* (abundances in plots 1–5 = 0, 200, 8, 23, 160, respectively) and cyanobacteria.

Mussels were measured in the five original *Mytilus* plots by Stephen. Sizes of mussels ranged 30–90 mm and mussel bed depths ranged 3–9 cm; all plots were monolayers, but several of the plots had the presence of numerous small *Mytilus* recruits attached to the upper surface of larger *Mytilus*. This information was noted on the field form. For reference, during the last visit (November 2015), Sizes of mussels ranged 10–80 mm and mussel bed depths ranged 3–8 cm; all plots were monolayers.

Owl limpets (*Lottia gigantea*) were counted and measured in the fixed plots by Stephen and Josh. Plots 600 (new) – 604 had N= 18, 1, 5, 7 and 18 owl limpets, respectively. Sizes throughout all five plots ranged <15–72 mm. Note that plot 600 (old) was not sampled because it was not located. In

February 2015, plots 600 (old) and 600 (new) – 604 had N= 11, 0, 16, 20, 11 and 24 owl limpets, respectively; sizes throughout all six plots ranged <15–83 mm.

The site appeared to be similar in biological composition to that of past visits with no obvious signs of disturbances. *Endocladia* was not particularly abundant, but the alga appeared to be healthy and robust with only a small percentage of the population appearing bleached. *Chthamalus* was abundant with small recruits observed throughout the site including within the lower zones. In comparison to *Chthamalus* abundances, *Balanus* was much less common. *Mytilus* appeared to be markedly more abundant this visit relative to recent past visits with numerous small newly-recruited individuals observed attached to the upper sides of larger mussels. *Phragmatopoma* abundances appear to be continuing to decrease as *Mytilus* abundances increase. As in past years, no rockweeds were observed anywhere throughout the site.

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 159/174999, January 2021

National Park Service
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