



Rocky Intertidal Community Monitoring at Channel Islands National Park

2018–19 Annual Report

Natural Resource Report NPS/MEDN/NRR—2023/2556



ON THE COVER

Rockweed (*Silvetia compressa*) in the intertidal zone at Cuyler Harbor, San Miguel Island.

Photograph by: NPS/STEPHEN WHITAKER

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August 2023

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

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Please cite this publication as:

Whitaker, S. G. 2022. Rocky intertidal community monitoring at Channel Islands National Park: 2018–19 annual report. Natural Resource Report NPS/MEDN/NRR—2023/2556. National Park Service, Fort Collins, Colorado. <https://doi.org/10.36967/2299674>

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Executive Summary

Channel Islands National Park includes the five northern islands off the coast of southern California (San Miguel, Santa Rosa, Santa Cruz, Anacapa, and Santa Barbara Islands) 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 National Park Service 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 2018–2019 sampling year efforts (from November 2018 to April 2019) and findings of the Channel Islands National Park 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, and 2) to determine population dynamics of black abalone (*Haliotis cracherodii*), owl limpets (*Lottia gigantea*), and ochre sea stars (*Pisaster ochraceus*). Objectives were met by monitoring percent cover of core species in target intertidal zones using photoplots and transects, and by measuring size frequency and abundance of black abalone, owl limpets, and sea stars using fixed plots or timed searches.

Twelve key species or assemblages, as well as the substrate, tar, have been monitored twice per year at 21 sites on the five park islands as part of the rocky intertidal community monitoring program. Fixed photoplots 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 *Pelvetiopsis californica* (formerly *Hesperophycus californicus*), turfweed (*Endocladia muricata*), 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 in circular plots. Size distribution and relative abundance of black abalone and ochre sea stars 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 monitored in 2018–2019. This was the third year that we officially reduced our sampling interval from twice per year (spring and fall) to once in order 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 photoplots 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 *Mytilus* were measured at Middle West Anacapa (Anacapa Island), Harris Point (San Miguel Island), Prisoner’s Harbor (Santa Cruz Island),

and Sea Lion Rookery (Santa Barbara Island) sites. The only site that appeared to have above average *Mytilus* cover was Scorpion Rock on Santa Cruz Island. All other sites had mussel cover near or below the long-term mean. Qualitatively, *Mytilus* recruitment appeared low at most sites. Both rockweed species, *Silvetia compressa* and *Pelvetiopsis californica* (formerly *Hesperophycus californicus*), continued to decrease markedly in abundance this year at the majority of sites compared to combined averages for previous years. Fossil Reef and Northwest-Talcott on Santa Rosa Island, Sea Lion Rookery on Santa Barbara Island, and South Frenchy's Cove on Anacapa Island were the only sites that supported *Silvetia* cover that was near the long-term mean. No sites exhibited above average cover of rockweed. Extremely high levels of recruitment for *Silvetia* and *Pelvetiopsis* were documented at many sites. Most sites exhibited marked declines in *S. compressa* abundances beginning in the early 2000s, with little recovery observed for the rockweed through this year. Barnacle (*Chthamalus/Balanus* spp.) cover fell below the long-term means at all islands except Anacapa, where barnacle cover was slightly above average. *Endocladia muricata* abundances remained comparable to the grand mean calculated for previous years at Santa Barbara, Santa Cruz, and Santa Rosa Islands, while cover of the alga decreased slightly below the long-term means at Anacapa and San Miguel Islands.

Black abalone (*Haliotis cracherodii*) abundances at the islands remain less than one percent of 1985 population levels. Zero abalone were found throughout the entire site at Landing Cove on Santa Barbara Island and South Frenchy's Cove on Anacapa Island. Above average abundances relative to the long-term mean generated from post-1995 data were observed at all but five sites. Juvenile black abalone were seen at all islands except Santa Barbara.

Ochre sea star (*Pisaster ochraceus*) 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 0–13 individuals per site with all but one site having fewer than 10 *P. ochraceus* seen during routine searches. Insufficient numbers of sea stars were seen to accurately estimate the size structure of *P. ochraceus* populations. Only two juveniles (i.e., <50 mm) were observed at all sites combined.

Giant owl limpet densities in 2018–2019 were comparable or slightly above the long-term mean at seven sites. Exceptionally high densities were measured at Northwest-Talcott on Santa Rosa Island, Otter Harbor on San Miguel Island, and Willows Anchorage on Santa Cruz Island. The sizes of *L. gigantea* this year varied among sites and islands. The smallest *L. gigantea* were observed at Otter Harbor followed closely by Willows Anchorage and Anacapa Middle West, and the largest were seen

at Northwest-Talcott. Temporally, the mean sizes of *L. gigantea* in 2018–2019 decreased below the long-term mean at each island except Anacapa.

Surfgrasses (*Phyllospadix* spp.) are typically monitored biannually at two sites each on Santa Cruz and Santa Rosa Islands. Beginning in 2015, all transects at each of the monitoring sites were only sampled once per year. At East Point on Santa Rosa Island, the conditions were not conducive to sampling the surfgrass transects, but qualitatively, percent cover of surfgrass appeared to be near 100% on all three transects. Relative to past years, cover of surfgrass increased above the long-term mean at Fraser Cove on Santa Cruz Island, fell slightly below the mean at Trailer on Santa Cruz Island, and remained approximately equivalent to the mean at the two Santa Rosa Island sites.

Overall, the abundance and diversity of shorebirds in 2018–2019 at all sites appeared similar to observations made in recent years, with the exception of elevated numbers of brown pelicans (*Pelecanus occidentalis*) observed at East Point on Santa Rosa Island. Black oystercatchers (*Haematopus bachmani*) were the most ubiquitous shorebird seen at all sites. Black turnstones (*Arenaria melanocephala*) were not common relative to past years.

Pinniped abundances remained comparable in 2018–2019 to historical counts for all three species that are commonly seen at the islands. Harbor seals (*Phoca vitulina*) were seen in the vicinity of eight sites this year. As in past years, harbor seals were most abundant at Otter Harbor and Harris Point on San Miguel Island. Elephant seals (*Mirounga angustirostris*) were seen at six sites during the year, where abundances ranged 1–5 individuals per location. California sea lions (*Zalophus californianus*) were common at Santa Barbara Island; 117 individuals were observed at Sea Lion Rookery. Sea lion abundances were higher than usual at Harris Point (N = 160) and Otter Harbor (N = 82) on San Miguel Island. Relative to past years, abundances this year were considered average at other locations.

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, database assistance and temperature loggers.

Dr. Pete Raimondi at University of California Santa Cruz provided two junior biological technicians (Michael Langhans and Kathryn Bland) to assist the Channel Islands National Park Rocky Intertidal Community Monitoring Program during the entire field season. The two researchers helped tremendously with field duties, including conducting searches and measurements for black abalone, sea stars, and owl limpets, as well as assisting with photographing plots and site panoramas. Michael and Kathryn also played instrumental roles in the office, including entry and QA/QC for data and labeling photographs.

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 2018–2019 sampling season, including Jade Blennau (SCA intern) and Josh Sprague (NPS).

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

Glossary

C:	Centigrade
CHIS:	Channel Islands National Park
CINMS:	Channel Islands National Marine Sanctuary
MARINe:	Multi-Agency Rocky Intertidal Network
NOAA:	National Oceanographic and Atmospheric Administration
NPS:	National Park Service
SSWD	Sea Star Wasting Disease
SSWS:	Sea Star Wasting Syndrome
UCSB:	University of California Santa Barbara
UCSC:	University of California Santa Cruz

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.

Channel Islands National Park (CHIS) and Channel Islands National Marine Sanctuary (CINMS) encompass the four northern Channel Islands (San Miguel, Santa Rosa, Santa Cruz, and Anacapa 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 Wildlife. 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).

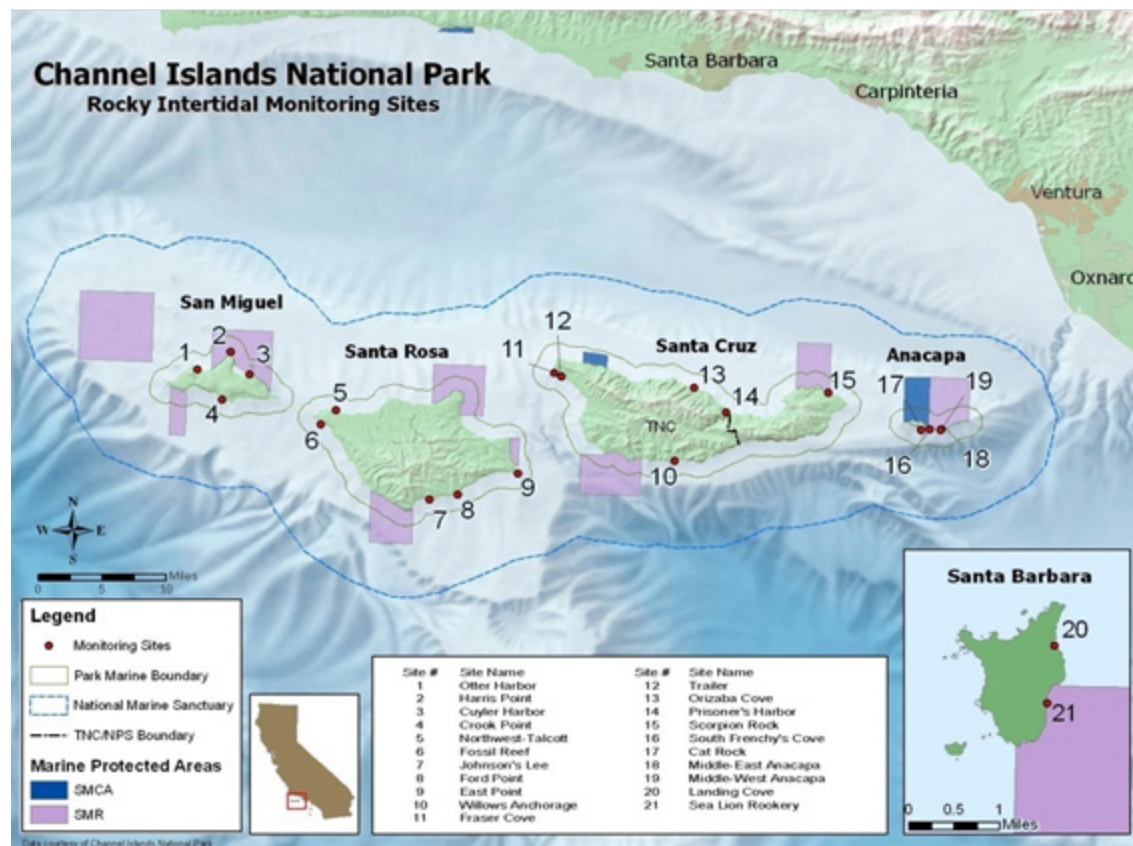


Figure 1. Rocky intertidal community monitoring site locations in Channel Islands National Park. Note: TNC = The Nature Conservancy, SMCA = State Marine Conservation Area, SMR = State Marine Reserve; Sites 18 and 19 are on adjacent reefs.

“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 black abalone (*Haliotis cracherodii*), owl limpets (*Lottia gigantea*), and ochre sea stars (*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 using photoplots, and measuring size frequency and abundance of black abalone, owl limpets, and sea stars 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. In 2015, 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 supported by a power analysis conducted by Dr. Pete Raimondi (University of California, Santa Cruz [UCSC]), which indicated there was sufficient power to detect changes within species assemblages targeted by the program with annual sampling (Raimondi et al. 2018). This year and during subsequent years, monitoring will occur once during fall–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 University of California, Santa Barbara (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 nongovernment 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 (Mexico) 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 2018–2019 sampling season efforts (fall–spring, from November 2018 to April 2019) and documents activities and observations of the Channel Islands National Park Rocky Intertidal Community Monitoring Program. Published reports from past years of monitoring are available on the Mediterranean Coast Network website: <https://www.nps.gov/im/medn/rocky-intertidal-habitat.htm>. Additional black abalone monitoring results have been presented in Haaker et al. (1992), Davis et al. (1992), Richards and Davis (1993), and Richards and Whitaker (2012).

Methods

Study Area

The California Channel Islands comprise eight islands in the Southern California Bight; five of the islands are located within the Channel Islands National Park. 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.

Field Data Collection

The Channel Islands National Park 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 in 2015 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 and 3–5 irregular-shaped and circular plots used to monitor black abalone and owl limpet densities, respectively. Surfgrass transects are monitored at four sites. Site selection considered visitation, accessibility, presence of representative organisms, wildlife disturbance, and safety. Sampling is usually conducted once each year, during fall–winter. In 2018–2019, monitoring occurred at all 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) and Engle (2008). See Appendix A for additional notes about the 2018–2019 program.

Data are maintained in Microsoft Access databases and Excel files in the Channel Islands National Park network and MARINe. Electronic data are 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 12 target species or assemblages, as well as the substrate, tar, is monitored in fixed photoplots (Table 1). The chosen target species and assemblages commonly occur throughout the Southern California Bight 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 *Pelvetiopsis californica*), turfweed (*Endocladia muricata*), 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 taxa and substrata; taxa are defined as species or groups of similar species that may not be easily separated in the field. Target taxa are those identified by MARINE as species to be searched for and counted by all groups (Engle 2008)). Fixed plots (50 × 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 target 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. Target species, higher taxa, and substrata scored in photoplots, point intercept transects, circular/irregular plots, timed searches and mobile invertebrate counts at all Channel Island National Park sites.¹

Category	Species or Substrate	Photoplots ²	Point Intercept Transects ^{2, 3}	Circular/Irregular Plots ²	Timed Searches ²	Mobile Invertebrate Counts ²
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>Pelvetiopsis californica</i> (formerly <i>Hesperophycus californicus</i>) ⁴	X	–	–	–	–
	<i>Sargassum muticum</i>	–	X	–	–	–
	<i>Scytosiphon</i> spp.	X	–	–	–	–
	<i>Silvetia compressa</i> (= <i>Pelvetia fastigiata</i>) (Rockweed) ⁴	X	–	–	–	–
	Other Brown Algae (any browns not listed above)	X	X	–	–	–
	Ephemeral Browns	X	–	–	–	–
Red Algae	<i>Endocladia muricata</i> (Turfweed) ⁴	X	–	–	–	–
	<i>Chondracanthus canaliculatus</i> (= <i>Gigartina canaliculata</i>)	X	–	–	–	–
	<i>Chondracanthus spinosus</i>	X	–	–	–	–
	<i>Gelidium coulteri/ Pterocladia capillacea</i>	X	–	–	–	–
	<i>Mastocarpus papillatus</i> (blade)	X	–	–	–	–
	<i>Mazzaella affinis</i> (= <i>Rhodoglossum affine</i>)	X	–	–	–	–

¹ Motile invertebrate counts were dropped from the standard protocol in 2011.

² An “X” indicates that species or substrate was observed, and a endash (“–”) that it was not observed.

³ Counts not conducted at all sites.

⁴ Target species and the tar substrate; also shown in bold

Table 1 (continued). Target species, higher taxa, and substrata scored in photoplots, point intercept transects, circular/irregular plots, timed searches and mobile invertebrate counts at all Channel Island National Park sites.¹

Category	Species or Substrate	Photoplots ²	Point Intercept Transects ^{2, 3}	Circular/Irregular Plots ²	Timed Searches ²	Mobile Invertebrate Counts ²
Red Algae (continued)	<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> (Surfgrass) ⁴	X	X	–	–	–
	Non-Coralline Crusts (reds and browns)	X	X	–	–	–
	Other Algae/Plants	–	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> (Black Abalone) ⁴	X	–	X	X	–
	<i>Lepidochitona hartwegii</i>	–	–	–	–	X
	<i>Littorina</i> spp.	–	–	–	–	X
	<i>Lottia gigantea</i> (Owl Limpet) ⁴	–	–	X ³	–	X
	<i>Mopalia</i> spp.	–	–	–	–	X

¹ Motile invertebrate counts were dropped from the standard protocol in 2011.

² An “X” indicates that species or substrate was observed, and a endash (“–”) that it was not observed.

³ Counts not conducted at all sites.

⁴ Target species and the tar substrate; also shown in bold

Table 1 (continued). Target species, higher taxa, and substrata scored in photoplots, point intercept transects, circular/irregular plots, timed searches and mobile invertebrate counts at all Channel Island National Park sites.¹

Category	Species or Substrate	Photoplots ²	Point Intercept Transects ^{2, 3}	Circular/Irregular Plots ²	Timed Searches ²	Mobile Invertebrate Counts ²
Molluscs (continued)	<i>Mytilus californianus</i> (California Mussel) ⁴	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 >15 mm (excluding <i>L. gigantea</i>)	–	–	–	–	X
	Medium Limpets 5–15 mm	–	–	–	–	X
	Small Limpets <5 mm	–	–	–	–	X
	<i>Littorina</i> spp.	X	–	–	–	X
	<i>Septifer/Brachydontes</i>	X	–	–	–	–
Barnacles	<i>Chthamalus dalli/fissus</i> & <i>Balanus glandula</i> (Acorn Barnacle) ⁴	X	–	–	–	–
	<i>Tetraclita rubescens</i> (Thatched Barnacle) ⁴	X	–	–	–	–
	<i>Pollicipes polymerus</i> (Goose Barnacle) ⁴	X	–	–	–	–
Echinoderms	<i>Pisaster ochraceus</i> (Ochre Star) ⁴	X	X	–	X	X
	<i>Pisaster giganteus</i>	–	–	–	X	X

¹ Motile invertebrate counts were dropped from the standard protocol in 2011.

² An “X” indicates that species or substrate was observed, and a endash (“–”) that it was not observed.

³ Counts not conducted at all sites.

⁴ Target species and the tar substrate; also shown in bold

Table 1 (continued). Target species, higher taxa, and substrata scored in photoplots, point intercept transects, circular/irregular plots, timed searches and mobile invertebrate counts at all Channel Island National Park sites.¹

Category	Species or Substrate	Photoplots ²	Point Intercept Transects ^{2, 3}	Circular/Irregular Plots ²	Timed Searches ²	Mobile Invertebrate Counts ²
Echinoderms (continued)	<i>Patiria miniata</i>	—	—	—	X	X
	<i>Strongylocentrotus purpuratus</i>	—	—	—	—	X
Crustaceans	<i>Pachygrapsus crassipes</i>	—	—	—	—	X
	<i>Pagurus</i> spp.	—	—	—	—	X
Invertebrates	Other Invertebrates (Other Animals) (any inverts not listed above)	X	X	—	—	—
Substrates	Rock (Bare Rock)	X	X	—	—	—
	Sand	X	X	—	—	—
	Tar ⁴	X	X	—	—	—
	Unidentified (cannot tell if plant, invert or substratum)	X	X	—	—	—

¹ Motile invertebrate counts were dropped from the standard protocol in 2011.

² An "X" indicates that species or substrate was observed, and a endash ("—") that it was not observed.

³ Counts not conducted at all sites.

⁴ Target species and the tar substrate; also shown in bold.

Generally, the percent cover of target organisms is determined either in the field by laying a grid (50 × 75 cm) of 100 evenly-spaced points (10 × 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 is created in Adobe Photoshop and overlaid on the image to provide complete coverage of the plot. Under both scoring protocols, layered organisms are not counted separately. Therefore the total cover of the topmost layer (with few exceptions—see Engle (2008)) is summed to 100%. Data are recorded onto pre-printed data sheets, transcribed into the computer database, verified, validated, and then certified as ready to analyze. In 2018–2019, all photoplots were photographed with a digital camera (Olympus Tough TG-5).



Figure 2. Stephen Whitaker scoring photoplots at Cuyler Harbor, San Miguel Island.

Relative abundance and size structure data are 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 on San Miguel Island, and Willows Anchorage on 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, 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 sea stars, are counted along with other species of sea stars (*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.

Mytilus californianus, California mussels, are sampled for size frequency within the fixed plots targeting *M. californianus* to complement the mussel cover data. At 10 predetermined locations within each plot, the nearest mussel is measured along the length of its axis to the nearest centimeter. Additionally, the thickness of the mussel bed or patch is measured to the nearest centimeter at five predetermined locations within each of the fixed mussel plots.

From 2002 to 2011, smaller motile invertebrates (last column of 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 20 × 20 cm or 10 × 10 cm, 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 Channel Islands National Park Rocky Intertidal Community Monitoring Program annual reports for years 2009–2011.

Phyllospadix spp., surfgrass, cover is measured on three 10 m fixed point-intercept transects (100 points per transect) at four sites (Trailer, Fraser Cove, East Point, Northwest-Talcott). Special circumstances and general conditions that may have affected sampling are 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.

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 are chosen for the minus tide series occurring during daylight hours. In 2018–2019, Stephen Whitaker conducted sampling with assistance from others for data recording and site searches. 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), Wolcott and Wolcott (2008), Abbott and Hollenberg (1976), McLean (1978), Morris et al. (1980), and Regents of the University of California (2014; http://ucjeps.berkeley.edu/californiaseaweeds_refs.html). Note that in this report, we have adopted the taxonomy of Wolcott and Wolcott (2008), 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 2018–2019. 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, goose barnacles, red algal turf, and tar) using JMP (2012). 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; they were not randomly placed and should not be interpreted as 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 in Figures 3–23 for each target species 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 by site and pooled across sites at each island.

As in most years, the mean percent cover of nearly all targeted species in 2018–2019 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 2018–2019 was higher than the long-term mean.

Mytilus californianus

Mytilus californianus (mussels) mean percent cover in 2018–2019 remained comparable to the mean of previous years at the majority of 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 and Sea Lion Rookery. In the cases of Anacapa Middle West and Sea Lion Rookery, mussel cover was near zero percent. Exceptionally high cover of mussels was measured at Scorpion Rock; seven other sites had values at or near the long-term average. Note that the graph for Johnson’s Lee represents the addition of four new mussel plots that were added in 2009. However, without the additional plots, the five original *M. californianus* plots still averaged approximately 50% mussel cover in 2018–2019. Qualitatively, *Mytilus* cover did not appear to increase much this year relative to recent years.

Overall, mussel cover has decreased below the long-term mean at Anacapa and Santa Barbara Islands during the past five years (Figure 4). *Mytilus californianus* percentages were approximately average at San Miguel and Santa Cruz Islands and above average at Santa Rosa in 2018–2019. 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 5).

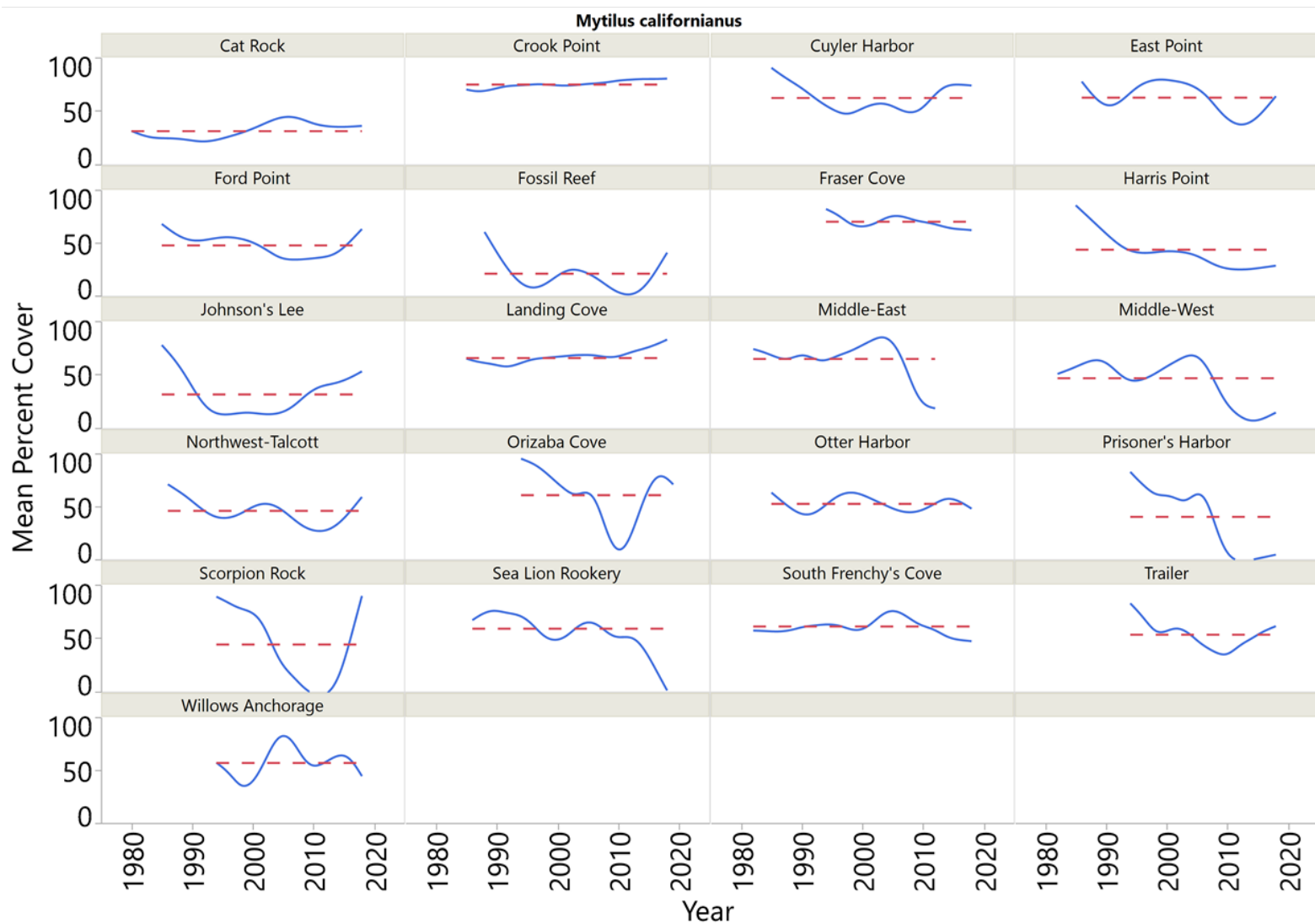


Figure 3. Departure from the long-term mean of percent cover for mussels, *Mytilus californianus*, at each site in Channel Islands National Park. Blue lines represent mean cover of *M. californianus* within the representative zone pooled across plots at each site. Red dashed lines represent long-term mean. Note that four new *Mytilus* plots were installed in 2008 at Johnson's Lee; all nine *Mytilus* plots are displayed here. Also note that Middle-East has not been sampled since 2013.

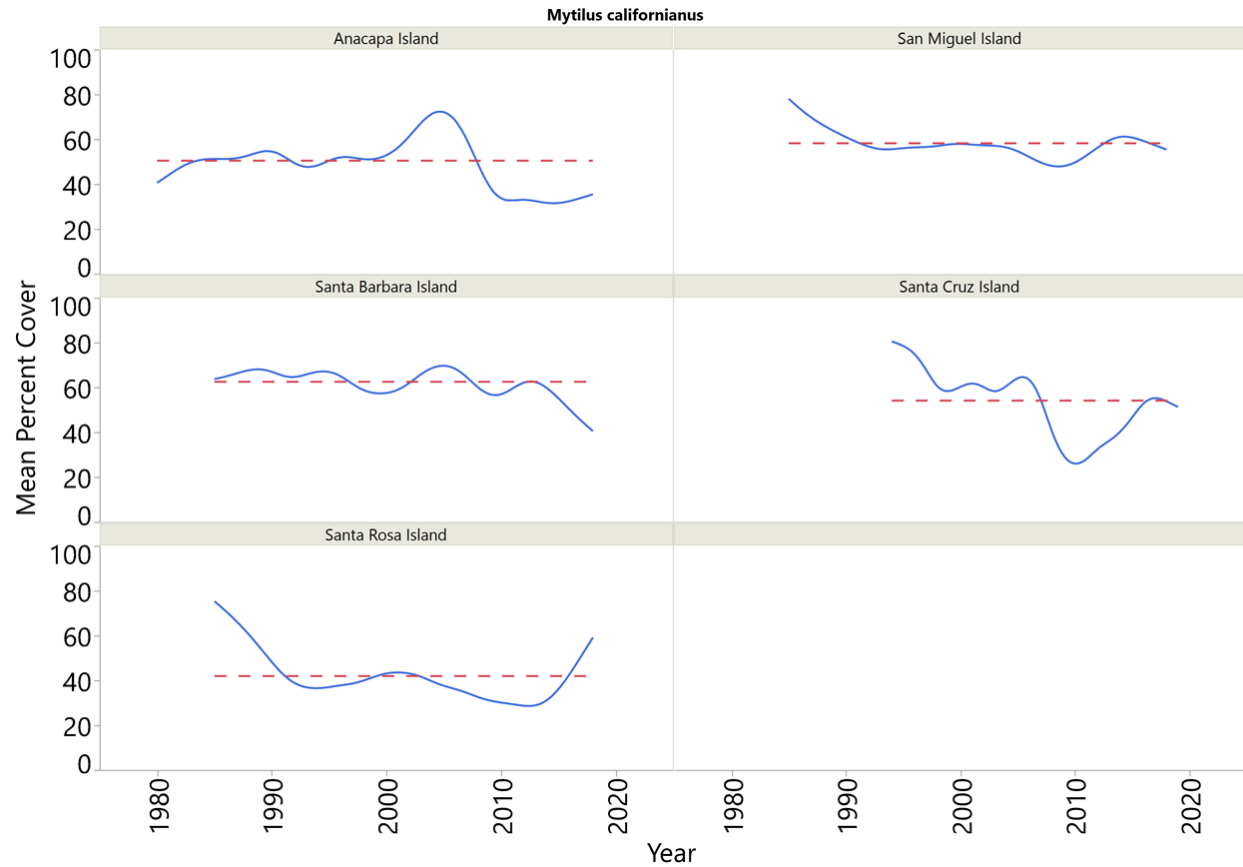


Figure 4. Departure from the long-term mean of percent cover for mussels, *Mytilus californianus* at each island in Channel Islands National Park. Blue wavy lines represent mean cover of *M. californianus* within the representative zone pooled across plots and sites at each island. Red dashed lines represent long-term mean. Note that four new *Mytilus* plots were installed in 2008 at Johnson's Lee, Santa Rosa Island; all nine *Mytilus* plots are included here.



Figure 5. Percent cover of mussels, *Mytilus californianus*, along with polychaete worm, *Phragmatopoma californica*, and bare rock in fixed plots within the *Mytilus* zone at each site in Channel Islands National Park. Colored areas represent the mean percent cover for representative and dominant taxa/substrata from replicated (usually five) *Mytilus* plots. Note that four new *Mytilus* plots were installed in 2008 at Johnson's Lee; all nine *Mytilus* plots are displayed here.

Silvetia compressa

Silvetia compressa (rockweed), abundances were very low in 2018–2019 compared to previous years (prior to 2000 in most cases). *Silvetia compressa* cover averaged across representative plots at each

site was well below long-term averages and measured <20% absolute cover at most sites (10 of 17 sites), many of which had the lowest recorded abundances and/or near-zero percent cover of rockweed (Figure 6). Fossil Reef, Northwest-Talcott, Sea Lion Rookery, and South Frenchy's Cove had approximately average cover of rockweed. Most sites exhibited marked declines in *S. compressa* abundances beginning in the early 2000s, with little recovery observed for the rockweed through this year. When pooled across sites at each island, *S. compressa* cover was markedly lower than the long-term averages for all islands except Santa Rosa, where it was slightly below average (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).

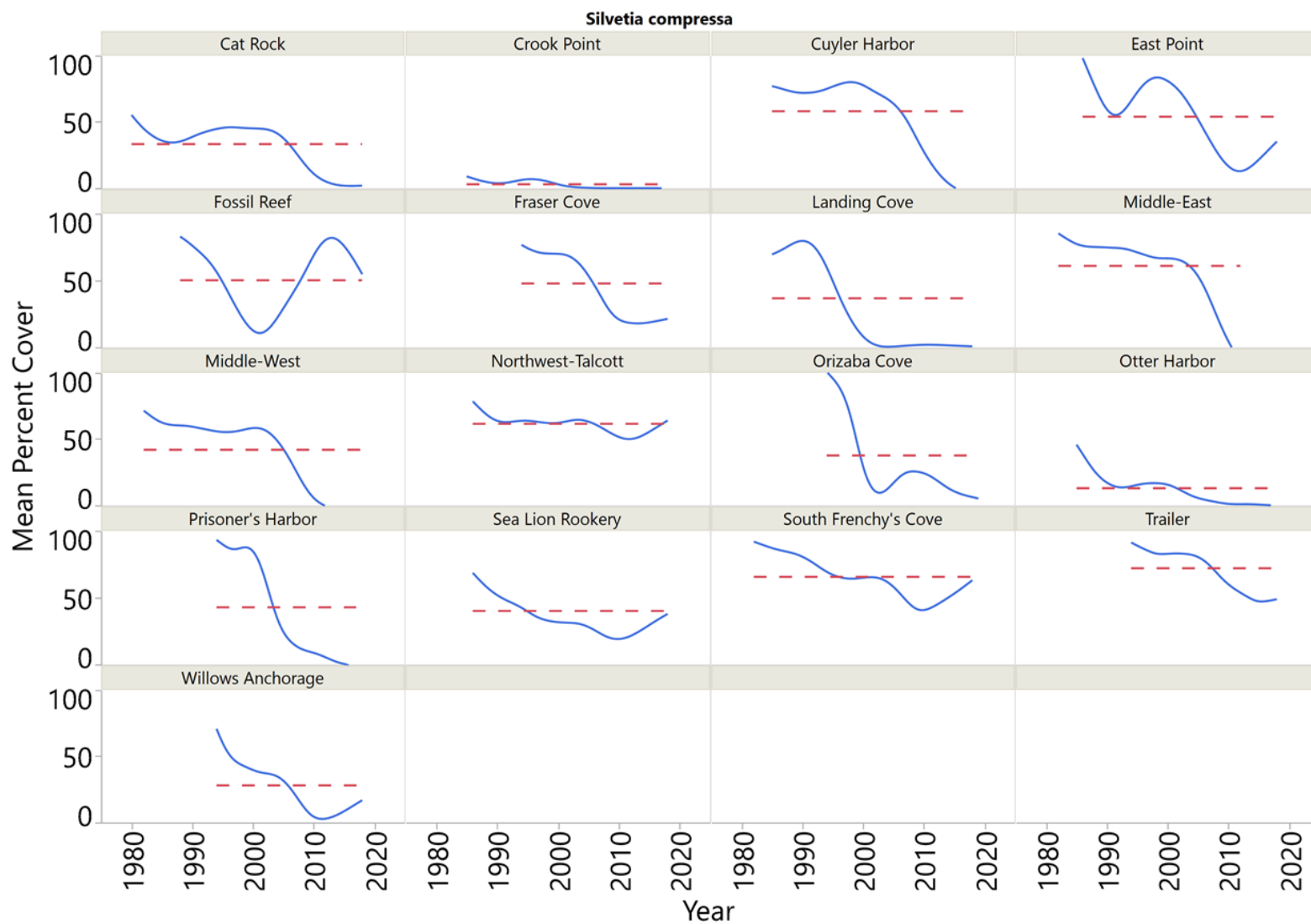


Figure 6. Departure from the long-term mean of percent cover for rockweed, *Silvetia compressa*, at each site in Channel Islands National Park. Blue wavy lines represent mean cover of *S. compressa* within the representative zone pooled across plots at each island. Red dashed lines represent long-term mean. Note that Middle-East has not been sampled since 2013.

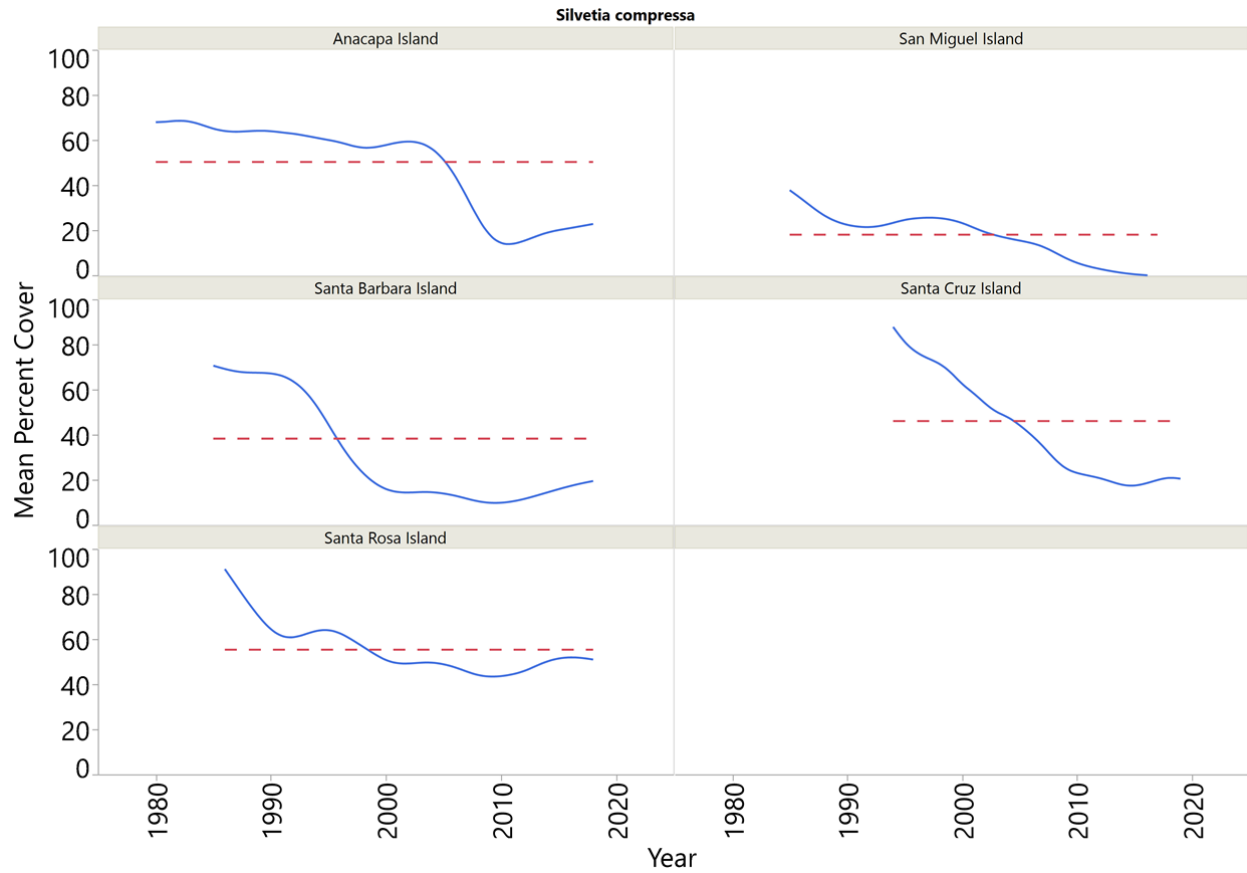


Figure 7. Departure from the long-term mean of percent cover for rockweed, *Silvetia compressa*, by island, in Channel Islands National Park. Blue wavy lines represent mean cover of *S. compressa* within the representative zone pooled across plots and sites at each island. Red dashed lines represent long-term mean.

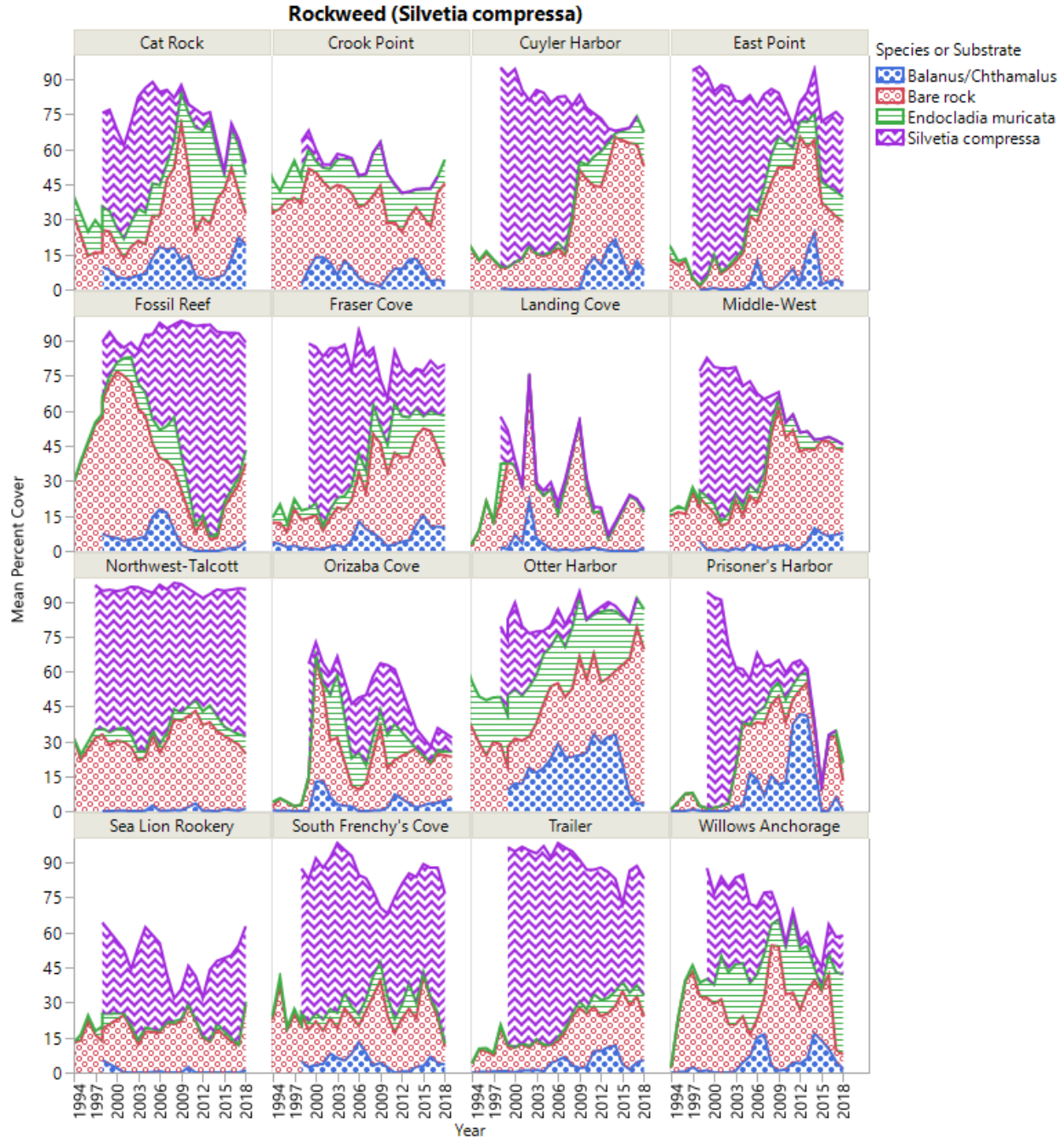


Figure 8. Percent cover of rockweed, *Silvetia compressa*, along with other dominant taxa and bare rock in fixed plots within the *Silvetia* zone at each site in Channel Islands National Park. Colored areas represent the mean percent cover for representative and dominant taxa/substrata from replicated (usually five) *Silvetia* plots.

Pelvetiopsis

The other rockweeds, *Pelvetiopsis californica* (formerly *Hesperophycus californicus*) and *Pelvetiopsis hybrida*, that occur in the region also declined or remained low in abundance at all sites (Figure 9). Note that *P. hybrida* was only recently identified as a separate species from *P.*

californica. Morphologically, *P. hybrida* is similar to *P. californica* and therefore it has historically been identified as *P. californica*. Beginning in 2016, we identified the two species separately, but we lumped the two species for purposes of reporting.

Pelvetiopsis californica and *P. hybrida* cover reached near record-low abundance at Fraser Cove, Harris Point, Prisoner's Harbor, Scorpion Rock and Willows Anchorage. Orizaba Cove and Trailer had average *P. californica* and *P. hybrida* cover in 2018–2019. Pooled across sites at each island, *P. californica* and *P. hybrida* 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 *P. californica* and *P. hybrida*, *Silvetia compressa*, *Endocladia muricata*, and *Chthamalus/Balanus* (Figure 11).

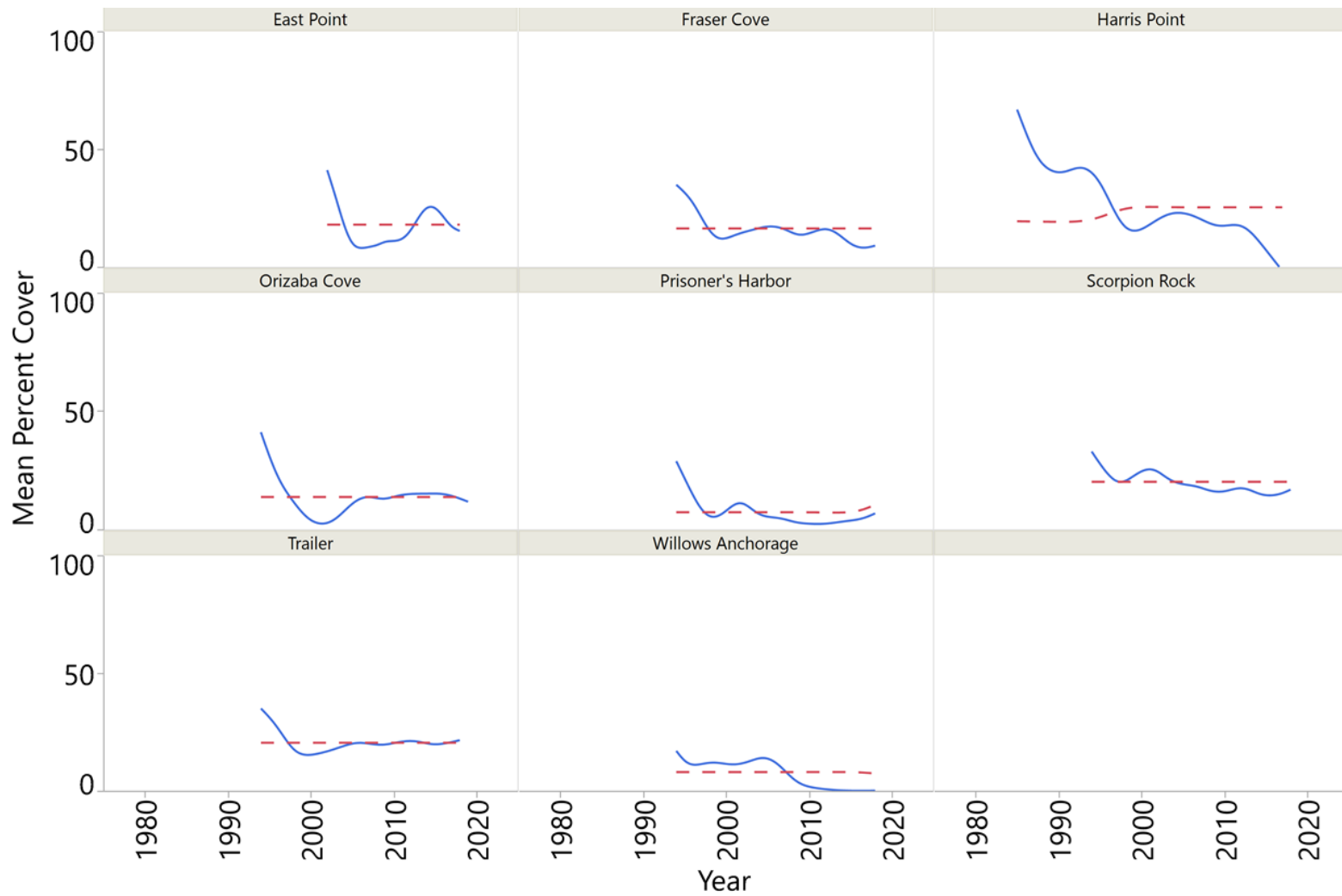


Figure 9. Departure from the long-term mean of percent cover for rockweed, *Pelvetiopsis californica* and *P. hybrida*, at each site in Channel Islands National Park. Blue wavy lines represent mean cover of *Pelvetiopsis californica* and *P. hybrida* within the representative zone pooled across plots at each site. Red dashed lines represent long-term mean.

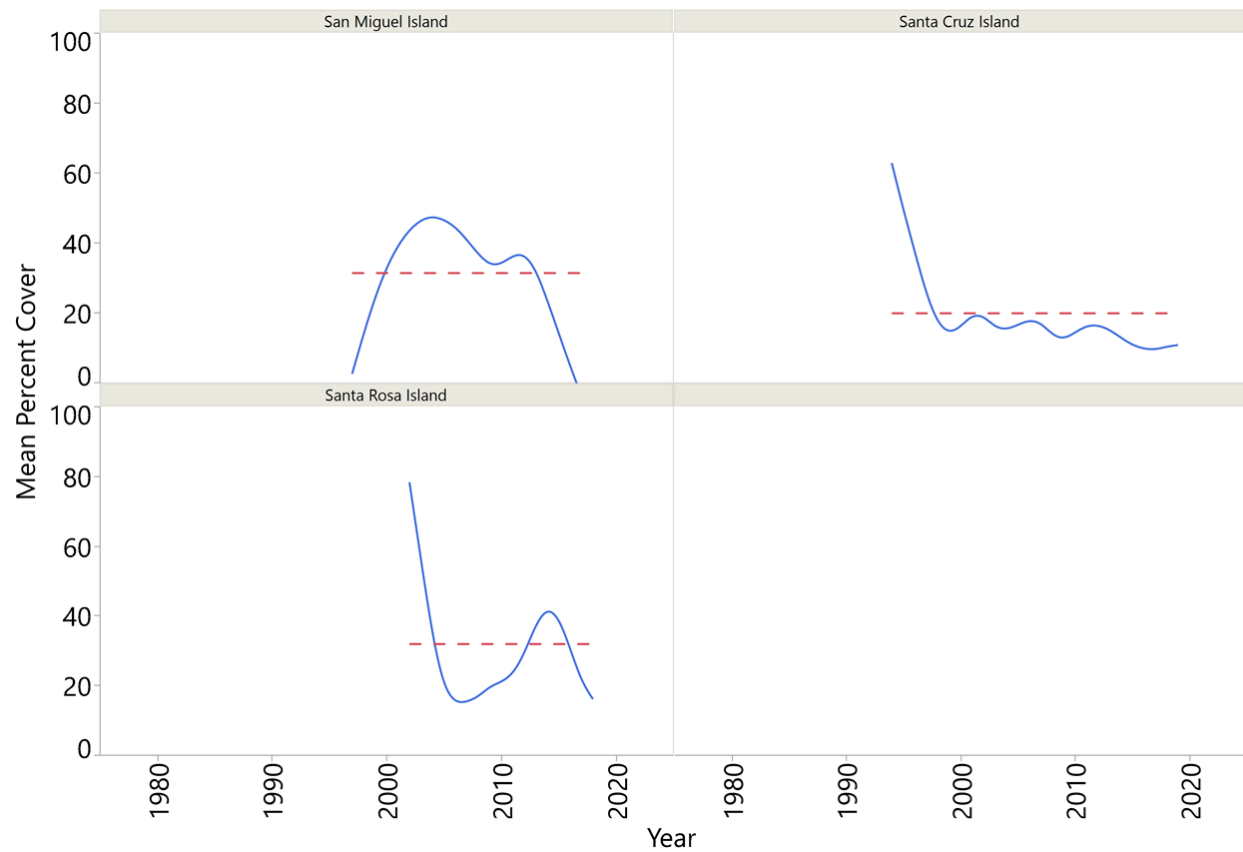


Figure 10. Departure from the long-term mean of percent cover for rockweed, *Pelvetiopsis californica* and *P. hybrida*, by island in Channel Islands National Park. Blue wavy lines represent mean cover of *Pelvetiopsis californica* and *P. hybrida* within the representative zone pooled across plots and sites at each island. Red dashed lines represent long-term mean.

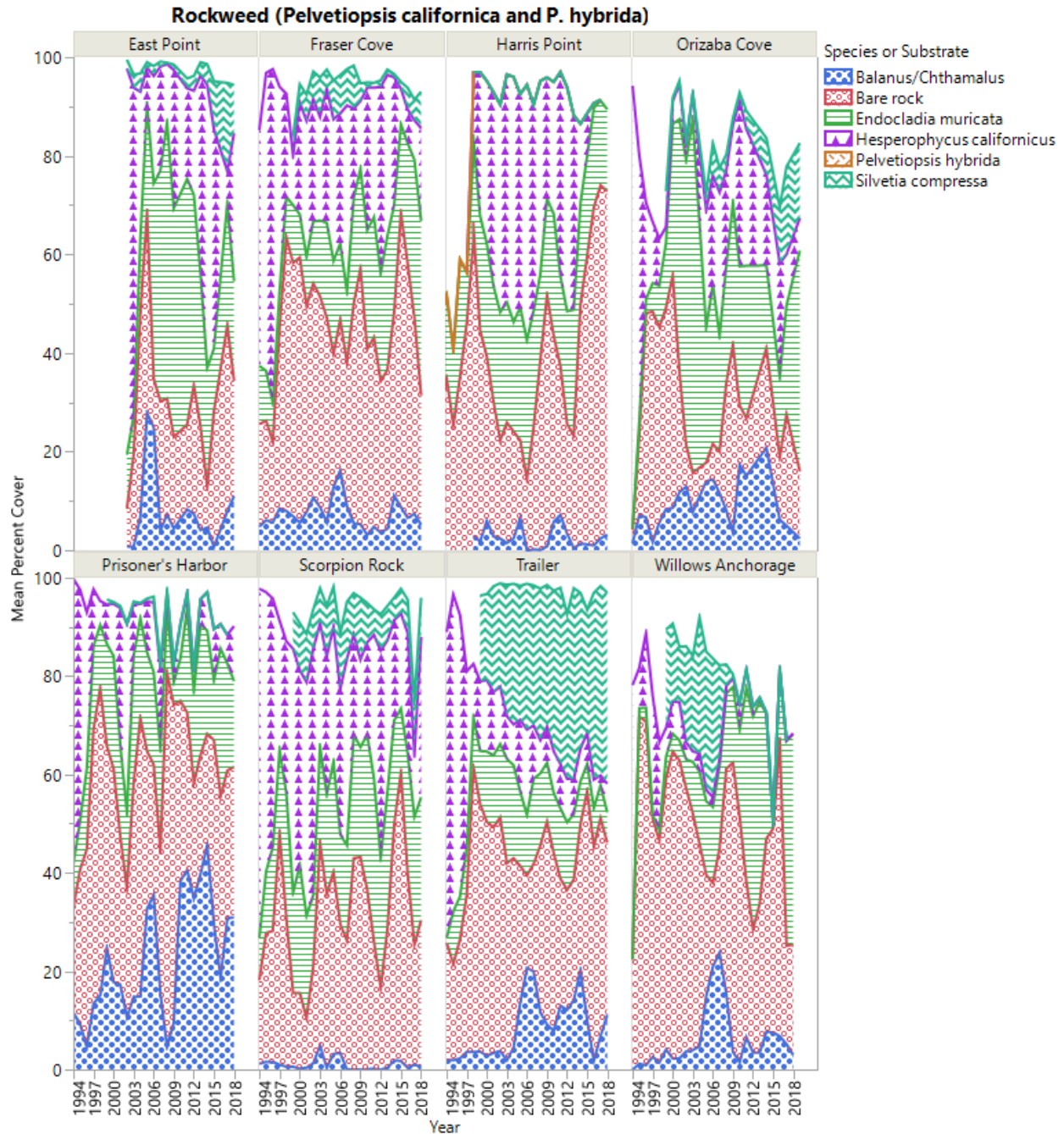


Figure 11. Percent cover of rockweed, *Pelvetiopsis californica* and *P. hybrida*, along with other dominant taxa and bare rock in fixed plots within the *Pelvetiopsis* zone at each site in Channel Islands National Park. Colored areas represent the mean percent cover for representative and dominant taxa/substrata from five *Pelvetiopsis* plots.

Endocladia muricata

Endocladia muricata (turfweed) cover in 2018–2019 remained roughly equivalent to mean abundances measured in past years at most sites (9 of 17 sites) (Figure 12). Record-low *E. muricata* abundances relative to long-term means were measured at numerous other locations, but in most

cases, abundances were only slightly below the long-term mean. Exceptions were Anacapa Middle West, Otter Harbor, Scorpion Rock and South Frenchy's Cove, which either had extremely low abundances overall or decreasing trends in cover markedly below the long-term mean. Moderately high cover of *E. muricata* compared to earlier years was not measured at any sites. Pooled across sites at each island, *E. muricata* abundances were approximately average at Santa Barbara, Santa Cruz and Santa Rosa. Cover of the alga was slightly below the long-term means at Anacapa and San Miguel Islands (Figure 13). Other dominant species in *E. muricata* plots have been *Silvetia compressa* and *Chthamalus/Balanus* (Figure 14).

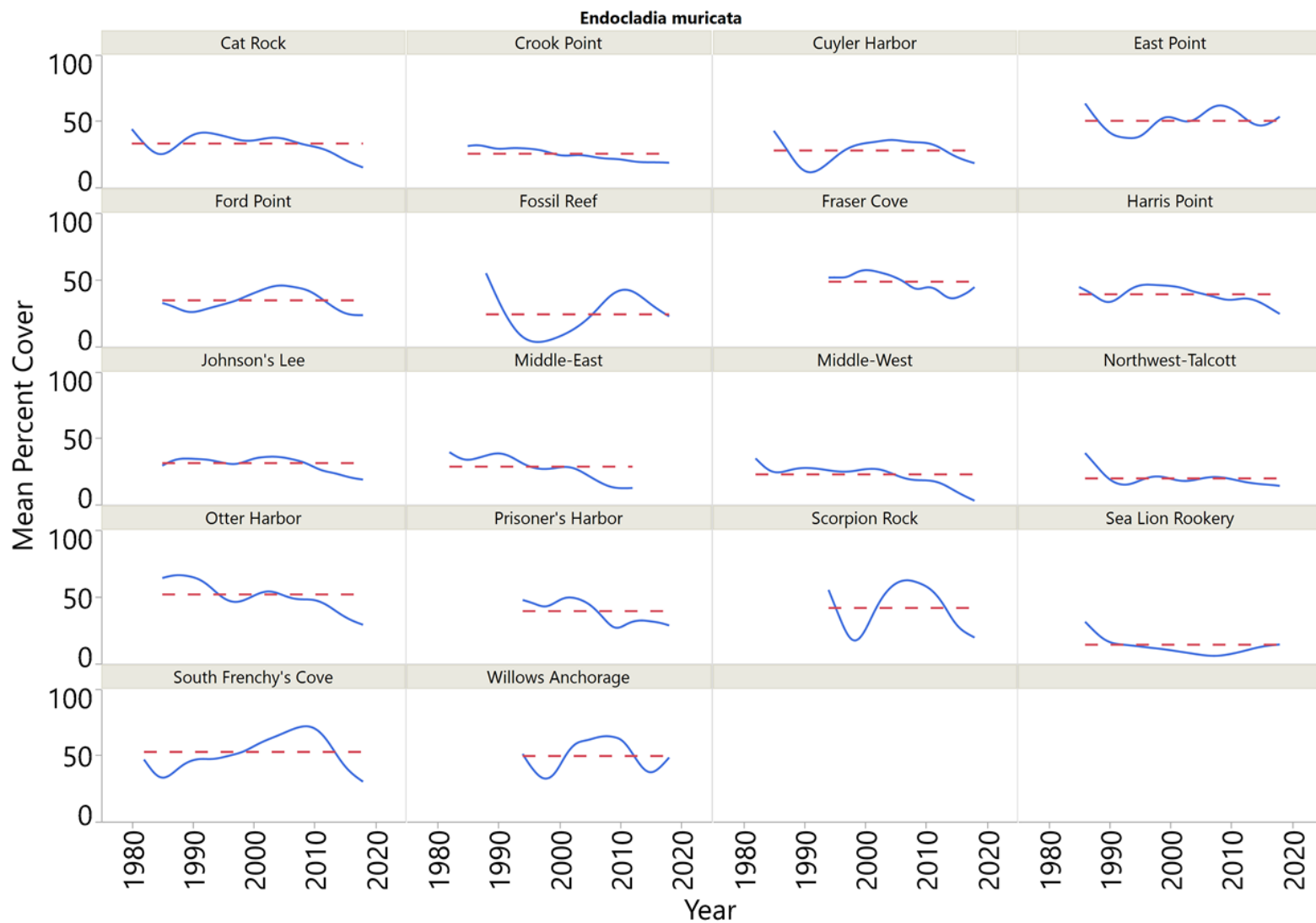


Figure 12. Departure from the long-term mean of percent cover for turfweed, *Endocladia muricata*, at each site in Channel Islands National Park. Blue wavy lines represent mean cover of *E. muricata* within the representative zone pooled across plots at each site. Red dashed lines represent long-term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

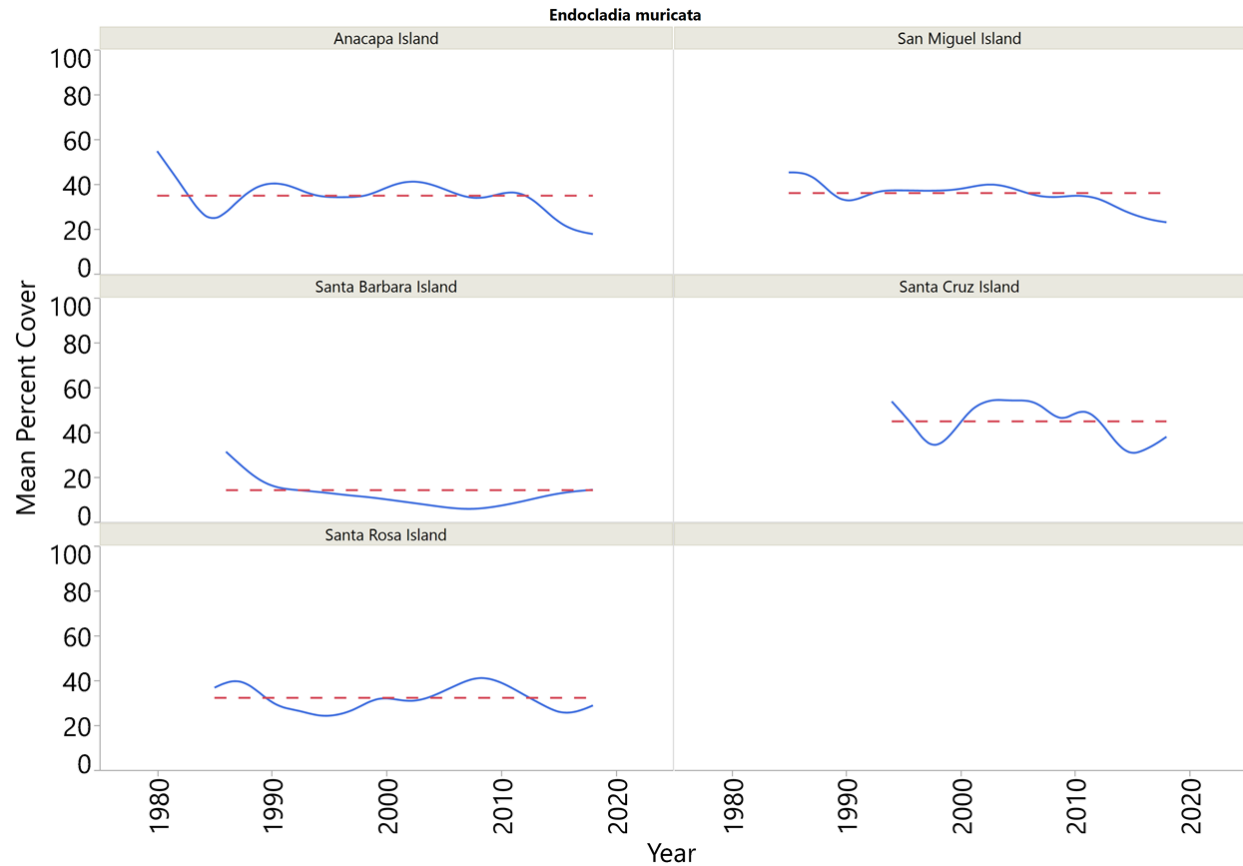


Figure 13. Departure from the long-term mean of percent cover for turfweed, *Endocladia muricata*, by island, in Channel Islands National Park. Blue wavy lines represent mean cover of *E. muricata* within the representative zone pooled across plots and sites at each island. Red dashed lines represent long-term mean.



Figure 14. Percent cover of turfweed, *Endocladia muricata*, along with other dominant taxa and bare rock in fixed plots within the *Endocladia* zone at each site in Channel Islands National Park. Colored areas represent the mean percent cover for representative and dominant taxa/substrata from replicated (usually five) *Endocladia* plots.

Chthamalus/Balanus

Chthamalus/Balanus spp. (barnacle) abundances in 2018–2019 appeared below average at many (13 of 19) of the sites sampled, with near record low abundances documented at Ford Point, Harris Point, Northwest-Talcott, Orizaba Cove, Otter Harbor and Prisoner's Harbor (Figure 15). Relative to the

long-term mean, most sites had approximately average cover of *Chthamalus/Balanus* spp., while only one location (Cat Rock) had slightly above average barnacle cover. At the island level, abundances pooled across sites in 2018–2019 fell below the long-term means at all islands except Anacapa, where barnacle cover was slightly above average (Figure 16). Other dominant species in *Chthamalus/Balanus* spp. plots have primarily been *Silvetia compressa* and *Endocladia muricata* (Figure 17).

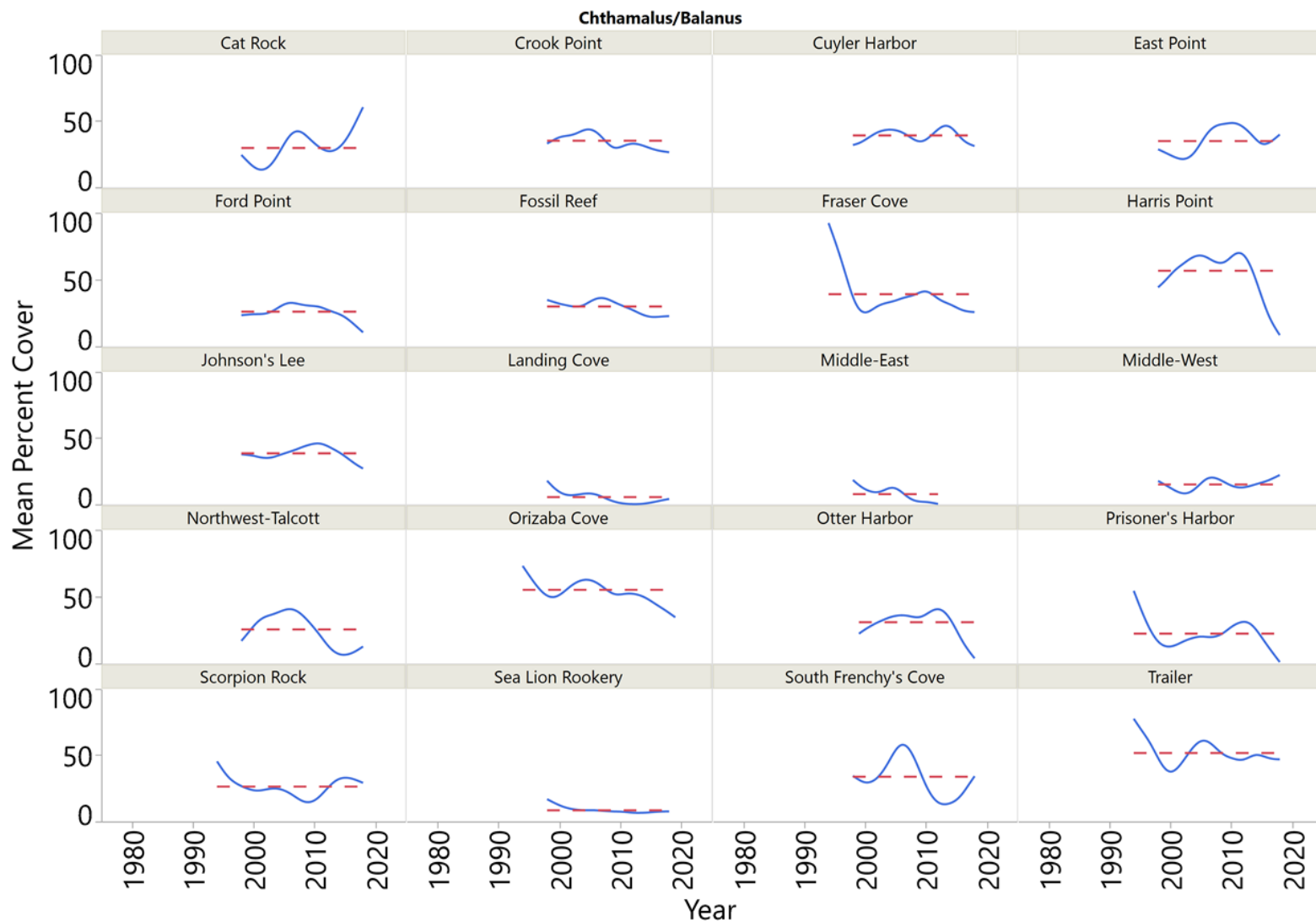


Figure 15. Departure from the long-term mean of percent cover for *Chthamalus/Balanus* spp., at each site in Channel Islands National Park. Blue wavy lines represent mean cover of *Chthamalus/Balanus* within the representative zone pooled across plots at each site. Red dashed lines represent long-term mean. Note that Middle-East has not been sampled since 2013.

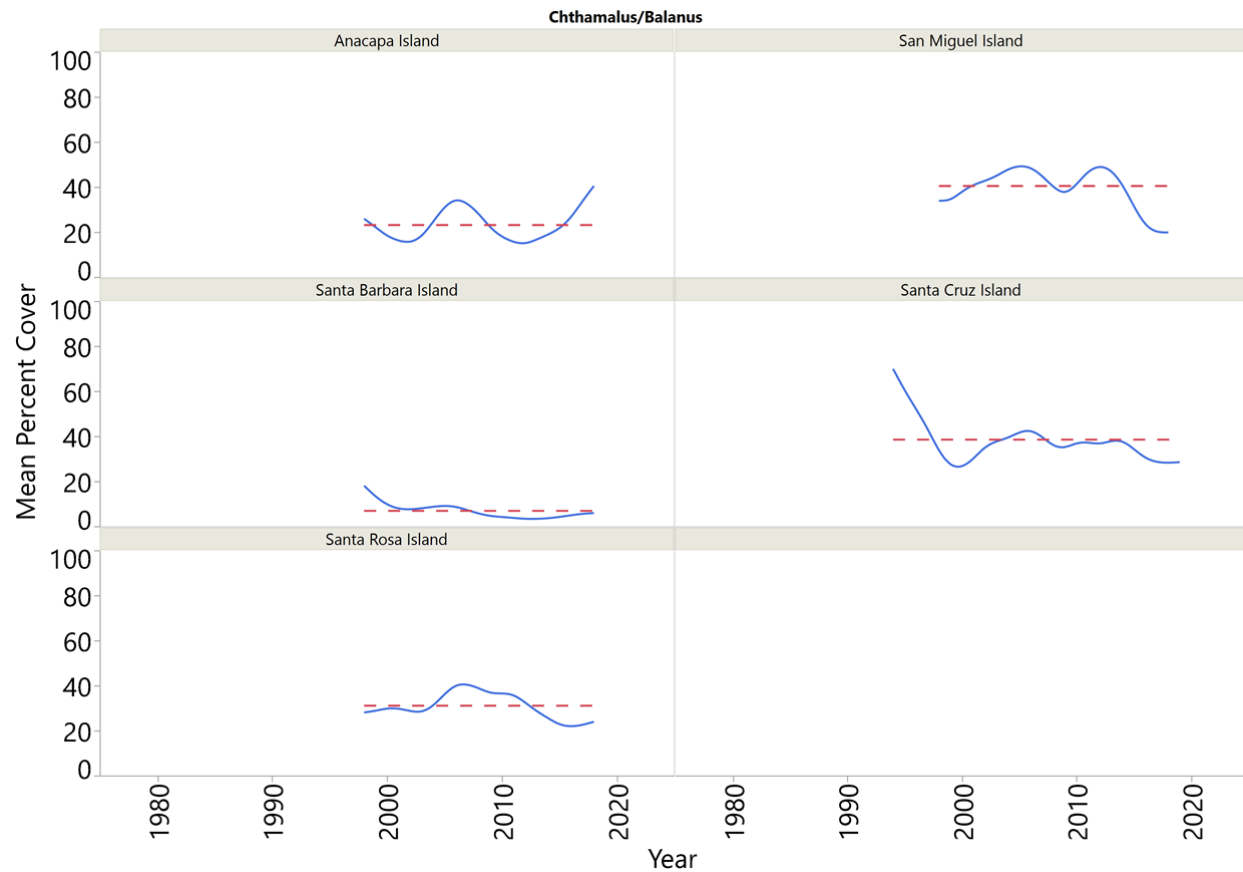


Figure 16. Departure from the long-term mean of percent cover for barnacles, *Chthamalus/Balanus* spp., by island, in Channel Islands National Park. Blue wavy lines represent mean cover of *Chthamalus/Balanus* within the representative zone pooled across plots and sites at each island. Red dashed lines represent long-term mean.

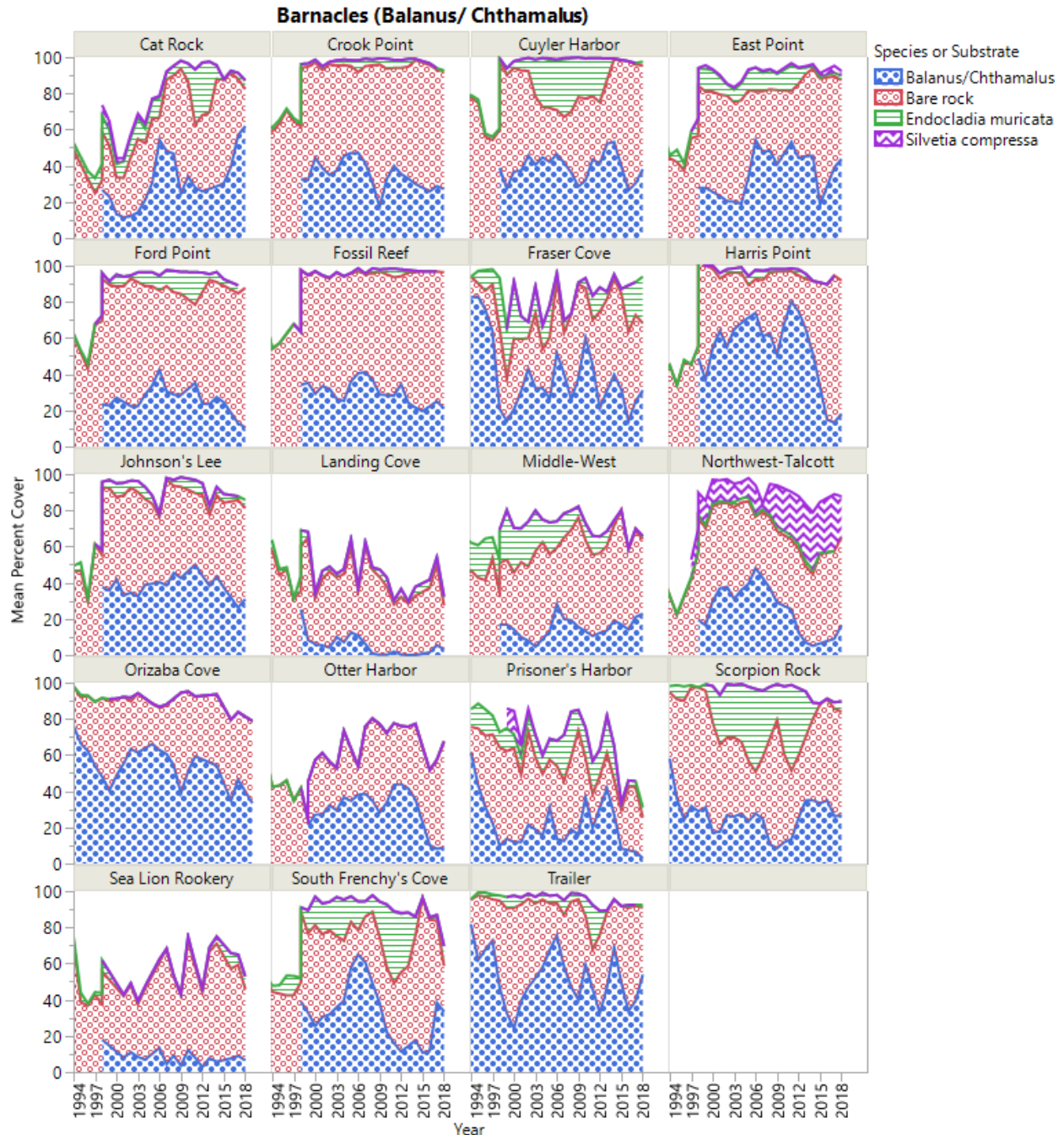


Figure 17. Percent cover of barnacles, *Balanus/Chthamalus* spp., along with turfgrass, *Endocladia muricata*, rockweed, *Silvetia compressa*, and bare rock in fixed plots within the barnacle (*Balanus/Chthamalus*) zone at each site in Channel Islands National Park. Note that barnacle species were not separated. Colored areas represent the mean percent cover for representative and dominant taxa/substrata from replicated plots (usually five) within the *Chthamalus/Balanus* zone.

Pollicipes polymerus

Pollicipes polymerus (goose or leaf barnacle) zone plots have only been established at Fraser Cove, where goose barnacle cover has declined slowly over time from approximately 20% in the mid-1990s

to well below 10% by 2009. *Pollicipes polymerus* cover has increased since 2009 and was near the long-term mean in 2018–2019 (Figure 18). Other dominant species in the *P. polymerus* plots have included *Mytilus californianus* and *Tetraclita rubescens* (Figure 19).

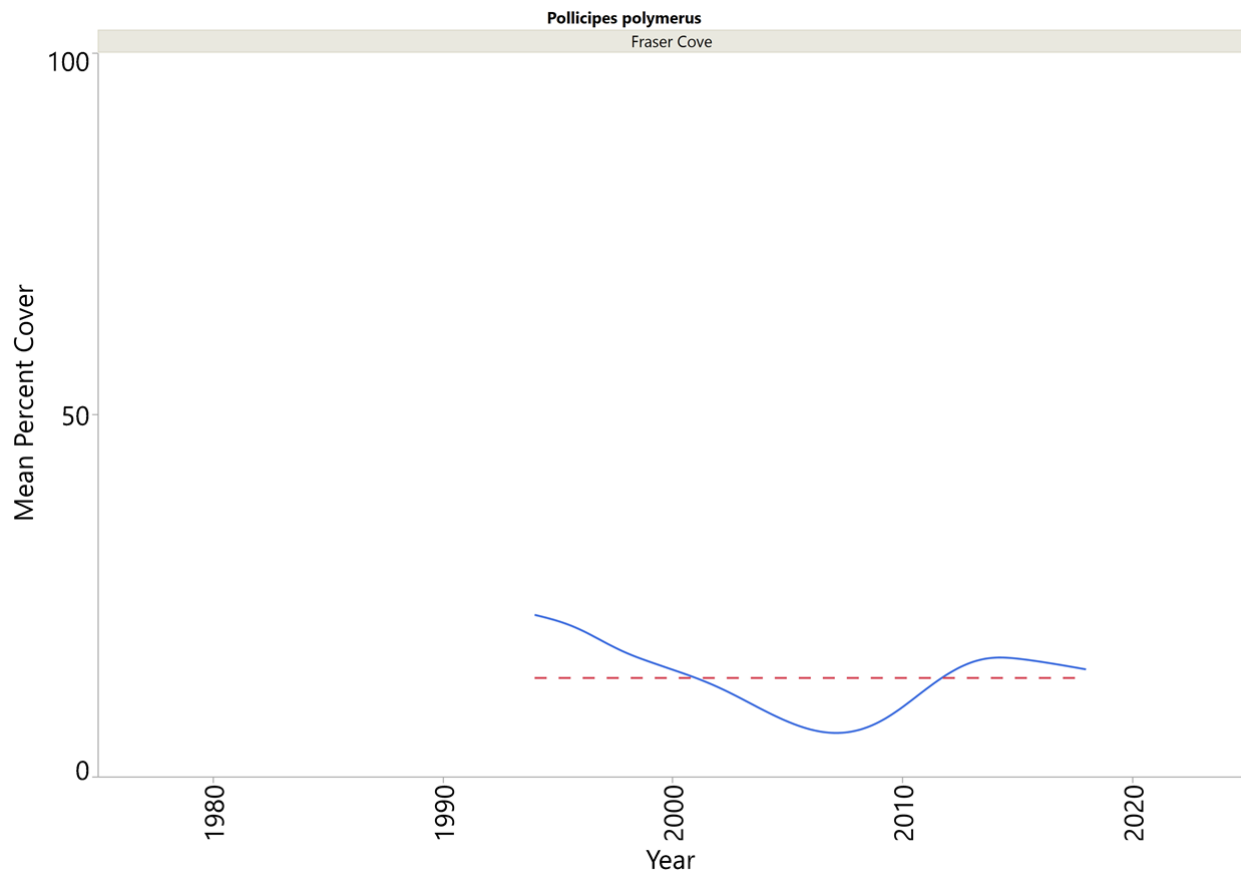


Figure 18. Departure from the long-term mean of percent cover for goose or leaf barnacles, *Pollicipes polymerus*, at Fraser Cove on Santa Cruz Island in Channel Islands National Park. Blue wavy lines represent mean cover of *P. polymerus* within the representative zone pooled across plots at Fraser Cove. Red dashed line represents long-term mean.

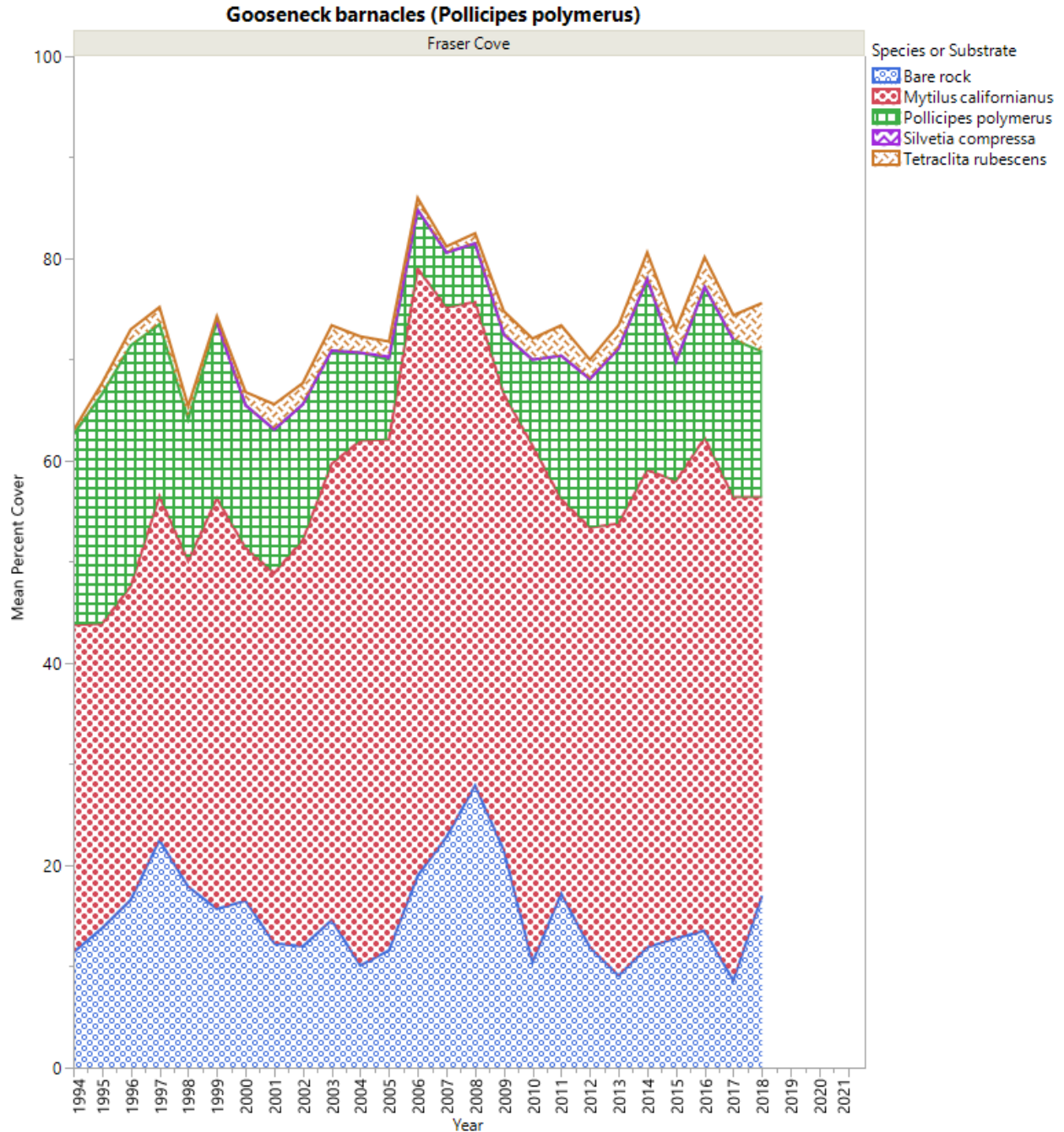


Figure 19. Percent cover of goose or leaf barnacles, *Pollicipes polymerus*, along with other dominant taxa and bare rock in fixed plots within the *Pollicipes* zone at Fraser Cove, Santa Cruz Island, in Channel Islands National Park. Colored areas represent the mean percent cover for representative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

Tetraclita rubescens

Tetraclita rubescens (thatched barnacle) is only monitored at three sites (Harris Point, Orizaba Cove, and Scorpion Rock). Thatched barnacles were near the long-term mean at all three locations in 2018–

2019 (Figure 20). Other dominant species in the *T. rubescens* plots have included *Mytilus californianus* and *Pollicipes polymerus* (Figure 21).

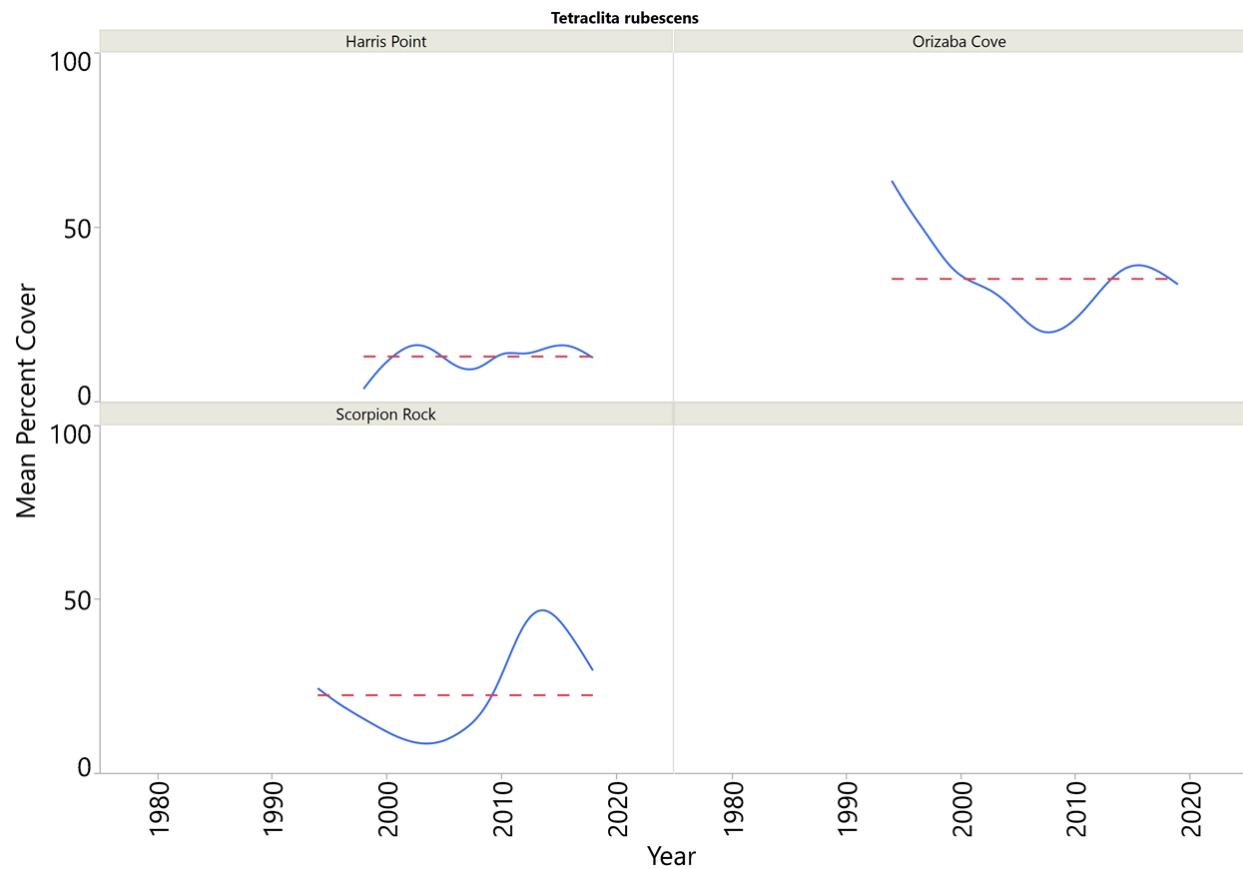


Figure 20. Departure from the long-term mean of percent cover for thatched barnacles, *Tetracrita rubescens*, by site, in Channel Islands National Park. Blue wavy lines represent mean cover of *T. rubescens* within the representative zone pooled across plots at each site. Red dashed line represent long-term mean.

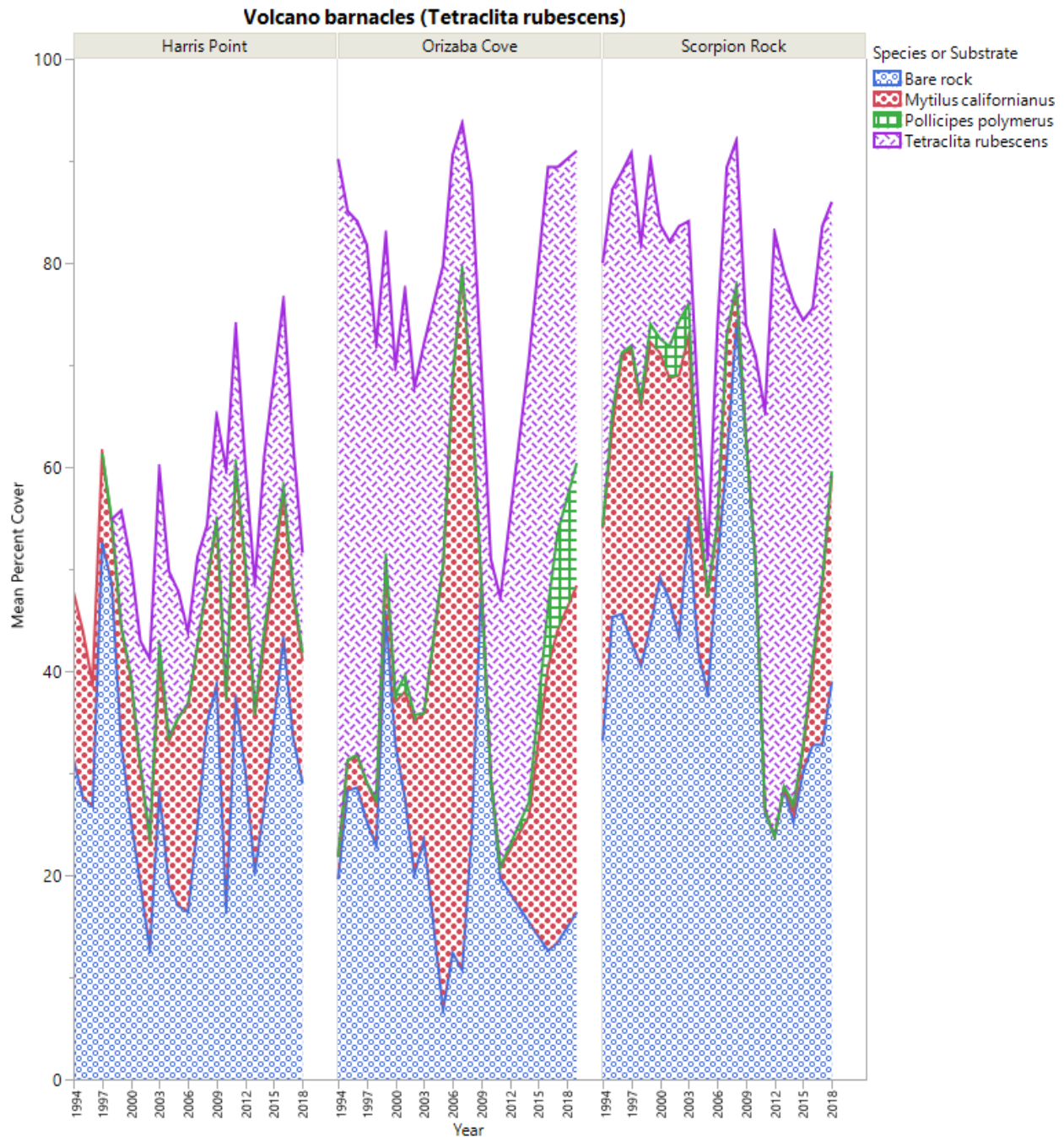


Figure 21. Percent cover of thatched barnacles, *Tetraclita rubescens*, along with other dominant taxa and bare rock in fixed plots within the *Tetraclita* zone at each site in Channel Islands National Park. Colored areas represent the seasonal mean percent cover for representative and dominant taxa/substrata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

Tar

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. In 2018–2019 tar cover was equivalent to the long-term mean (approximately 50%) (Figures 22–23).

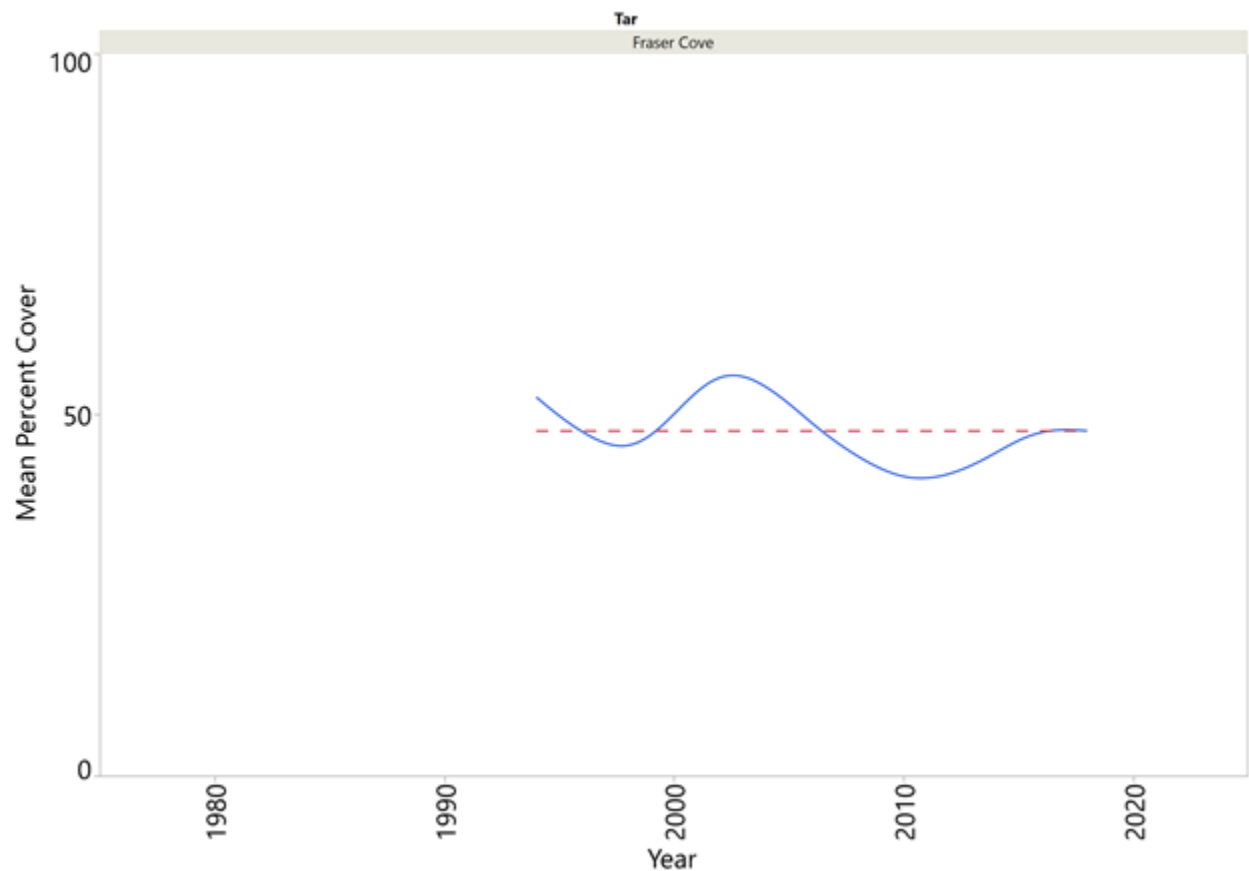


Figure 22. Departure from the long-term mean of percent cover for tar at Fraser Cove on Santa Cruz Island in Channel Islands National Park. Blue wavy line represents mean cover of tar within the representative zone pooled across plots at Fraser Cove. Red dashed line represents long-term mean.

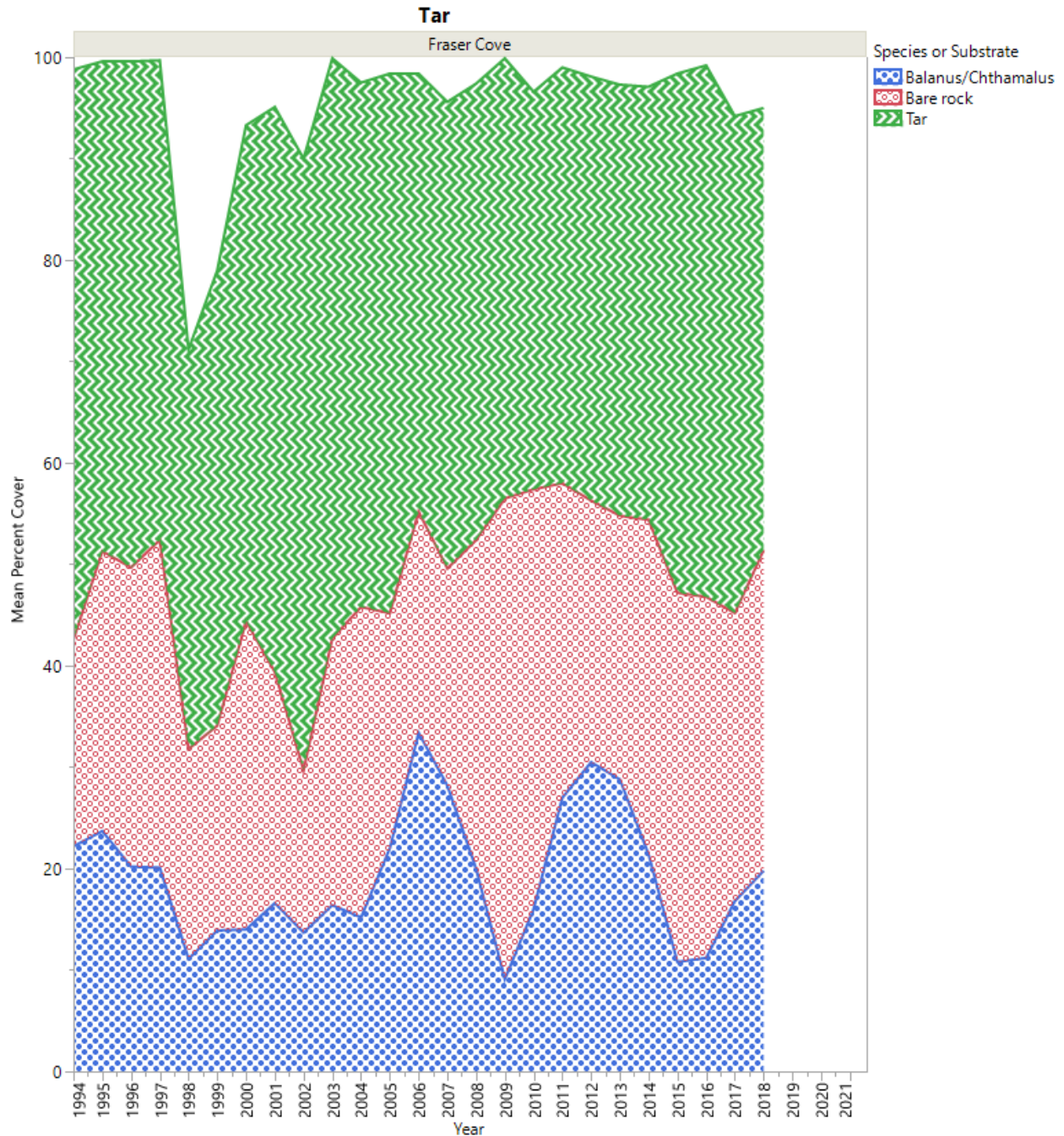


Figure 23. Percent cover of tar along with other dominant taxa and bare rock in fixed plots within the tar zone at Fraser Cove, Santa Cruz Island, in Channel Islands National Park. Colored areas represent the mean percent cover for representative and dominant taxa/substrata from five tar plots.

Haliotis cracherodii

Following the collapse of the black abalone (*Haliotis cracherodii*) population in southern California due to Withering Syndrome in the late 1980s and early 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, 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 have been checked most years for comparison to early samples, but abalone have rarely been encountered in the plots. In 2018–2019 fixed plots at many 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 historical photographs and bolt-to-bolt location measurements.

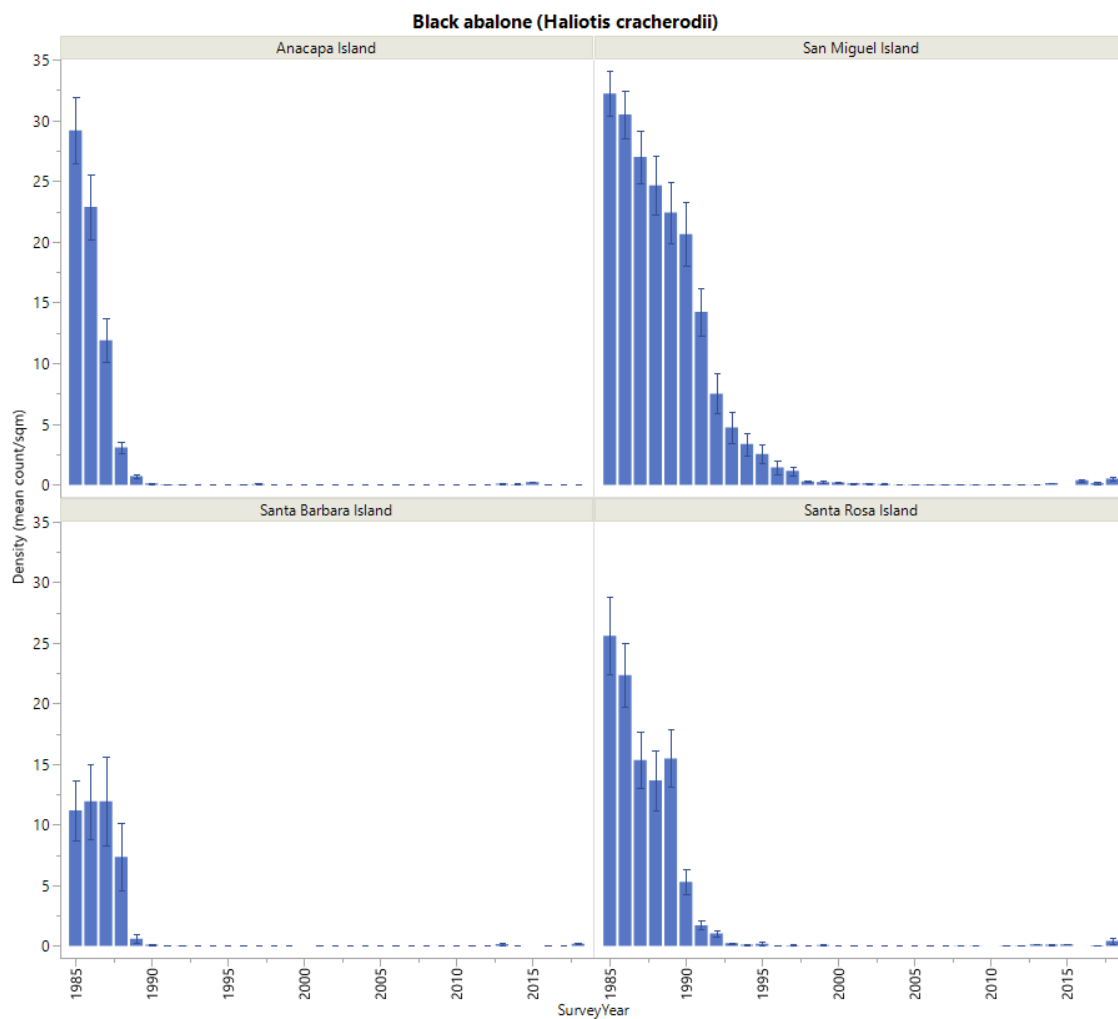


Figure 24. Black abalone, *Haliotis cracherodii*, density from fixed plots at all islands except Santa Cruz from 1985 to 2018/19 in Channel Islands National Park. Note that fixed plots were not established at Santa Cruz Island. Also note that not all fixed plots are sampled every year due to logistical and time constraints. Standard error bars were constructed using one standard error from the mean.

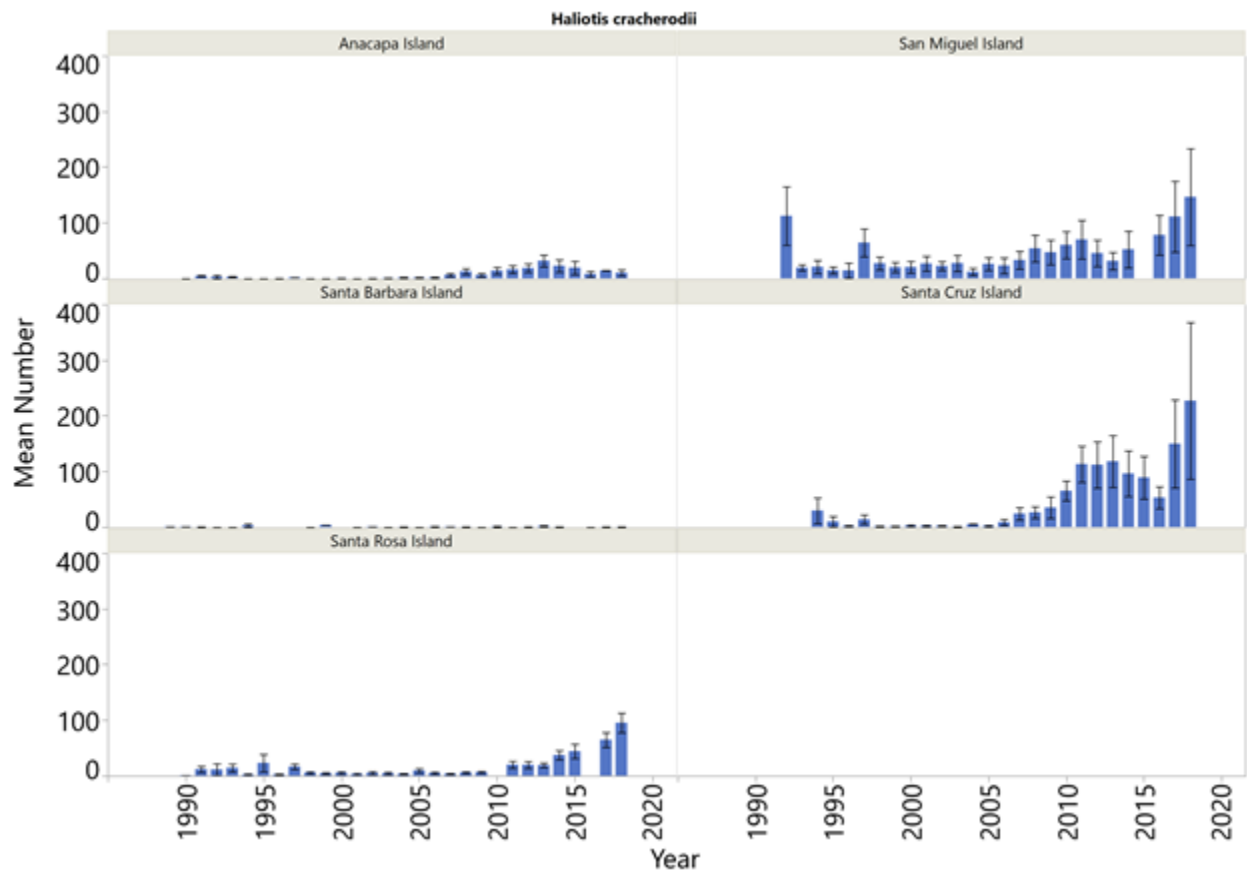


Figure 25. Mean counts of black abalone, *Haliotis cracherodii*, at all islands from 1990 to 2018/19 in Channel Islands National Park. Count data are generally derived from site-wide searches. Error bars were constructed using one standard error from the mean.

During routine timed searches, black abalone were entirely absent from Landing Cove and South Frenchy's Cove. Of the remaining sites where black abalone were seen, fewer than 10 individuals were located at Prisoner's Harbor and Sea Lion Rookery. In contrast, >100 black abalone were observed at seven sites (East Point, Ford Point, Fossil Reef, Otter Harbor, Scorpion Rock [Site B], Trailer, and Willows Anchorage) (Figure 26). Note that search effort increased at several locations due to the greater number of abalone encountered and the greater availability of time. Searches at all sites except Willows Anchorage were conducted within the confines of the site boundaries as defined by the Channel Islands National Park Rocky Intertidal Community Monitoring Program (Richards and Davis 1988) and updated protocol summaries (Richards and Lerma 2000). At Willows, a subset of the entire site was searched (see corresponding trip reports in Appendix B for details).

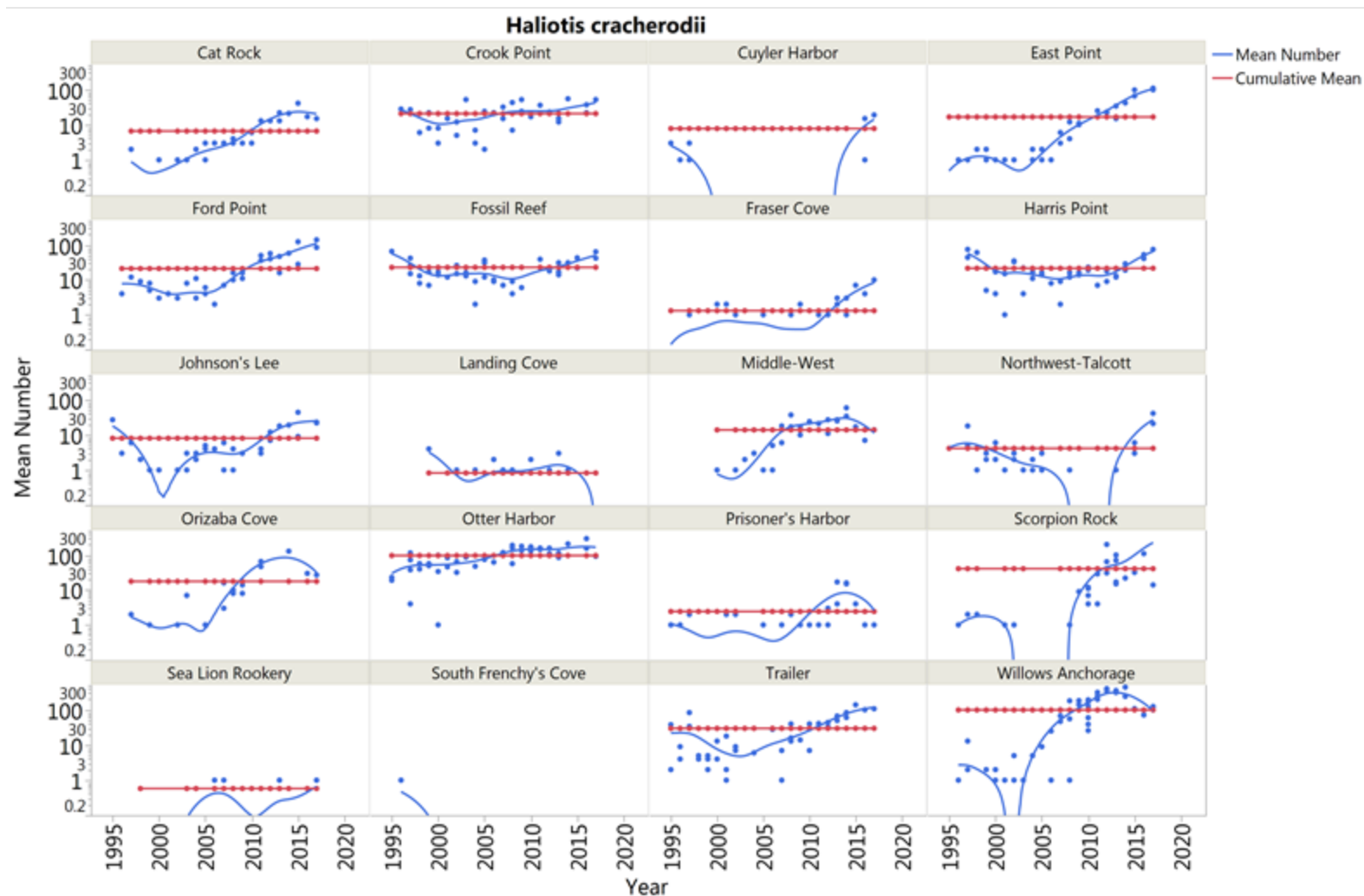


Figure 26. Departure from the long-term mean number for black abalone, *Haliotis cracherodii*, at each site in Channel Islands National Park. Blue wavy lines represent the trend of the mean number of *H. cracherodii* at each site. Horizontal red lines represent cumulative mean. Note that data are displayed on a logarithmic scale.

Above average abundances relative to the long-term mean generated from post-1995 data were observed at all but five sites (Anacapa Middle West, Landing Cove, Prisoner's Harbor, South Frenchy's Cove, and Willows Anchorage) (Figure 26). In some cases, increases were only slightly above the long-term mean, but substantial increases in abundances were documented in 2018–2019 at East Point, Ford Point, Fraser Cove, Northwest-Talcott, Scorpion Rock Site B, and Trailer. At most locations where black abalone counts have increased above the long-term mean, abundances began increasing approximately in 2007–2009.

At the island level, mean abundances of *H. cracherodii* in 2018–2019 measured above the cumulative mean calculated from all years post-1995 for Santa Cruz, Santa Rosa, and San Miguel Islands (Figure 27). The population at Anacapa was comparable to the long-term mean. 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.

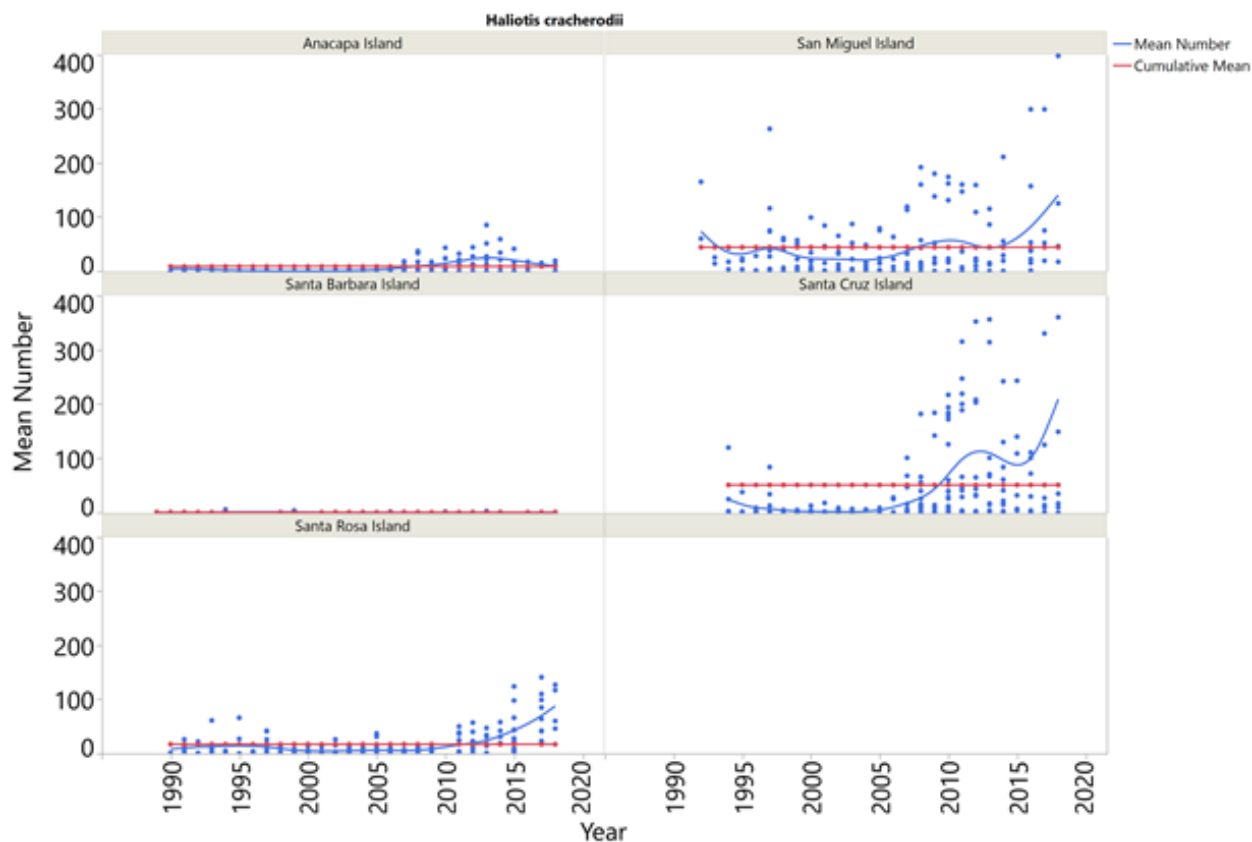


Figure 27. Departure from the long-term mean number for black abalone, *Haliotis cracherodii*, at each island in Channel Islands National Park. Blue wavy lines represent the trend of the mean number of *H. cracherodii* at each island. Horizontal red lines represent cumulative mean.

In 2018–2019, the size frequency distributions of black abalone for all islands (except Santa Barbara) reflected the effects of recruitment through the presence of juvenile (≤ 50 mm shell length) black abalone (Figures 28–30). Medians for populations at Anacapa, Santa Cruz, Santa Rosa and San

Miguel Islands ranged from approximately 75 to 90 mm. Note that the two sites on Santa Barbara Island supported too few abalone to accurately assess population size distribution.

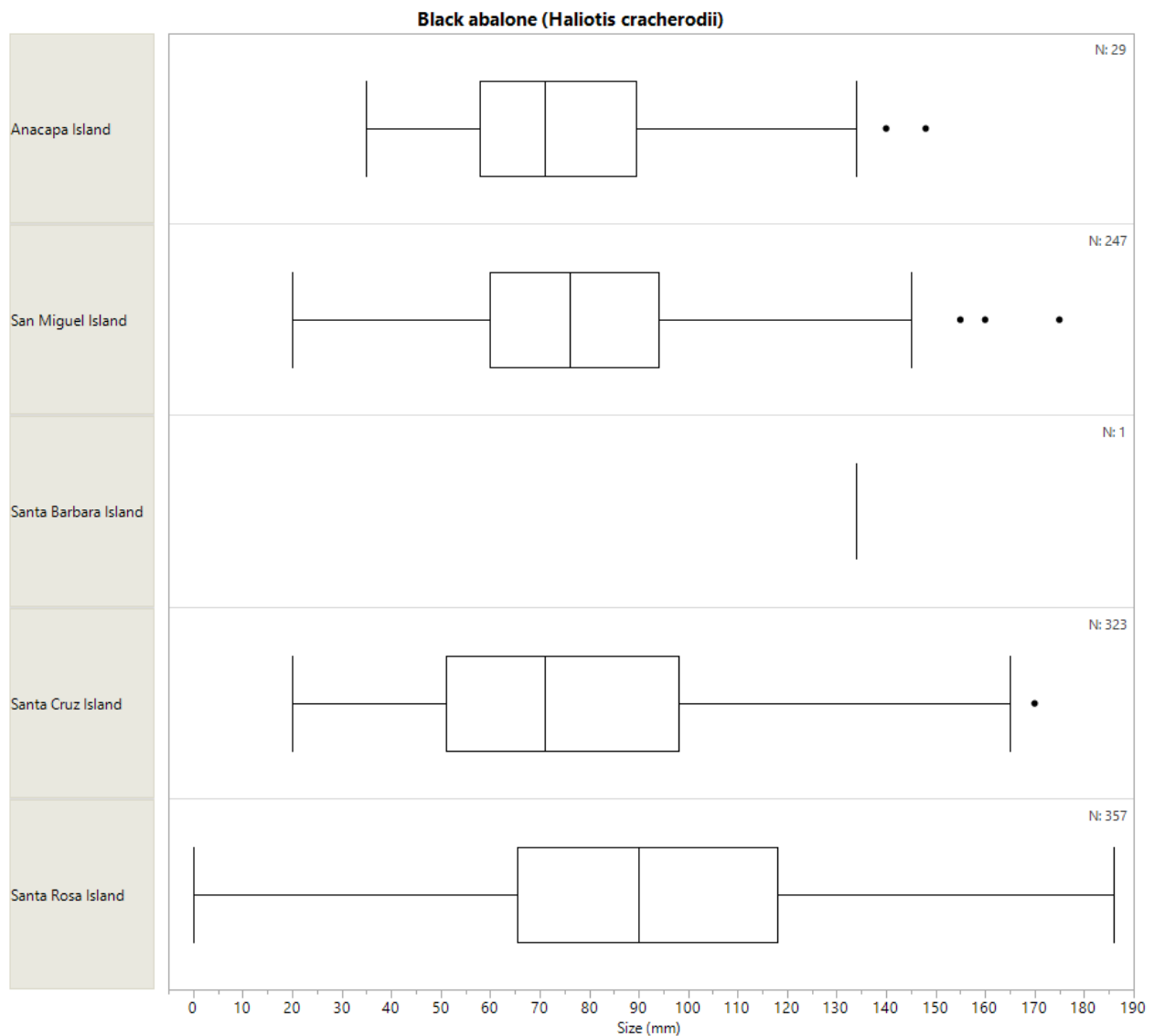


Figure 28. Black abalone, *Haliotis cracherodii*, size frequency distributions pooled across sites at each island measured in 2018–2019 in Channel Islands National Park. Box-and-whisker plots indicate the spread and degree of skewness of the size frequency data. The ends of the boxes represent the 25th 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.

At the site level, in 2018-19, juvenile (≤ 50 mm shell length) black abalone were present at all but four sites (Cuyler Harbor, Fraser Cove, Prisoner’s Harbor, Sea Lion Rookery) (Figure 29). Medians for populations at each site ranged from approximately 55 to 105 mm.

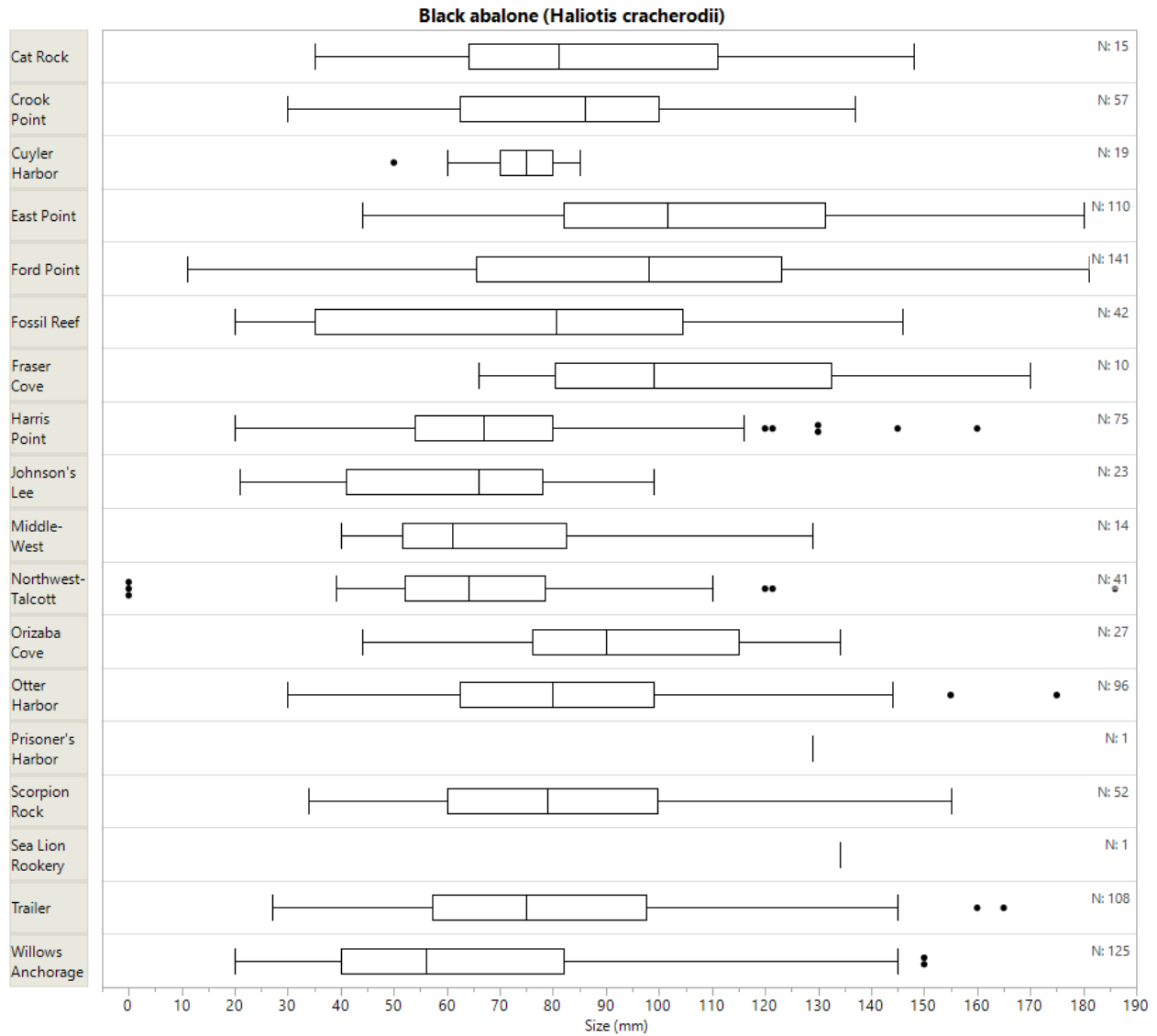


Figure 29. Size frequency distributions of black abalone, *Haliotis cracherodii*, measured at each site in 2018–2019 in Channel Islands National Park. Box-and-whisker plots indicate the spread and degree of skewness of the size frequency data. The ends of the boxes represent the 25th and 75th quartiles, 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.

Over time, the size class frequency distributions of black abalone at each island have varied markedly (Figure 30). At Anacapa Island, relative to the long-term mean, the mean size of black abalone has remained below average since 2006. In 2018–19, the mean size of black abalone at Anacapa increased slightly to approximately the long-term mean for the island population. At San Miguel Island, relative to the long-term mean, the mean size of black abalone has remained below average since 2016. In 2018–19, the mean size of black abalone at San Miguel remained below the long-term mean for the island population. At Santa Barbara Island, there have been too few black abalone since 1990 to estimate the size class frequency distribution for the island population. At

Santa Cruz Island, relative to the long-term mean, the mean size of black abalone has remained approximately average or slightly above average since 2011. At Santa Rosa Island, relative to the long-term mean, the mean size of black abalone has remained below average since 2015.

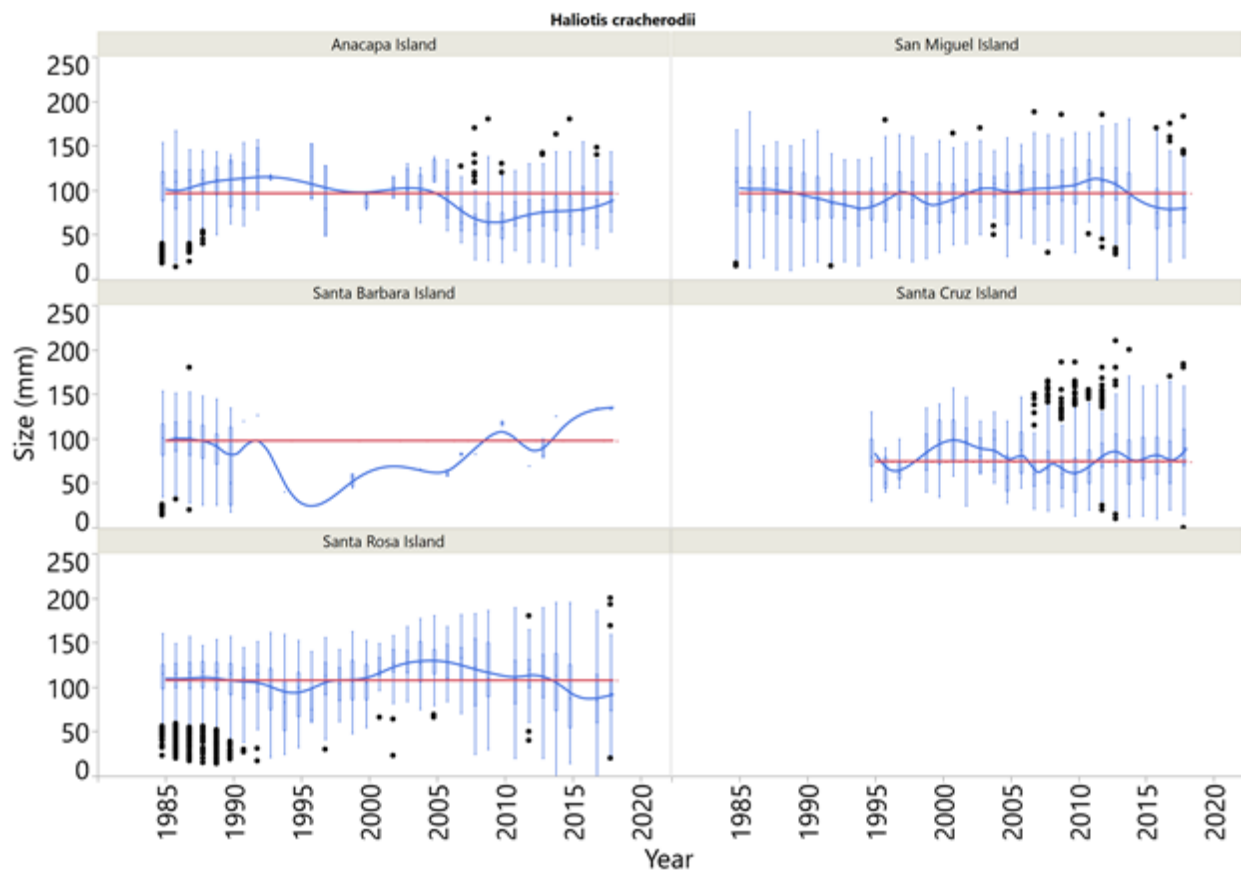


Figure 30. Box plots describing the spread of black abalone, *Haliotis cracherodii*, sizes each year at each island in Channel Islands National Park. Blue wavy lines represent mean sizes of *H. cracherodii* at each island pooled across and sites. Horizontal red lines represent the cumulative mean, and black dots represent outliers.

Shrunken foot, one of the symptoms of Withering Syndrome, was only observed for one dead black abalone at Willows Anchorage in 2018–2019. 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 Withering Syndrome.

Lottia gigantea

Lottia gigantea (owl limpets), were sampled at all sites in 2018–2019 where fixed plots for *L. gigantea* have been established. Averaged across sites for each island, the mean density of limpets increased above the long-term mean at San Miguel and Santa Cruz Islands (Figure 31). The mean densities of *L. gigantea* were comparable to the long-term means at Anacapa and Santa Rosa Islands where fixed plots exist. Note that Santa Barbara Island sites do not have any fixed plots for *L. gigantea*.

At the site level, mean densities of *L. gigantea* were comparable to the long-term mean values calculated for the respective sites at seven locations (Figure 32). Owl limpet densities were exceptionally high at three sites (Northwest-Talcott, Otter Harbor and Willows Anchorage) this year. Below-average densities of limpets were measured at Ford Point and Johnson's Lee.

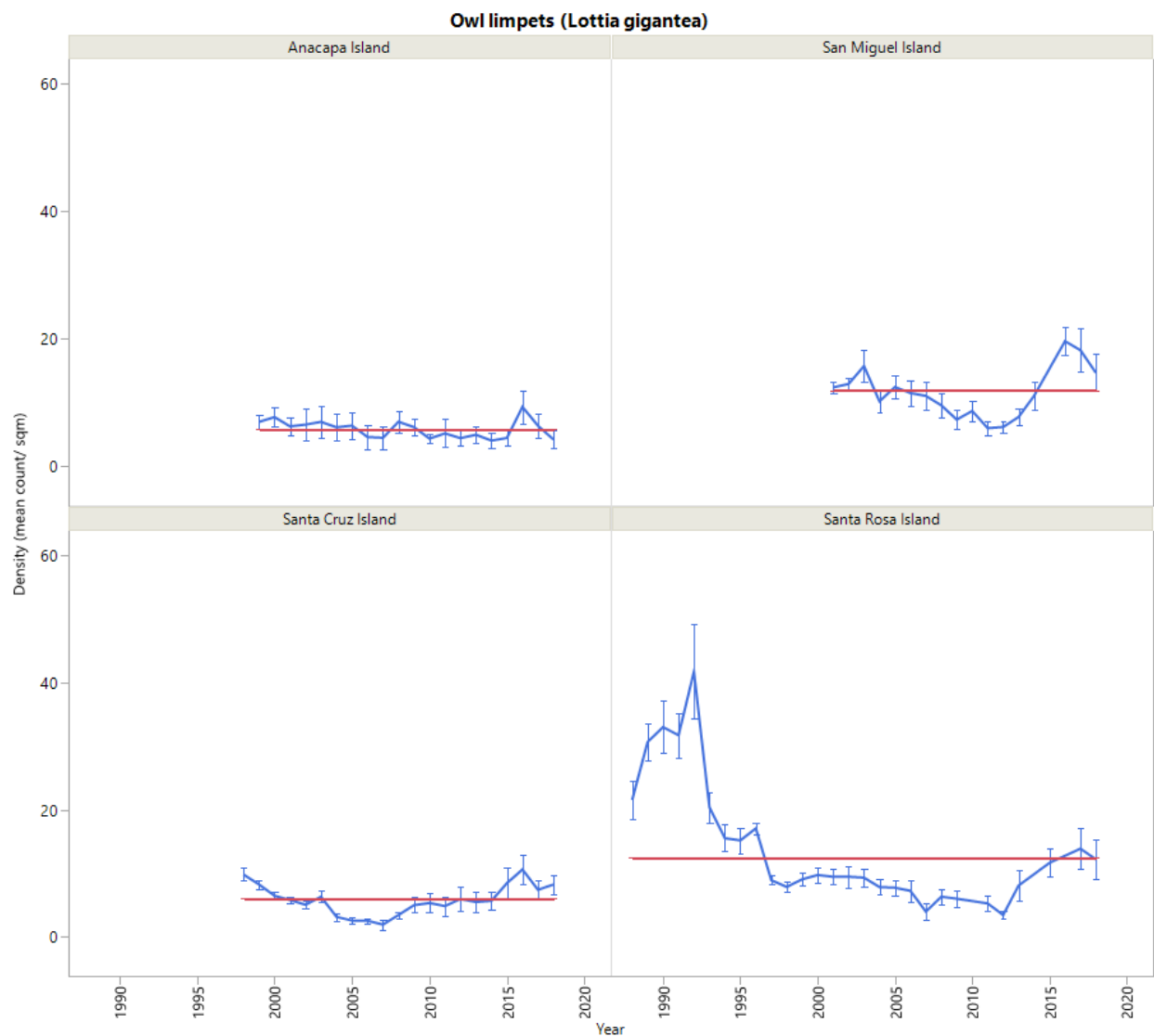


Figure 31. Departure from the long-term mean in density for owl limpet, *Lottia gigantea*, at each island in Channel Islands National Park. Blue wavy lines represent mean density of *L. gigantea* at each island pooled across fixed plots and sites. Horizontal red lines represent cumulative mean density. Error bars were constructed using one standard error from the mean.

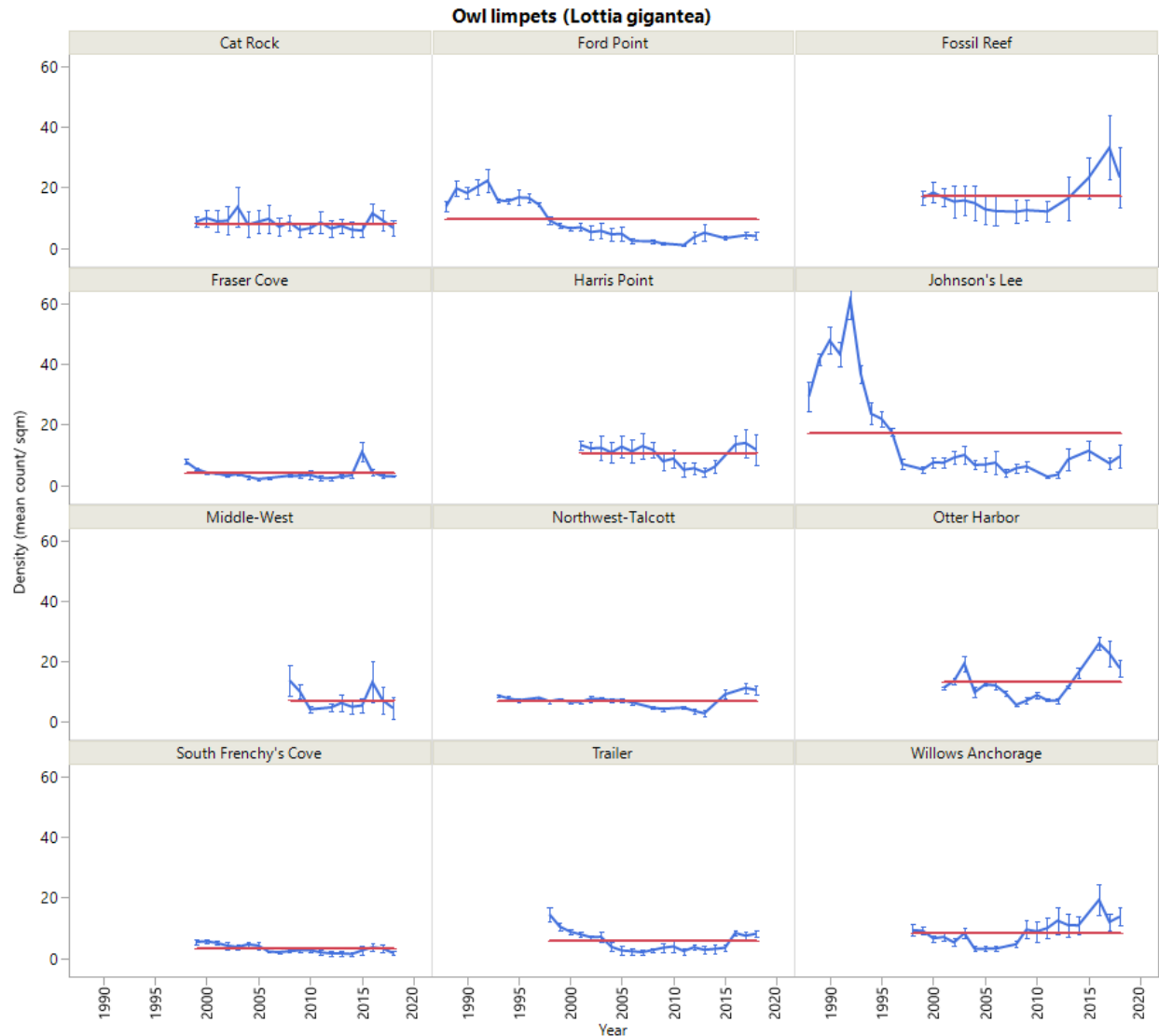


Figure 32. Departure from the long-term mean in density for owl limpet, *Lottia gigantea*, at each site in Channel Islands National Park. Blue wavy lines represent mean density of *L. gigantea* at each site pooled across fixed plots. Horizontal red lines represent cumulative mean density. Error bars were constructed using one standard error from the mean.

The mean size of *L. gigantea* varied among islands (median = 35–45 mm) and sites (median range = 35–55 mm) in 2018–2019 (Figures 33–34). Relative to the mean values, median sizes of owl limpets were slightly lower among islands (range = 30–40 mm) and sites (range = 30–50 mm). The smallest *L. gigantea* were observed at Otter Harbor, followed closely by Willows Anchorage and Anacapa Middle West, and the largest were seen at Northwest-Talcott.

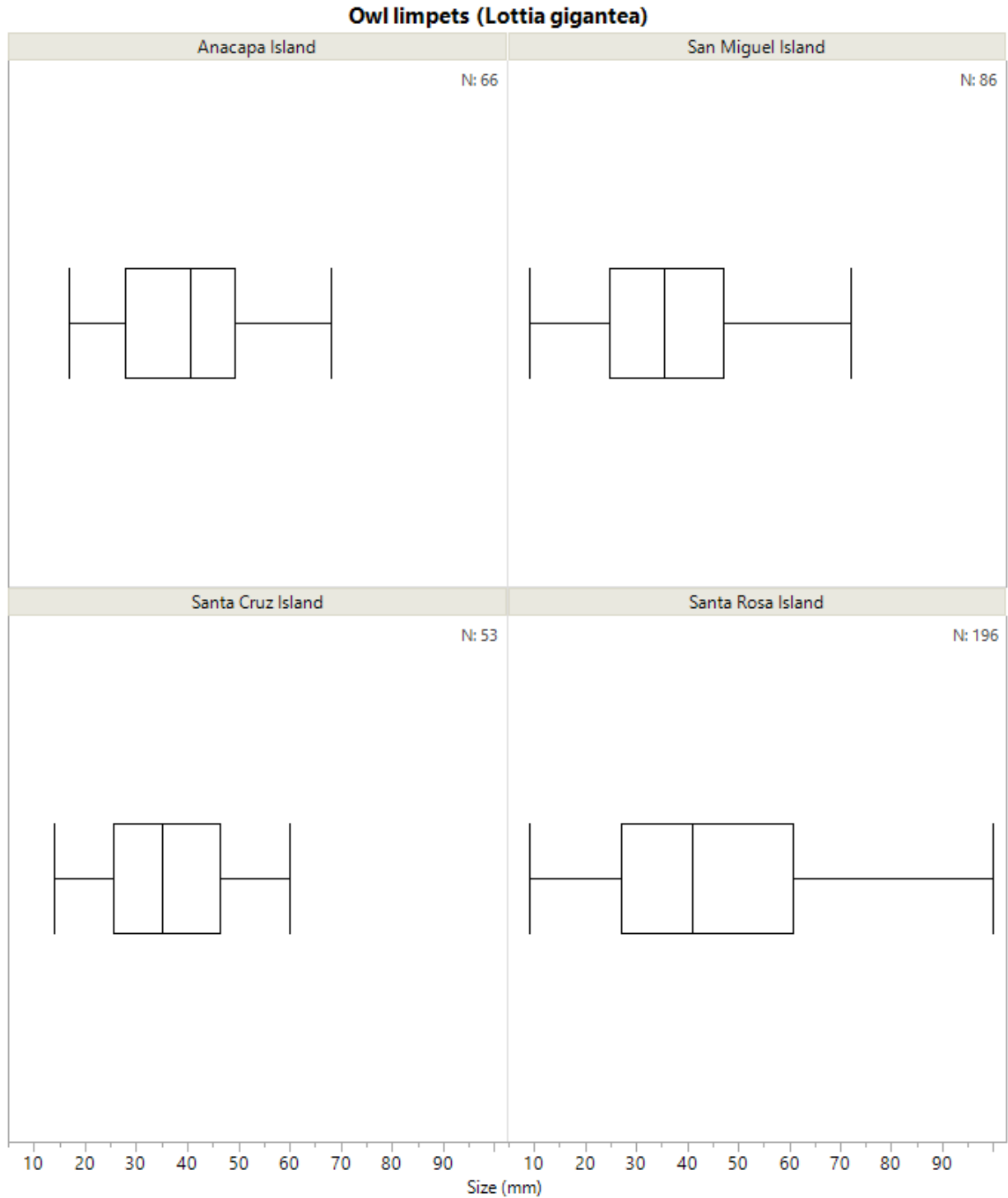


Figure 33. Owl limpet, *Lottia gigantea*, size distributions at each island measured in 2018–2019 in Channel Islands National Park. Box-and-whisker plots indicate the spread and degree of skewness of the size frequency data. The ends of the boxes represent the 25th and 75th quartiles, the vertical line inside the box indicates the median value, and 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. Note that data for Santa Cruz Island only includes Willows Anchorage and a subset of plots at Fraser Cove (data from Trailer and some plots at Fraser Cove were not archived properly and were lost as a result).

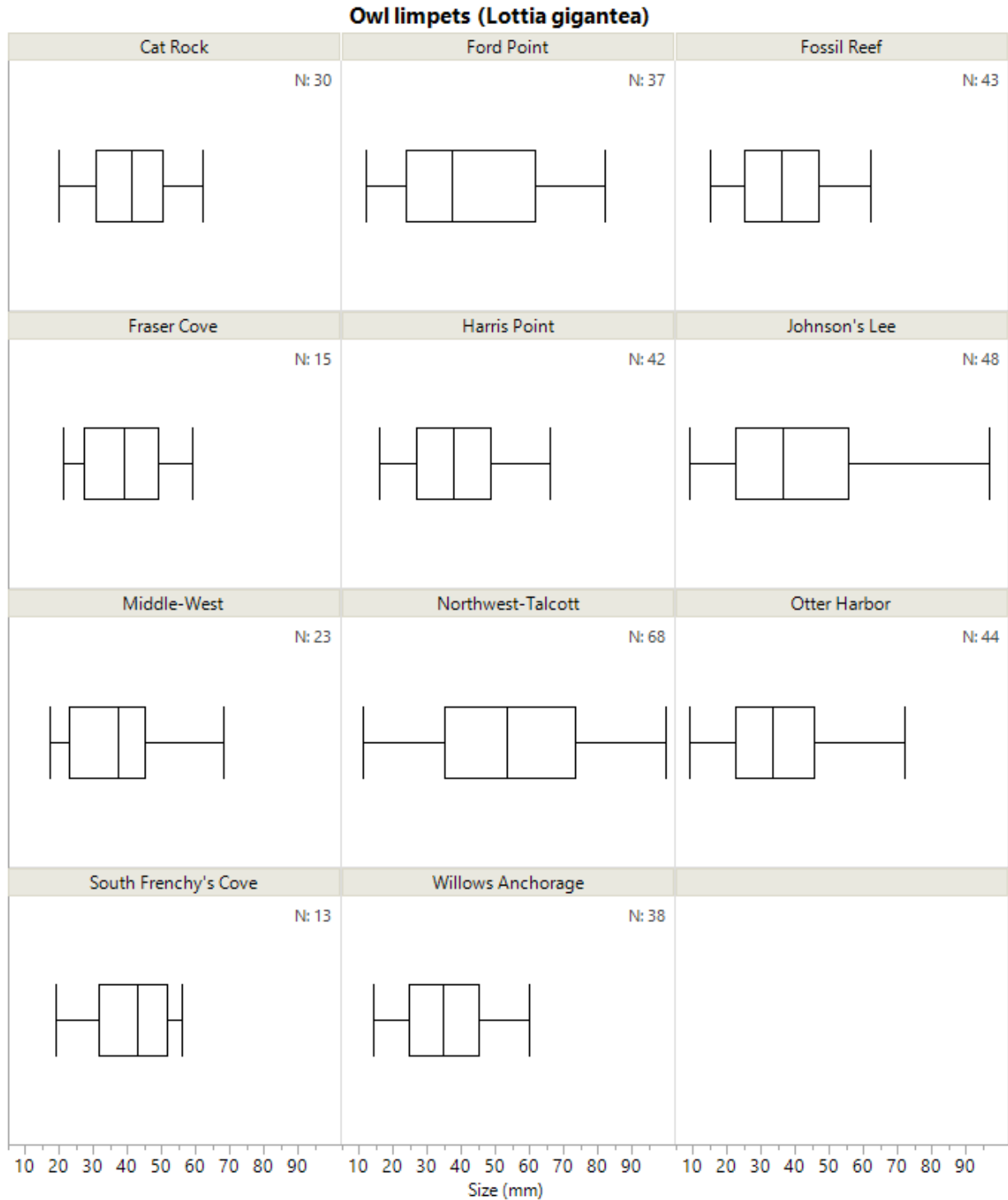


Figure 34. Owl limpet, *Lottia gigantea*, size distributions at each site measured in 2018–2019 in Channel Islands National Park. Box-and-whisker plots indicate the spread and degree of skewness of the size frequency data. The ends of the boxes represent the 25th and 75th quartiles, the vertical line inside the box indicates the median value, and 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. Note that data for Trailer and Fraser Cove are not displayed since they were lost due to improper archival procedures.

Temporally, the mean sizes of *L. gigantea* in 2018–2019 decreased below the cumulative mean for each island except Anacapa (Figure 35). At the site level, mean sizes of owl limpets were near or below average at all locations due to the increased presence of smaller individuals (Figure 36).

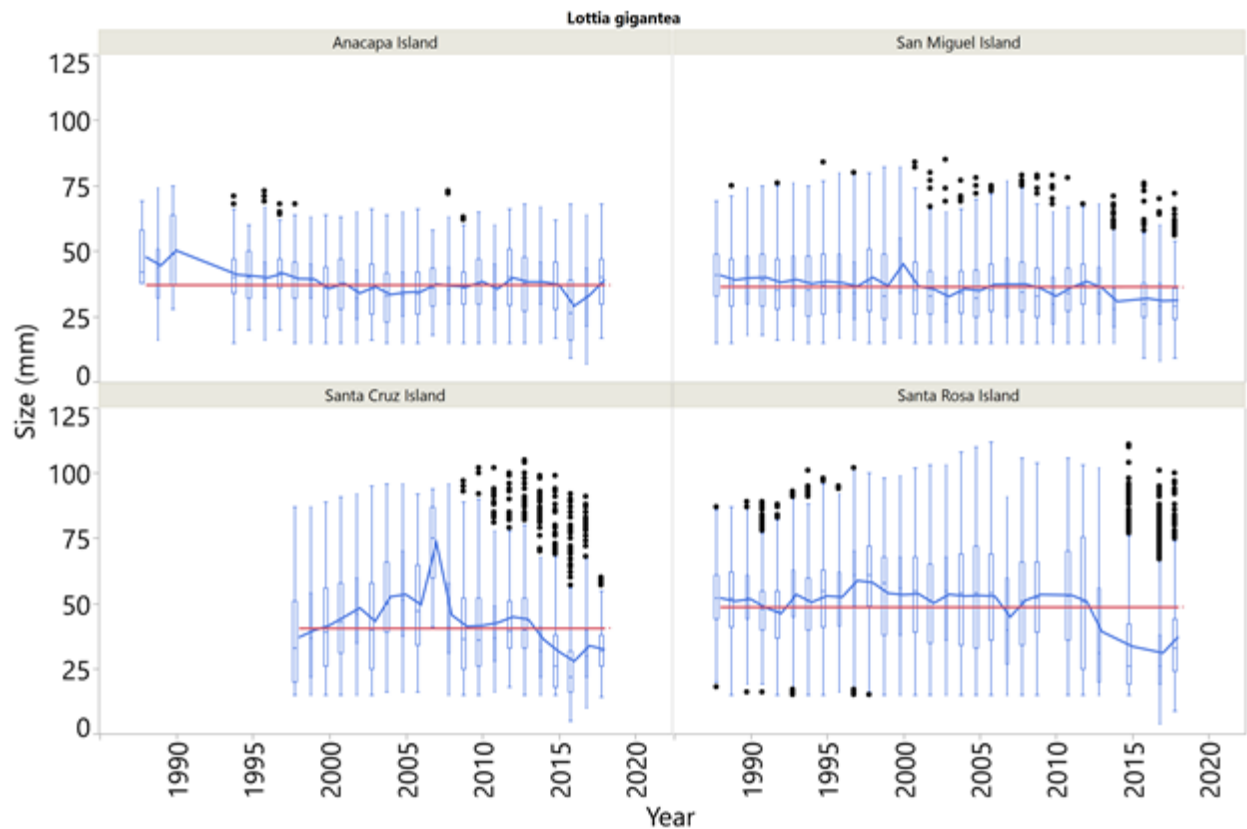


Figure 35. Box plots describing the spread of owl limpet (*Lottia gigantea*) sizes each year at each island in Channel Islands National Park. Blue wavy lines represent mean sizes of *L. gigantea* at each island pooled across fixed plots and sites. Horizontal red lines represent the cumulative mean, and black dots represent outliers.

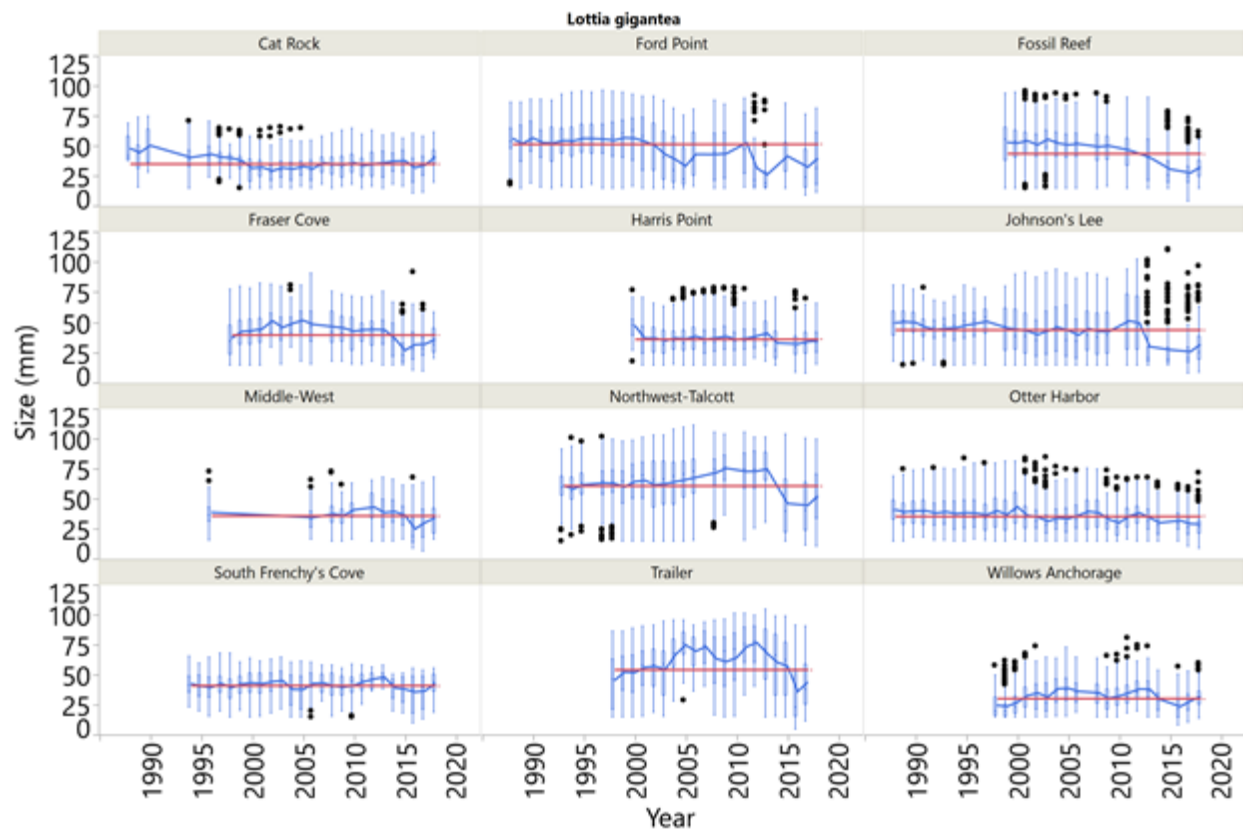


Figure 36. Box plots describing the spread of owl limpet (*Lottia gigantea*) sizes each year at each site in Channel Islands National Park. Blue wavy lines represent mean sizes of *L. gigantea* at each site pooled across fixed plots. Horizontal red lines represent the cumulative mean, and black dots represent outliers.

Pisaster ochraceus

Temporally, the abundances of *Pisaster ochraceus* (sea star) 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 in 2018–2019 at all sites that were sampled (Figures 37–39). At various times during the past decade, extremely high abundances (approximately 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 from 0 to 13 individuals per site, with all but one site (Willows Anchorage) recording fewer than 10 *P. ochraceus* individuals during routine searches.

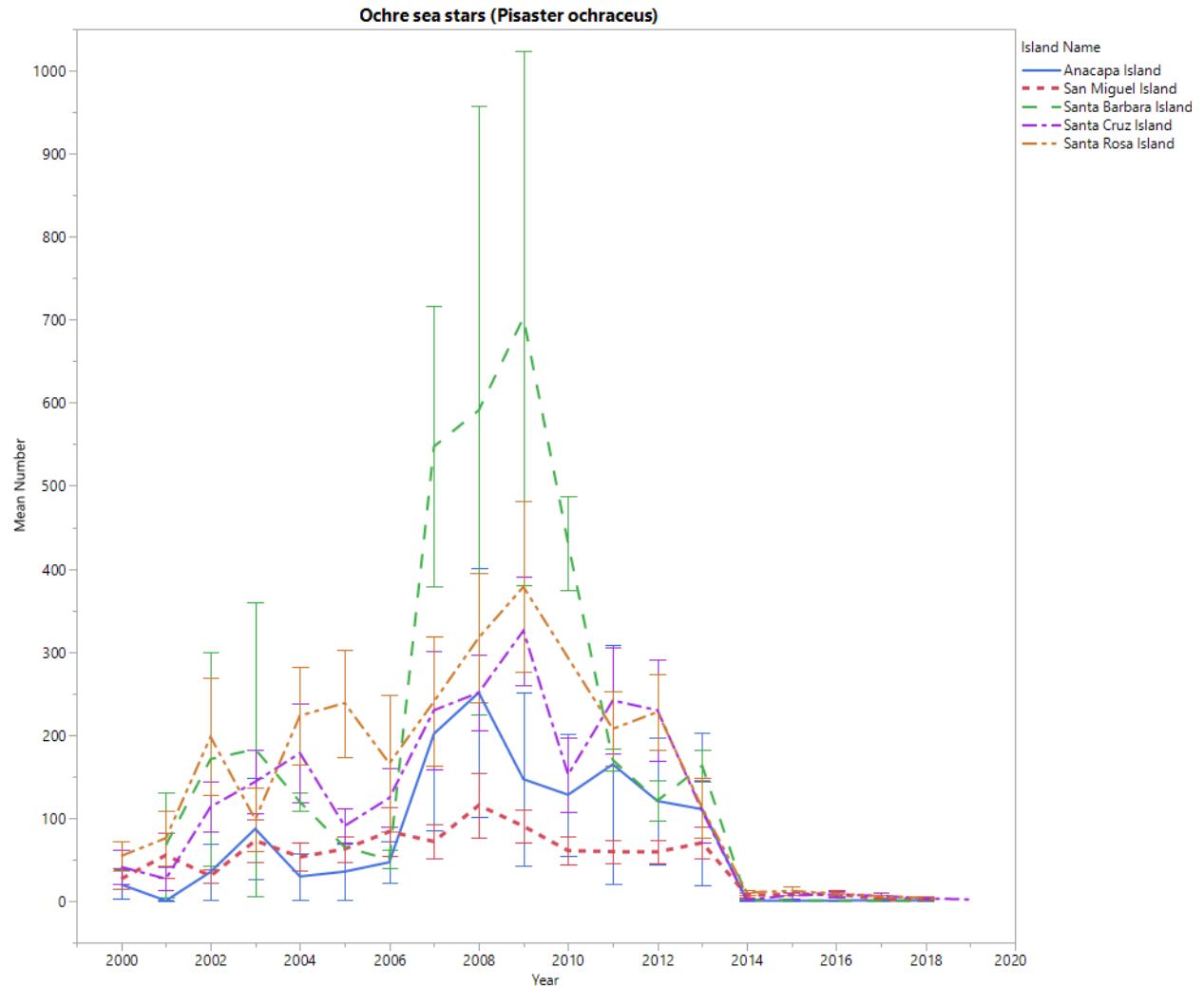


Figure 37. Sea star, *Pisaster ochraceus*, counts pooled across all sites at each island from 2000 to 2019 in Channel Islands National Park. Count data were obtained from 30-minute timed searches. Error bars were constructed using one standard error from the mean.

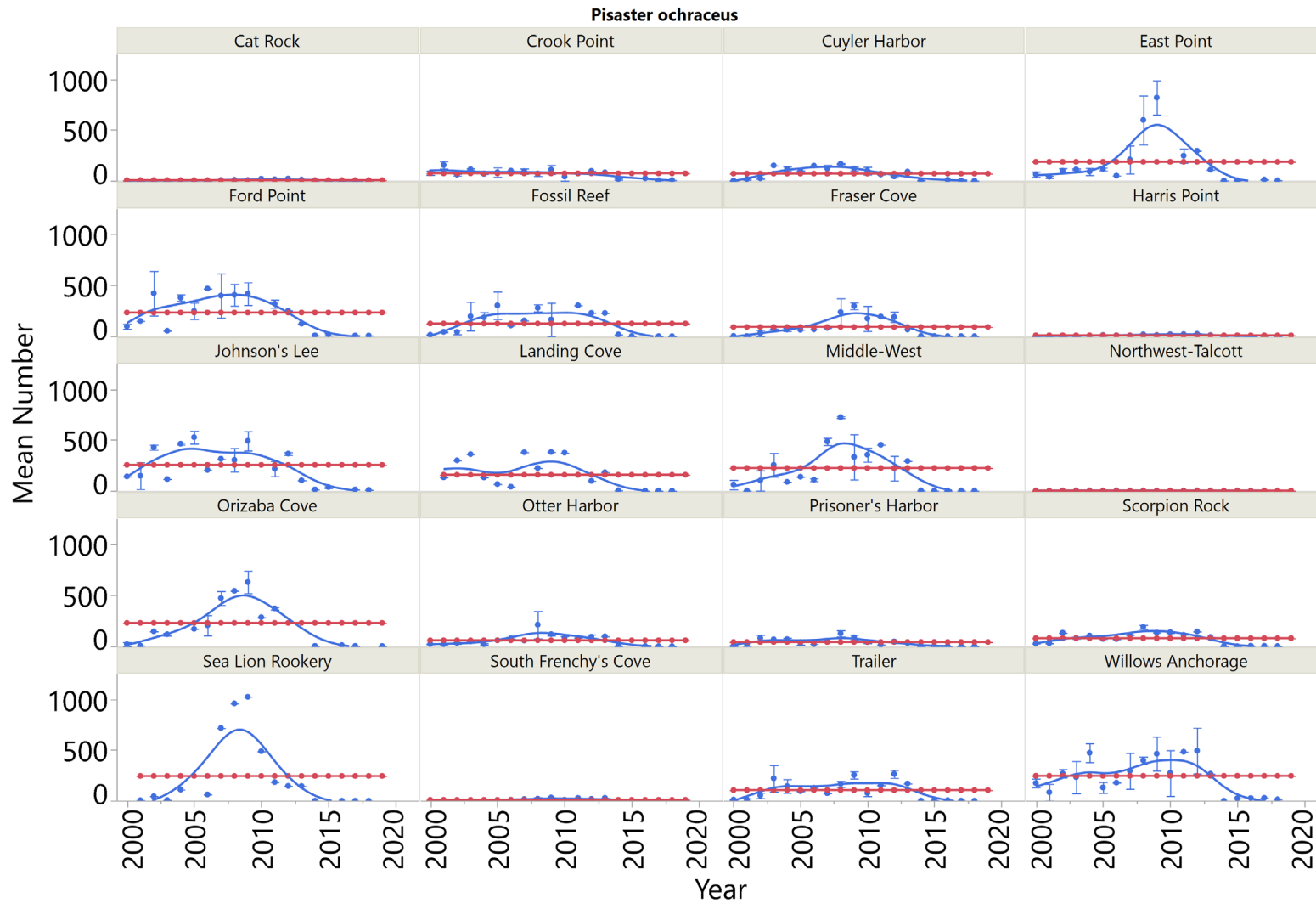


Figure 38. Sea star, *Pisaster ochraceus*, counts at each site from 2000 to 2019 in Channel Islands National Park. Count data were obtained from 30-minute timed searches. Blue wavy lines represent the mean number of *P. ochraceus* and horizontal red dashed lines indicate the long-term mean number of *P. ochraceus* at each site. Error bars were constructed using one standard error from the mean.

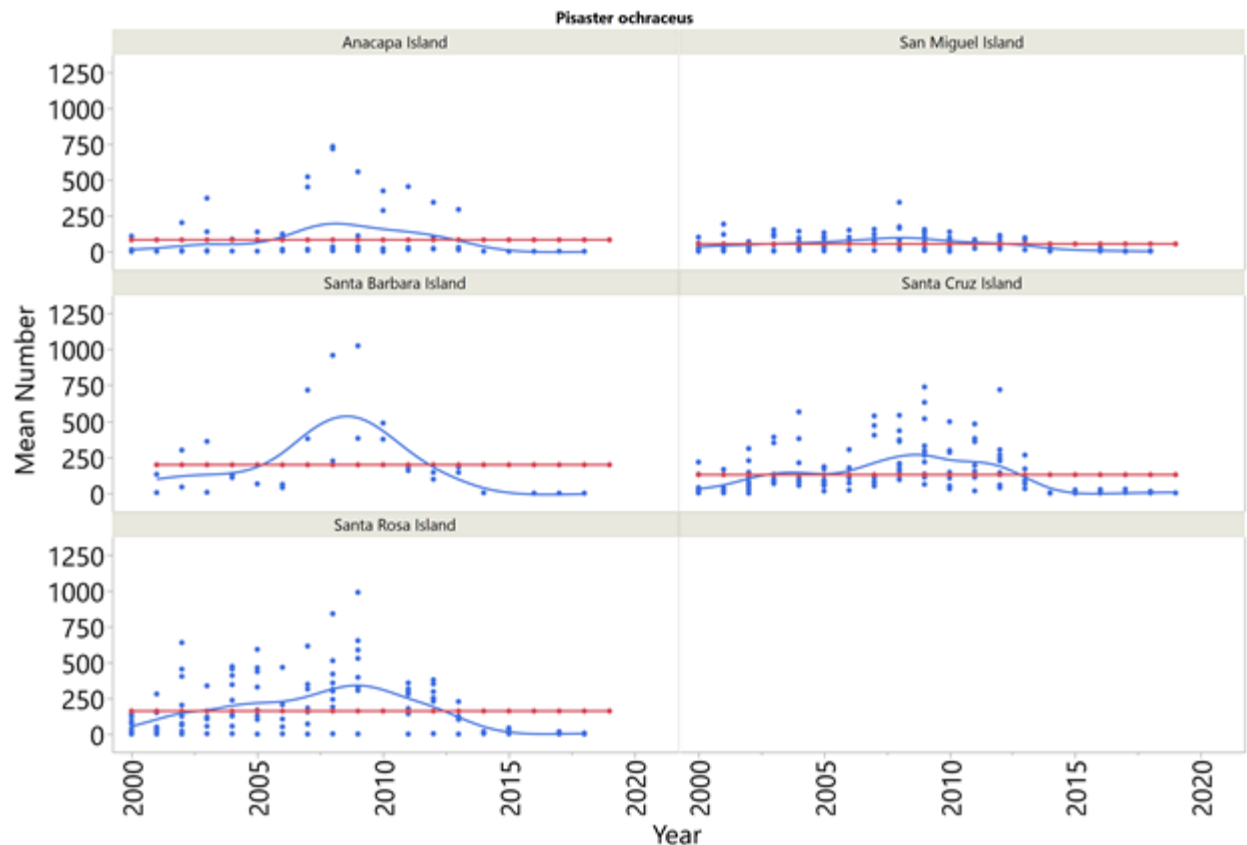


Figure 39. Sea star, *Pisaster ochraceus*, mean counts at each island from 2000 to 2019 in Channel Islands National Park. Count data were obtained from 30-minute timed searches. Blue wavy lines represent the mean number of *P. ochraceus* and horizontal red dashed lines indicate the long-term mean number of *P. ochraceus* at each island.

Beginning in June 2013, a disease event swiftly and significantly impacted *P. ochraceus* (among other species of sea star) 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 was tied to sea star wasting syndrome (SSWS), also called sea star wasting disease (SSWD). The syndrome is typically characterized by a suite of symptoms that initially consist of lesions forming in the ectoderm, which then lead 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, animals that appeared outwardly healthy 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.

Size frequency measurements for *P. ochraceus* were collected at all sites sampled in 2018–2019. 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 2018–2019, size data for each island (sites lumped across islands) and site are displayed in Figures 40–42. This year we only observed small juvenile (e.g., <50 mm) *P. ochraceus* at East Point and Willows Anchorage.

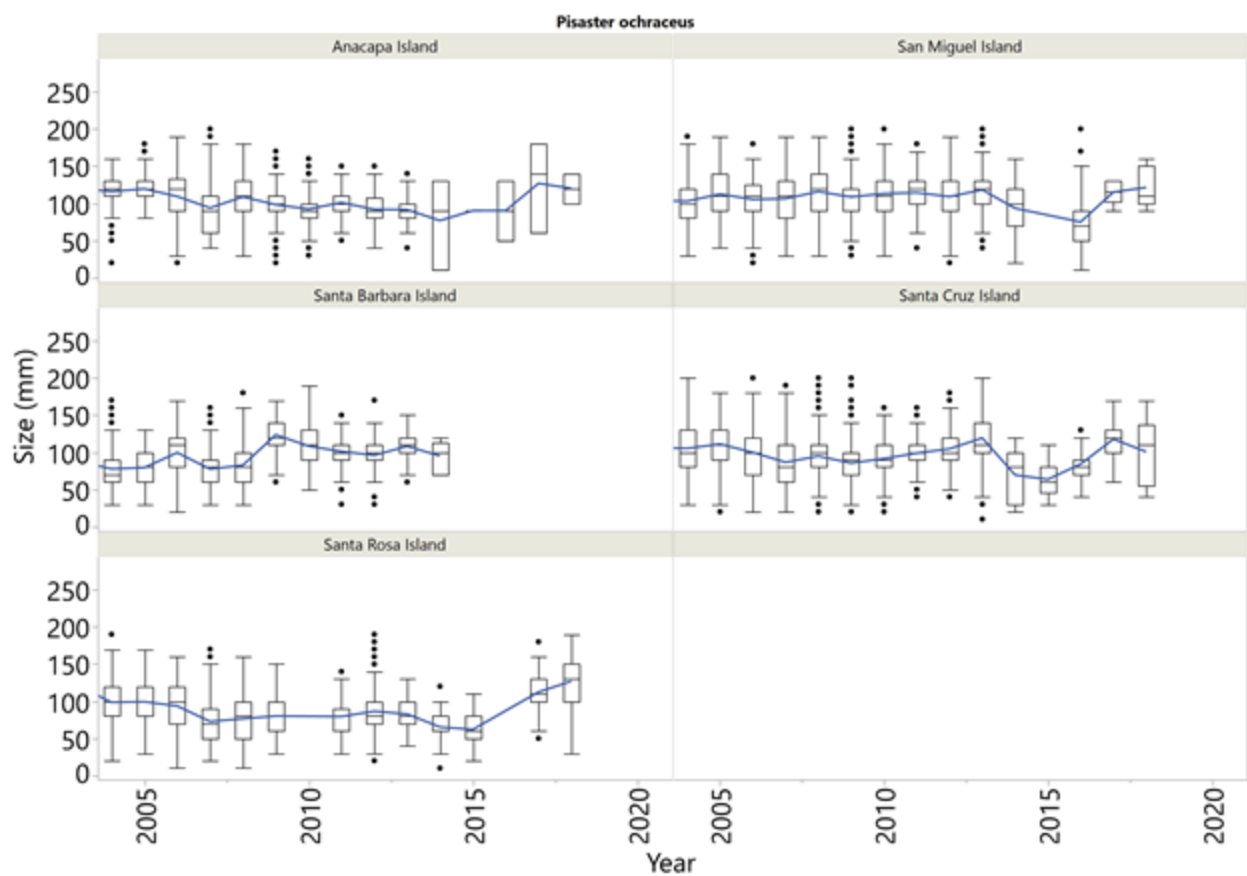


Figure 40. Box plots for sea star, *Pisaster ochraceus*, sizes by year at each island from 2004 to 2018 in Channel Islands National Park. Blue wavy lines represent mean sizes of *P. ochraceus* at each island pooled across sites. Note that low abundances of *P. ochraceus* have been observed at nearly all sites since 2014.

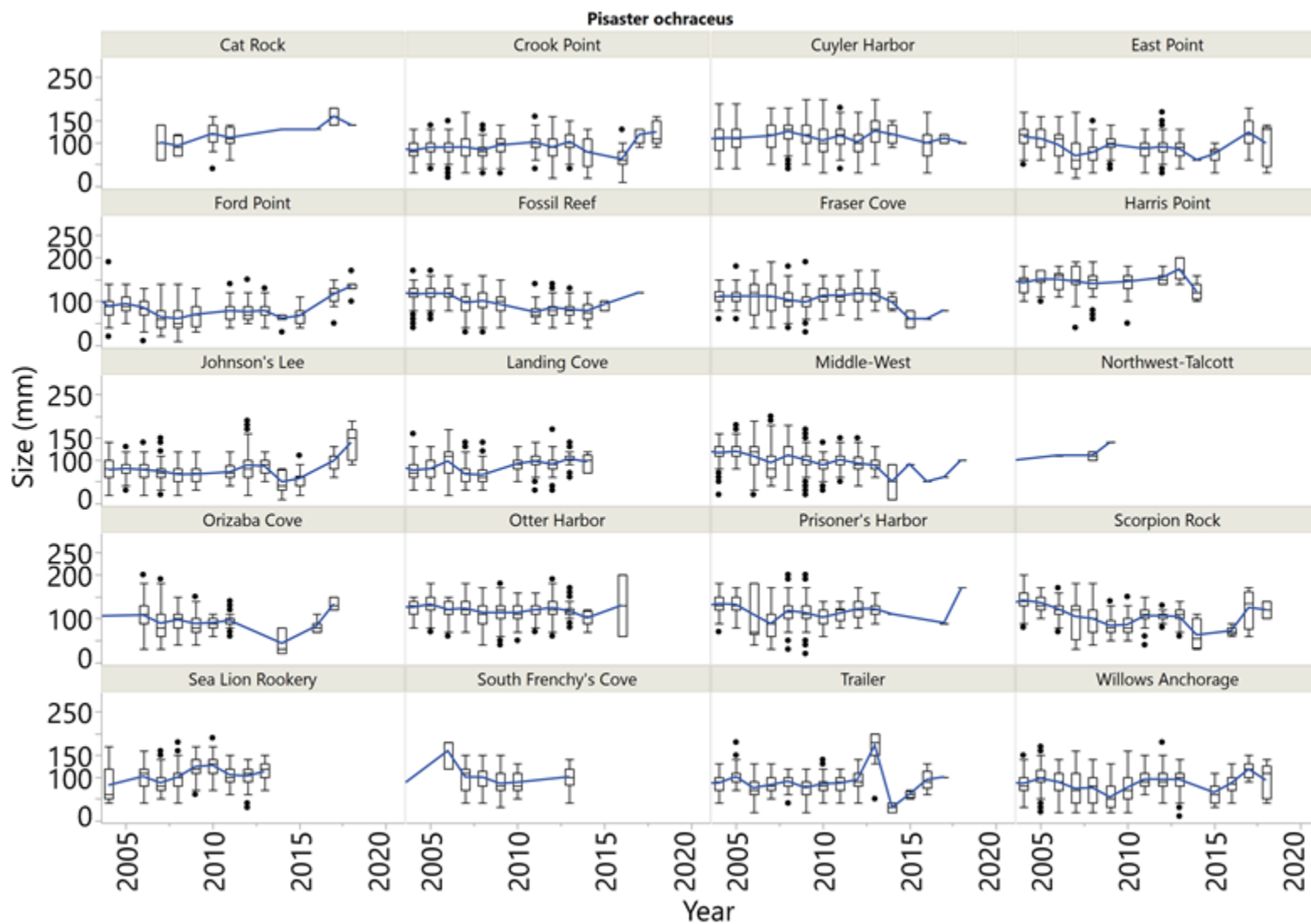


Figure 41. Box plots for annual size of sea star, *Pisaster ochraceus*, at each site in Channel Islands National Park. Blue lines represent mean sizes of *P. ochraceus* at each site. Note that low abundances of *P. ochraceus* have been observed at nearly all sites since 2014.

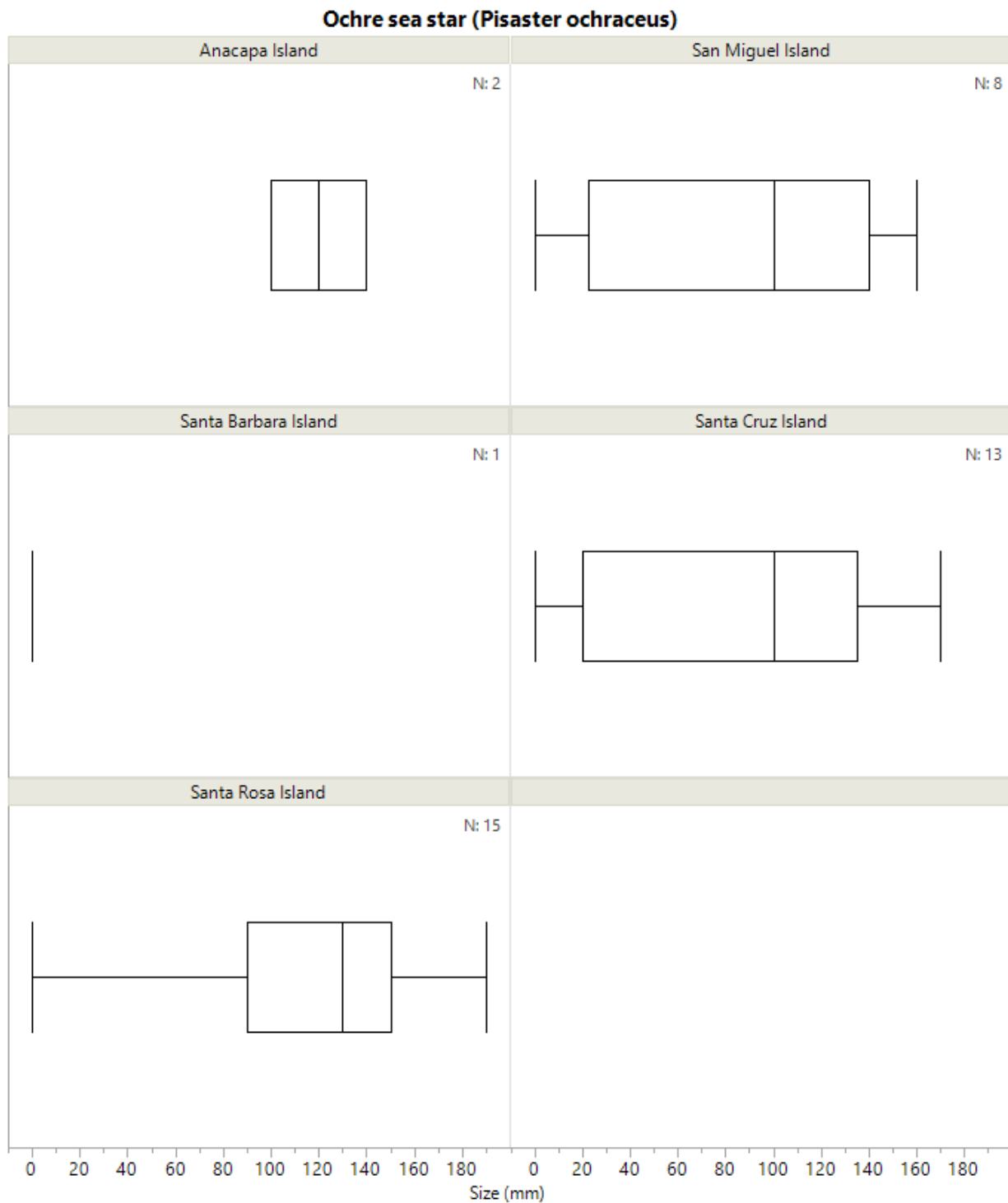


Figure 42. Sea star, *Pisaster ochraceus*, box plot size distributions at each island measured in 2018–2019 in Channel Islands National Park. Box-and-whisker plots indicate the spread and degree of skewness of the size frequency data. The ends of the boxes represent the 25th and 75th quartiles, the vertical line inside the box indicates the median value, and 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.

***Mytilus californianus* shell length and bed depth**

Mytilus californianus (California mussel) shell length and bed depth measurements were obtained at each site annually since 2014 (Figures 43–46). At the island level in 2018–2019, the range and median sizes of mussels appeared comparable to 2014 measurements at all islands (note that Anacapa Island data are not available). Median bed depth measurements in 2018–2019 also appeared similar to measurements obtained in previous years at all islands and sites.

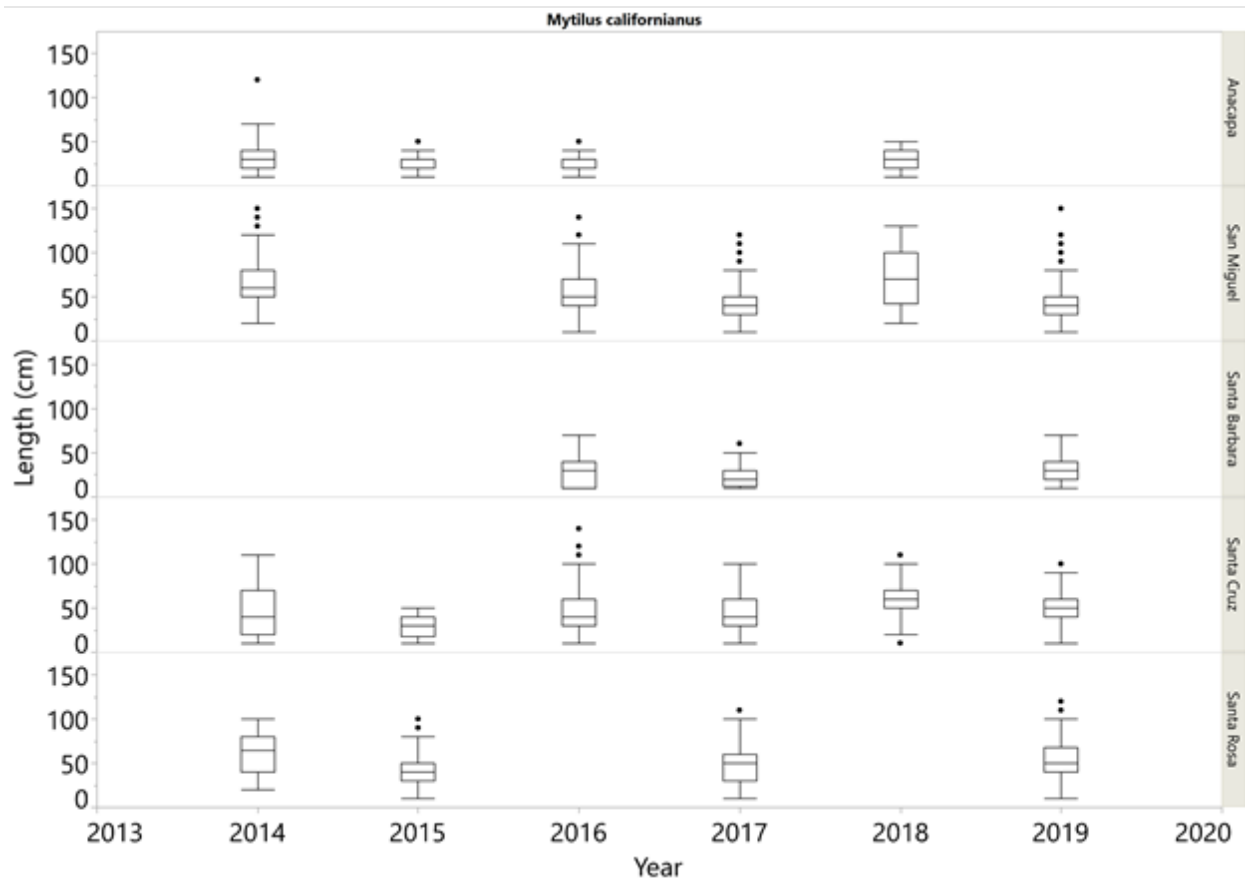


Figure 43. Shell length measurements for mussels, *Mytilus californianus*, summarized across plots and sites for each island from 2014 to 2019 in Channel Islands National Park. Box-and-whisker plots indicate the spread and degree of skewness of the size frequency data. The ends of the boxes represent the 25th and 75th quartiles, the horizontal 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.

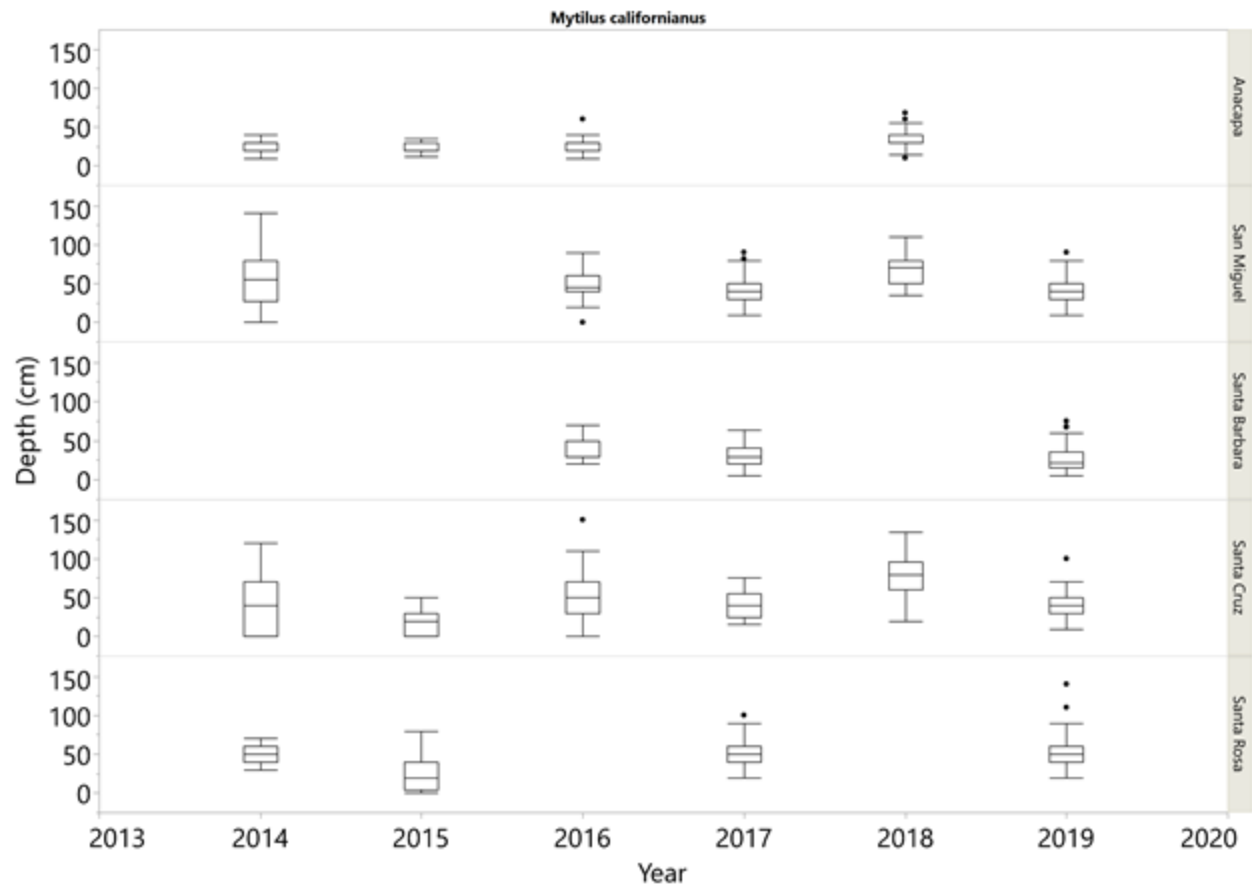


Figure 44. Bed depth measurements for mussels, *Mytilus californianus*, summarized across plots and sites for each island from 2014 to 2019 in Channel Islands National Park. Box-and-whisker plots indicate the spread and degree of skewness of the size frequency data. The ends of the boxes represent the 25th and 75th quartiles, the horizontal 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.

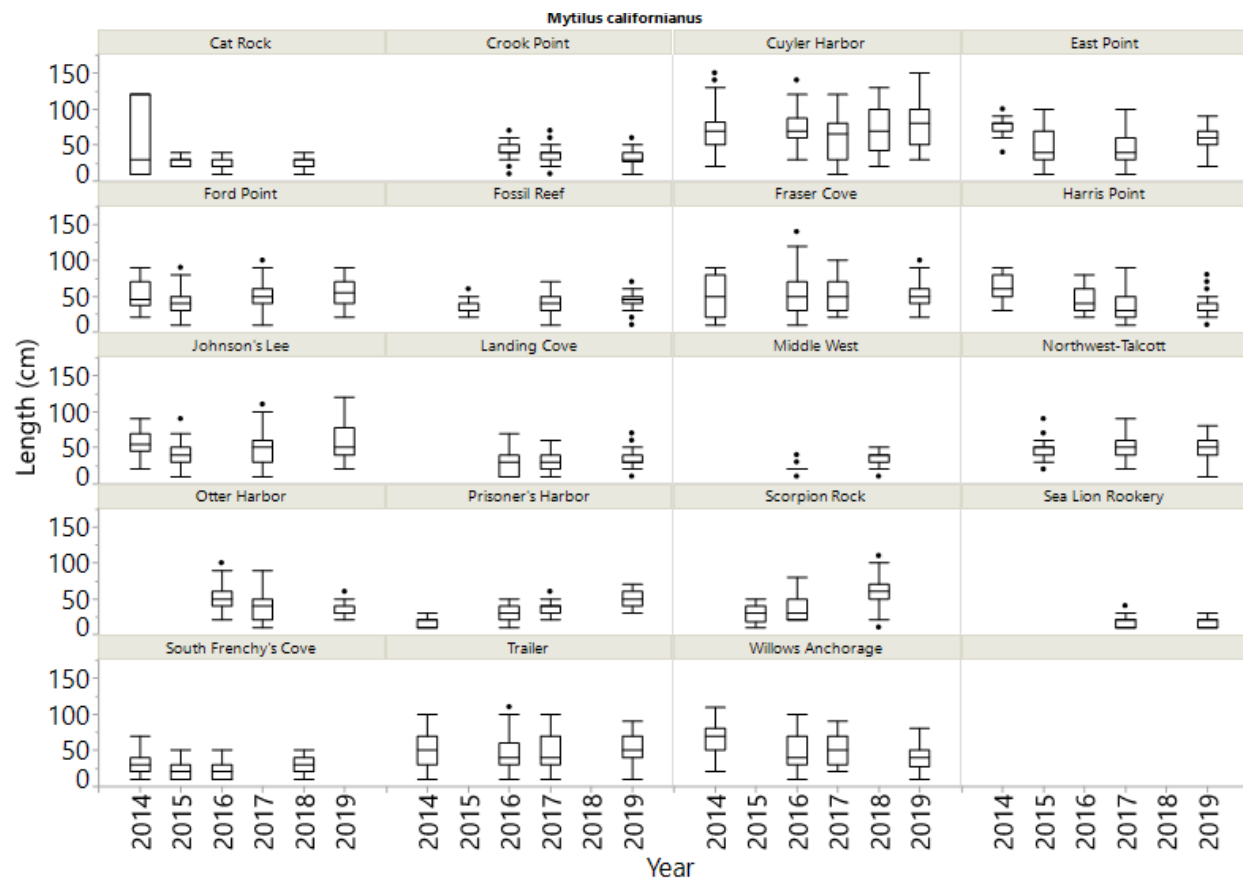


Figure 45. Shell length measurements for mussels, *Mytilus californianus*, summarized across plots for each site from 2014 to 2019 in Channel Islands National Park. Box-and-whisker plots indicate the spread and degree of skewness of the size frequency data. The ends of the boxes represent the 25th and 75th quartiles, the horizontal 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.

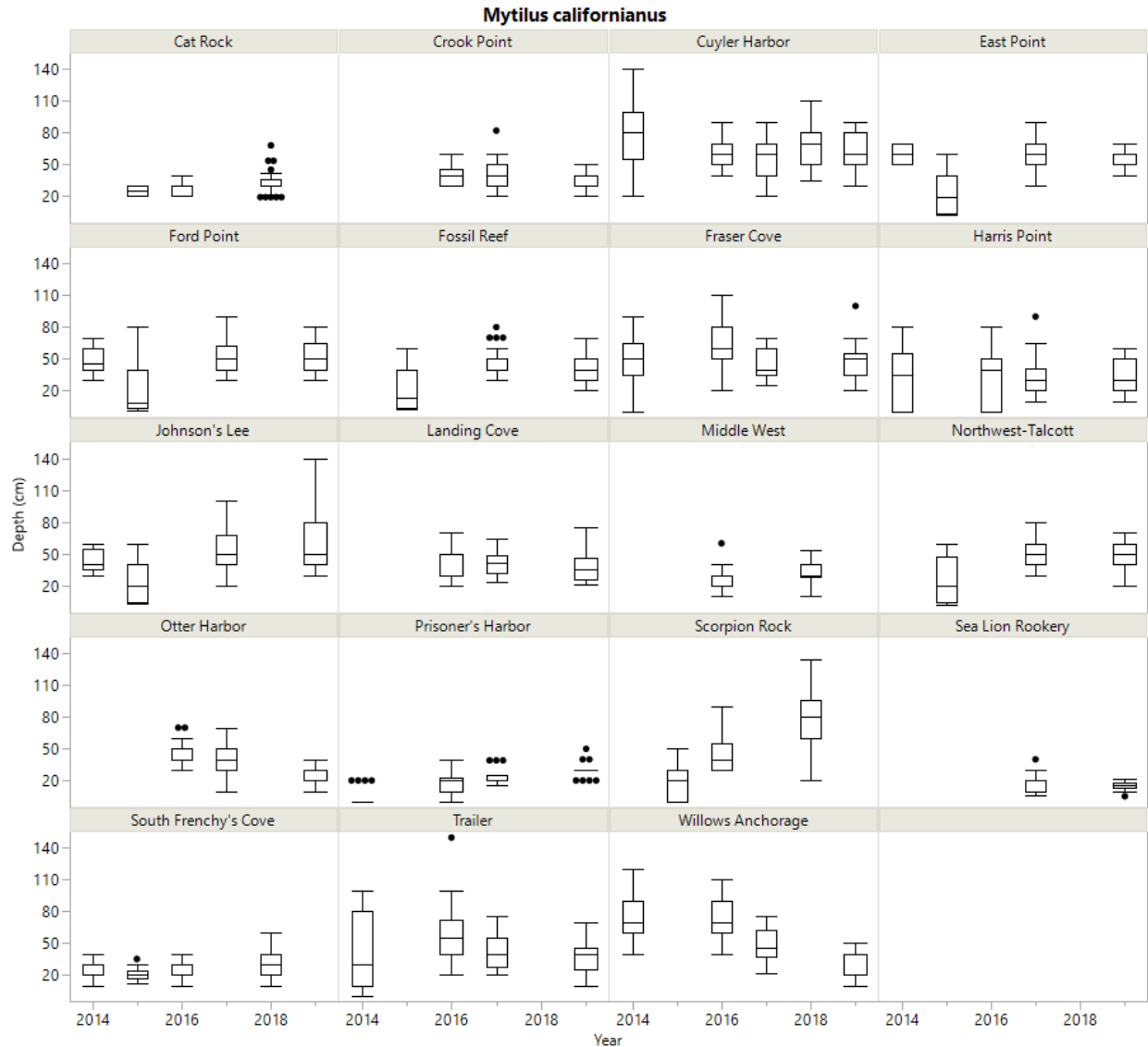


Figure 46. Bed depth measurements for mussels, *Mytilus californianus*, summarized across plots for each site from 2014 to 2019 in Channel Islands National Park. Box-and-whisker plots indicate the spread and degree of skewness of the size frequency data. The ends of the boxes represent the 25th and 75th quartiles, the horizontal 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.

***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 47–49). 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.

An attempt is made each year to sample surfgrass abundance on the fixed transects at each of the four monitoring sites. In 2018–2019, all transects were successfully sampled at all monitoring sites.

Strong seasonal patterns have been observed over the years at the two Santa Cruz Island sites, where surfgrass overstory cover has routinely declined in spring and increased in fall. Beginning in 2015, all sites were only sampled once a year, precluding any ability to study seasonal differences. Relative to past years, cover of *Phyllospadix* spp. along the three transects at Fraser Cove decreased below the long-term mean after five consecutive years above the mean (Figures 47–48). At Trailer, surfgrass cover has been below average since at least 2010, but during the last several years, cover has increased above the long-term mean. The decline in past years was due to low surfgrass cover recorded on one transect that then increased slightly beginning in 2013. Over time, *Phyllospadix* spp. cover has ranged from approximately 45 to 80% at Fraser Cove and approximately 50 to 75% at Trailer.

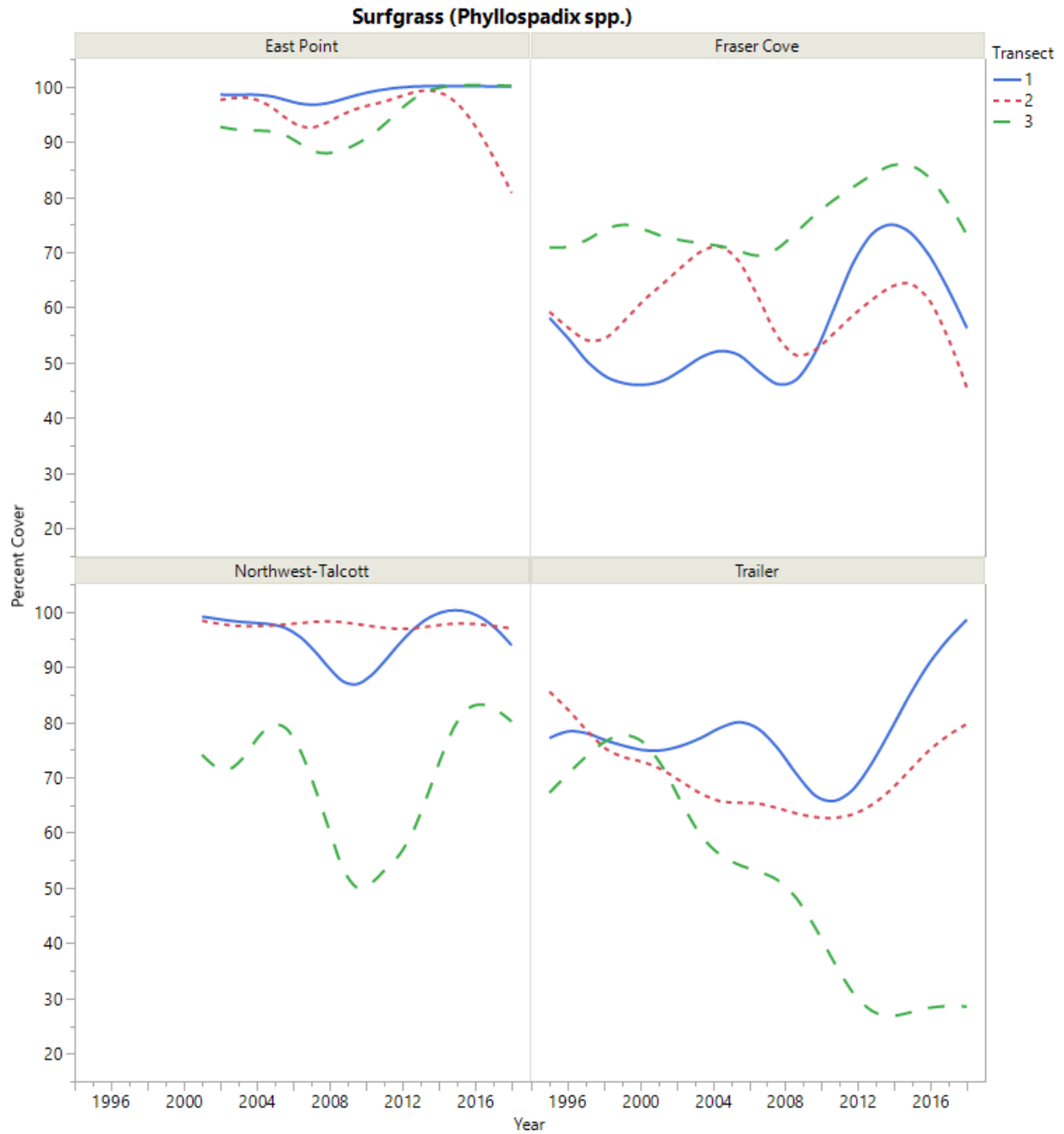


Figure 47. Mean percent cover of surfgrass, *Phyllospadix* spp., by transect, at each site from 1995 to 2019 in Channel Islands National Park.

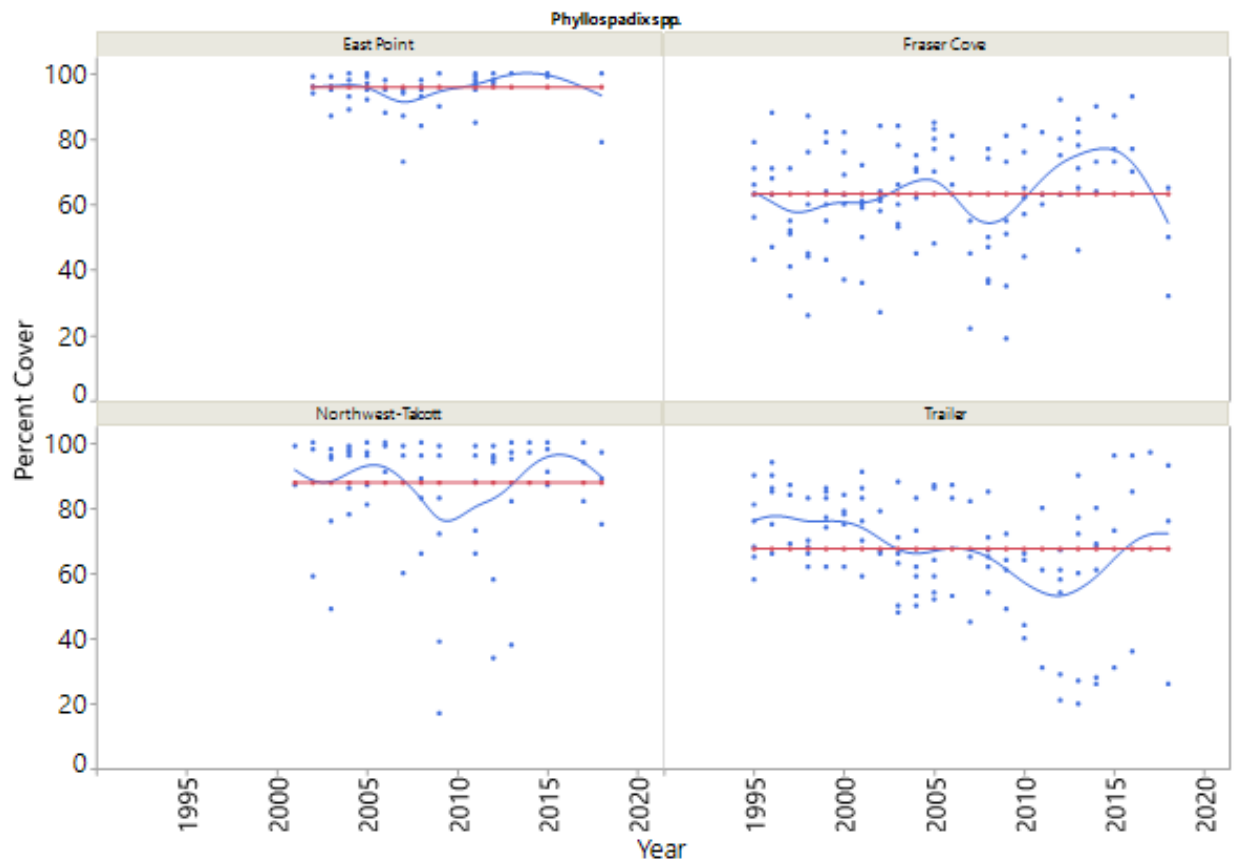


Figure 48. Mean percent cover of surfgrass, *Phyllospadix* spp., pooled across transects at each site in Channel Islands National Park. Blue wavy lines represent the mean percent cover trend for *Phyllospadix* spp. and horizontal red lines indicate the long-term mean percent cover of *Phyllospadix* spp. at each site from 1995 to 2019.

Santa Rosa Island sites, East Point and Northwest-Talcott, typically have not displayed a strong seasonal pattern in *Phyllospadix* spp. abundances. Instead, surfgrass cover on all three transects at East Point and cover on two transects at Northwest-Talcott have 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 2018–2019, surfgrass overstory cover at East Point was 80–100% on all three transects, which is typical of past year abundances at this site. At Northwest-Talcott, *Phyllospadix* cover ranged from approximately 75 to 100% on the three transects. Combined, the mean cover for surfgrass was near the long-term mean this year.

Red algae, composed primarily of *Chondracanthus canaliculatus*, *Prionitis lanceolata*, and *Mazzaella affinis*, were relatively common on the three transects at both Fraser Cove and East Point in 2018–2019. Red algae abundances averaged across the three transects at the two sites was approximately 20% at both sites (Figure 49). At the other two sites, red algae were less abundant.

The overall condition of surfgrass at the two sites on Santa Cruz Island appeared to be healthy with only low to medium cover of epiphytic algae (e.g., *Smithora naiadum* and *Melobesia mediacris*) and

minimal bleaching observed. At East Point on Santa Rosa Island, epiphytic algal cover was also low, but it was abnormally high at Northwest-Talcott.

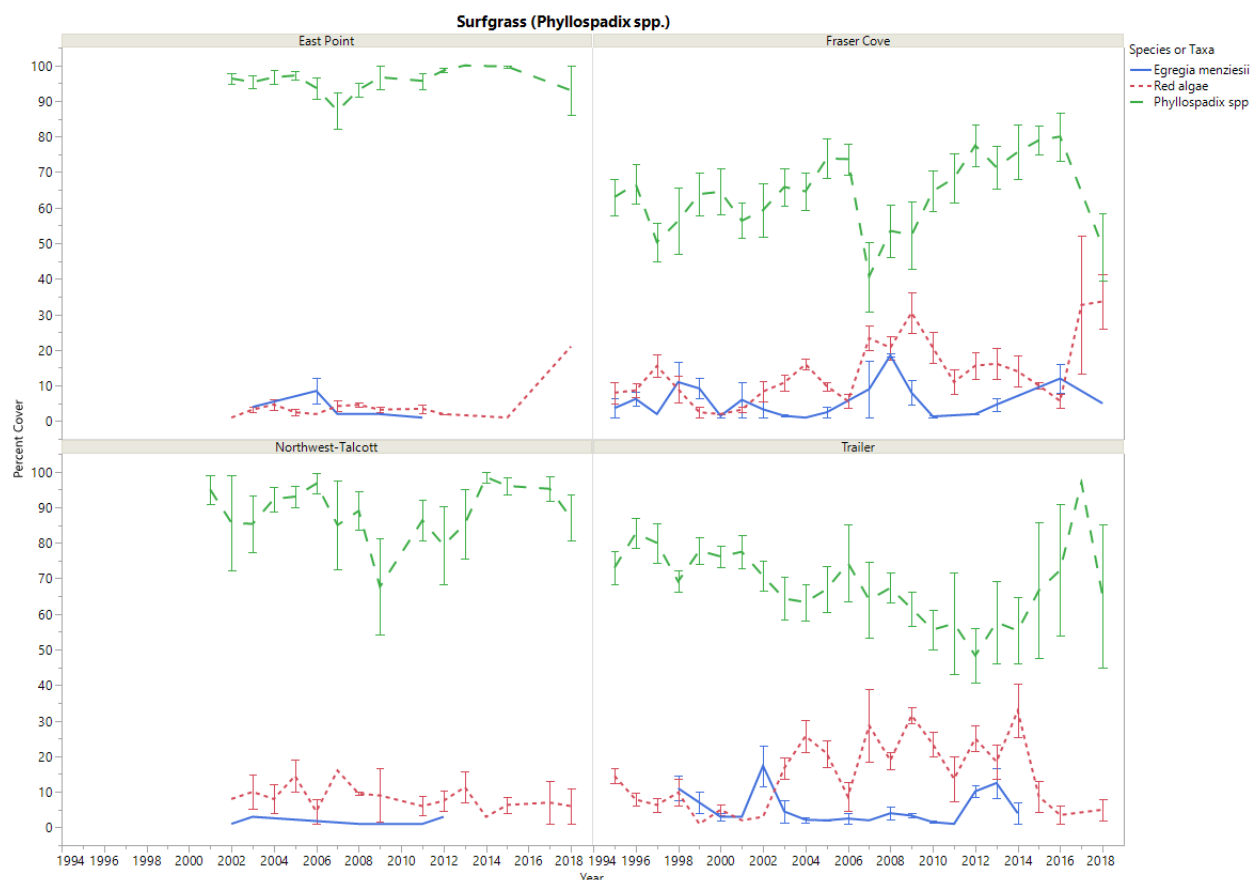


Figure 49. Surfgrass, *Phyllospadix* spp., cover at all sites. Colored lines represent the mean percent cover for *Phyllospadix* spp. and other dominant taxa from 10 m point-intercept transects at Channel Islands National Park. Error bars were constructed using one standard error from the mean.

Shorebirds and Pinnipeds

The maximum number of shorebirds and pinnipeds observed at any one time during a visit to the sites during the 2018–2019 field season is summarized in Table 2 and Figures 50–51. Overall, the abundances and diversity of shorebirds and pinnipeds this year at all sites appeared similar to observations made in recent years, with the exception of elevated numbers of brown pelicans (*Pelecanus occidentalis*) ($N = \sim 300$) and California sea lions (*Zalophus californianus*) observed at East Point and Otter Harbor, respectively.

Table 2. Shorebirds and pinnipeds most commonly encountered at monitoring sites in 2018–2019 (maximum seen at any one time).*

Site Name	Black Oyster-catcher (<i>Haematopus bachmani</i>)	Black Turn-stone (<i>Arenaria melanocephala</i>)	California Sea Lion (<i>Zalophus californianus</i>)	Cormorants (<i>Phalacrocorax</i> spp.)	Harbor Seal (<i>Phoca vitulina</i>)	Northern Elephant Seal (<i>Mirounga angustirostris</i>)	Western Gull (<i>Larus occidentalis</i>)
Cat Rock	—	—	—	—	1	—	—
Crook Point	5	—	—	30	—	5	—
East Point	—	—	—	50	—	3	—
Ford Point	2	—	—	—	1	2	—
Fossil Reef	1	2	—	—	—	5	—
Harris Point	—	—	160	—	8	1	—
Johnson's Lee	4	—	1	—	1	—	—
Middle-West	—	—	1	—	—	—	—
Northwest-Talcott	4	—	—	—	—	—	2
Otter Harbor	4	—	82	—	8	1	—
Prisoner's Harbor	—	—	—	—	1	—	—
Scorpion Rock	2	—	—	—	—	—	2
Sea Lion Rookery	3	—	117	—	—	—	—
Trailer	2	—	—	—	1	—	—
Willows Anchorage	—	—	—	—	1	—	—

* Sites without any bird or mammal detections are not presented.

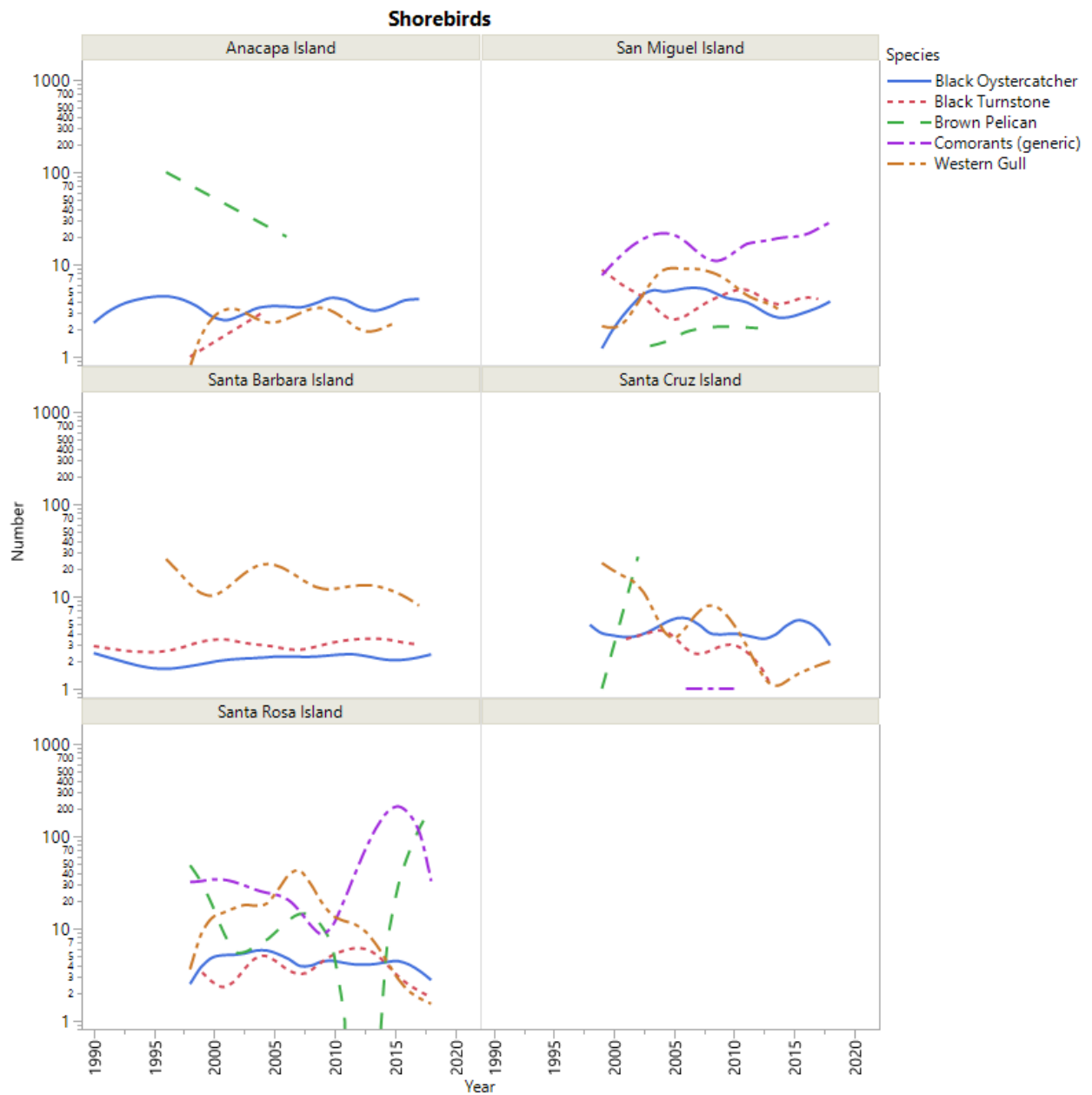


Figure 50. Maximum number of shorebirds pooled across sites at each island from 1990 to 2019 in Channel Islands National Park. Note that data are displayed on a logarithmic scale.

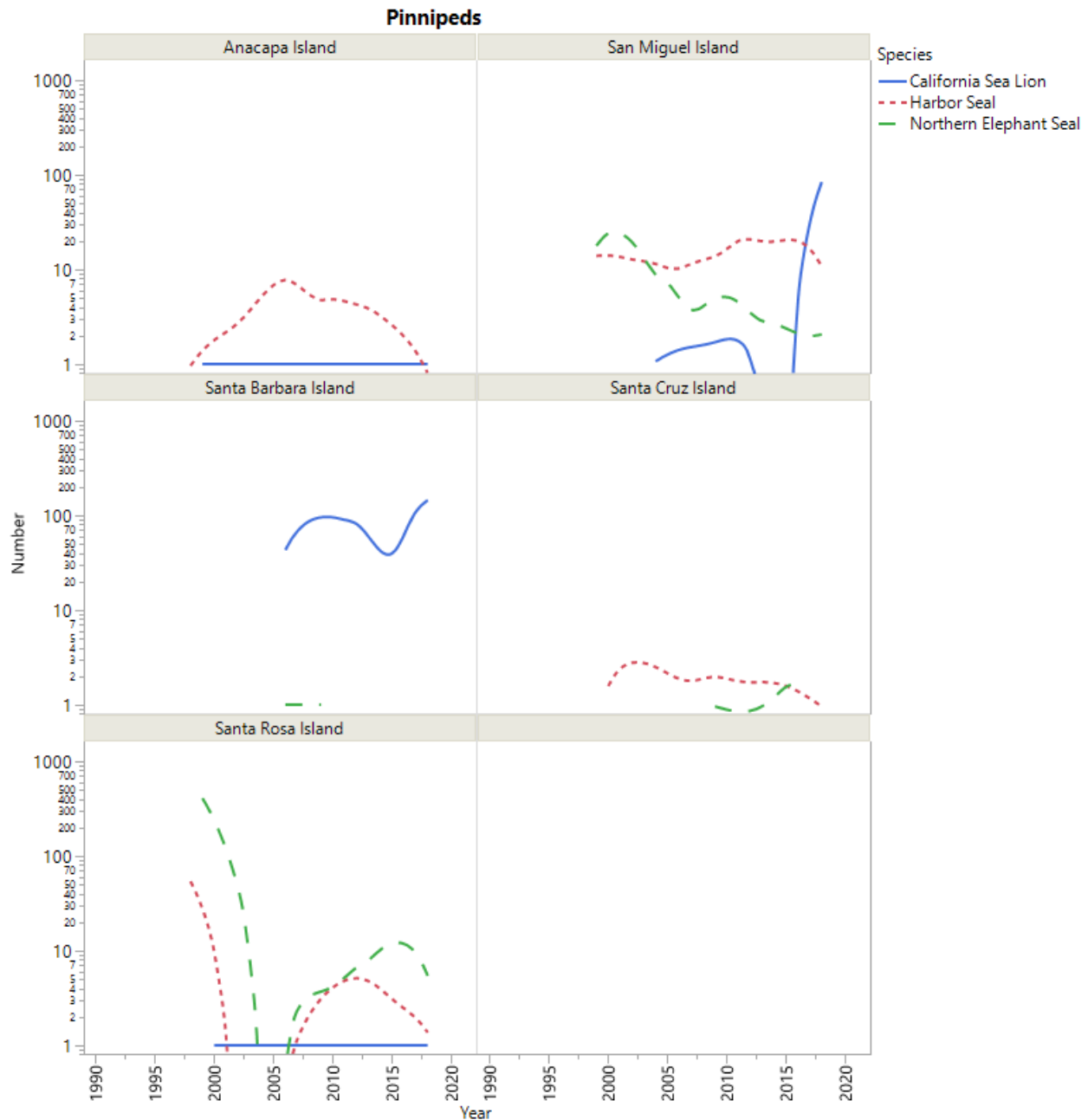


Figure 51. Mean number of pinnipeds pooled across sites at each island from 1990 to 2019 in Channel Islands National Park. Note that data are displayed on a logarithmic scale.

Black oystercatchers were again the most ubiquitous shorebirds at the rocky intertidal sites. With the exception of six sites (Anacapa Middle West, Cat Rock, East Point, Harris Point, Prisoner’s Harbor and Willows Anchorage), at least one black oystercatcher was present at each site. In contrast to past years, relatively large flocks of black oystercatchers were not observed at any of the sites this year.

American oystercatchers (*Haematopus palliatus*) have gradually become more common at the islands in recent years. However, in 2018–2019, no American oystercatchers were sighted.

Black turnstones were not common in 2018–2019 compared with previous years. They were only seen at Fossil Reef.

Less common shorebirds, such as wandering tattlers (*Tringa incana*) and willets (*Tringa semipalmata*), are occasionally seen on the reefs, while black-bellied plovers (*Pluvialis squatarola*) and snowy plovers (*Charadrius alexandrinus*) usually inhabit adjacent beaches. Seabirds such as cormorants, gulls, pelicans and occasionally pigeon guillemots (*Cepphus columba*), 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 2018–2019, gulls were much less common than usual since they were only present in low numbers at Northwest-Talcott and Scorpion Rock.

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). This year, approximately 50 cormorants were seen at East Point. At Crook Point, approximately 30 cormorants were observed roosting on the reef.

Harbor seals were observed at or within the immediate vicinity of eight sites; abundances ranged from 1 to 8. The greatest number of seals was seen at Harris Point and Otter Harbor (commonly used haul outs for harbor seals). Abundances for San Miguel Island sites in 2018–2019 appeared comparable to counts obtained in past years, but they were below average at most other sites.

Northern elephant seals 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 as weaned pups that have not yet gone to sea or as adults coming ashore to molt. In 2018–2019, elephant seals were seen at six sites; abundances ranged from 1 to 5 individuals per site. The greatest number of elephant seals was seen at Crook Point and Fossil Reef. Abundances this year were comparable to counts obtained in past years at most locations, with the exception of San Miguel Island sites, which had slightly fewer seals relative to past years.

California sea lions were common (approximately 117) at the aptly named Sea Lion Rookery on Santa Barbara Island, but none were observed at the other site (Landing Cove) sampled on the island. Sea lion abundances were higher than usual at Harris Point (N = 160) and Otter Harbor (N = 82). At other locations, abundances this year were considered average relative to past years.

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Appendix A: Program Notes

Although 2018-19 was an El Niño, it was a relatively mild event resulting in less ecological stress than conditions experienced in recent years. That said, record warm waters were recorded at the Scripps pier on August 1, 2019, surpassing the previous record set in 1931. Qualitatively, the condition of many target taxa appeared to have gradually improved at most sites. *Silvetia compressa*, a rockweed that has declined significantly at most locations, appeared to improve as relatively high recruitment for the species was observed at most locations where it occurs. The same was true to a lesser degree for another rockweed species, *Pelvetiopsis californica*. *Mytilus californianus* and various species of barnacles were noted as abundant and healthy in appearance nearly everywhere. This year was also another good one for the recovery of black abalone, *Haliotis cracherodii*. Nearly all sites experienced increases in the abundance of *H. cracherodii* relative to the long-term mean generated from post-1995 data and juveniles were present at all islands except Santa Barbara.

The monitoring effort also benefited from the relatively placid conditions. Despite the relatively high amount of precipitation, we were able to conduct most trips without failure or need for rescheduling. As a result, all sites were sampled this field season (2018–2019). Rough conditions generated from swell and surge only affected site searches for black abalone and sea stars at a few sites.

Time (two days) was secured on the CINMS NOAA Vessel Shearwater this year to assist with several of the monitoring sites that require vessel access. All three of the Anacapa Island sites were accessed via the Shearwater. We used Island Packers to access one of the other sites, Orizaba Cove, that traditionally has required a vessel. A combination of Island Packers and kayaks were used to access Scorpion Rock.

The annual MARINE workshop was cancelled this year due to the government shutdown, which lasted 35 days from December 22, 2018, until January 25, 2019. In place of the in-person meeting, a call involving many of the MARINE practitioners was held to discuss some of the items on the agenda that pertained to protocols and upcoming action items.

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 nonnative 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 (Anacapa Middle East was not sampled) in 2018. 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 other than 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 where 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. This year appeared to be a good one for *Caulacanthus* since it increased in cover at all three locations where it

has been documented. Unfortunately, the invasive alga is likely here to stay at Santa Rosa and Anacapa Islands 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 California, Mexico, and around the following islands: San Clemente, Catalina, Santa Barbara, Anacapa, and Santa Cruz. *Sargassum 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, Associate Professor, California State Polytechnic University, Pomona, personal communication with S. Whitaker). 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 2014, *S. horneri* appeared to have expanded its distribution at Anacapa Middle West and in 2018-19 occupies a portions of several fixed photo plots and other areas in the mid and lower intertidal. It was also seen in relatively high abundance at Sea Lion Rookery and lower abundance at Willows Anchorage.

We received three data requests in 2018–2019, including the biodiversity and fixed plot data for a student at UCSB, sea star data to be used in an analysis conducted at the University of Vermont, and rockweed data to be incorporated into an analysis for a master's thesis at California State Polytechnic University, Pomona.

An array of temperature loggers was deployed at nearly every one of the 17 sites that have *Silvetia* monitoring plots. For each site, $N = 3$ loggers were placed under the rockweed canopy and adjacent locations without canopy. The loggers will remain deployed for at least one year to record temperature at 30-minute intervals.

Western snowy plover surveys on Santa Rosa Island were conducted during spring and winter months overlapping with rocky intertidal monitoring. Routine sand beach monitoring was conducted at Santa Rosa Island during the summer; those data are reported separately.

Appendix B. Trip Reports

The following are trip reports from the rocky intertidal monitoring 2018–2019 field season (November 2018 through April 2019). Reports were prepared by Stephen Whitaker and Jade Blennau. 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.

Anacapa Island, November 6–8, 2018

Prepared by Stephen Whitaker and Jade Blennau

Purpose

To monitor rocky intertidal sites at Anacapa Island.

Personnel

- Stephen Whitaker, Marine Ecologist, Channel Islands National Park
- Katy Bland, Technician, UCSC
- Michael Langhan, Technician, UCSC

Procedure and General Observations

We accessed the site via the R/V Shearwater. 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 Tough TG-5 12 Megapixel digital camera. Timed-searches for black abalone and sea stars were conducted. *Lottia gigantea* were sampled 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. Mussel sizes and mussel bed depths were measured at all three sites.

11/16/2018. Middle West

Low tide -0.2 ft at 1443 hrs. The conditions were excellent for sampling. There was light wind (<5 kt) and swell/surge was minimal (<1'). No shorebirds and one California sea lion (in surge channel) were observed at the site. The site was monitored from 1015 to 1530.

Plots were photographed by Langhan and Bland. Site panoramas were photographed by Langhan. Photoplots were scored in the field by Whitaker.

A 30-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Langhan and Bland. N = 12 black abalone were observed site-wide. Most individuals were located 1–5 m apart. Sizes ranged from 54 to 126 mm. Less abalone were seen this year compared to fall 2017, in which N = 15 black abalone were observed site-wide. In fall 2016, N = 7 black abalone were observed site-wide, and N = 17 were seen in fall 2015.

A 30-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by Langhan and Bland. 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 (100 mm) was observed site-wide.

The field log was completed by Whitaker.

Lottia gigantea were measured within the fixed plots by Langhan and Bland (and plots were then checked for accuracy by Whitaker). Abundances in plots 1–3 were N = 35, 0, and 6, respectively. Sizes ranged 10–52 mm. For reference, last fall, abundances in plots 1–3 were N = 48, 1, and 16, respectively. Sizes ranged 9–68 mm.

No plot repairs were necessary during this visit. Temp logger #20186768 located above the upper intertidal zone (air zone) inshore of *Lottia* plot 2 (9.2 m) and 14 m inshore from L3 was replaced by #10999089 at 1600. Temp logger 10999092 was replaced by temp logger #20186751 in the low zone.

Mussels were measured in the five original *Mytilus* plots by Whitaker. Sizes of mussels ranged 20–50 mm and mussel bed depths ranged 2–5 cm; all plots were monolayers. The mussel beds were noted to have very few small *Mytilus* attached to upper surface of base layer. For reference, last fall, mussel beds were noted as being fairly empty, with the majority of mussels being very small and clustered in little patches. In fall 2015, 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.) plots had 23% mean barnacle cover. For reference, last fall, mean barnacle cover was 21%. The majority of point contacts in the five plots were bare rock, though the plots were relatively diverse for the barnacle zone. *Chthamalus* plots had *Caulacanthus* comprise between 9 and 31% cover in plots 448–451. Last fall, *Caulacanthus* comprised 10.2% of the plots and was seen in plots 448–450. *Endocladia* plots had 5.6% mean *Endocladia* cover (last fall, mean *Endocladia* cover was 6.2%). 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 a small amount of non-coralline crust. *Caulacanthus* was measured in all five *Endocladia* plots this season and ranged 4–15%. Last fall, the invasive alga was found in three plots and its cover ranged from 1 to 12%. 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 *Tetraclita* all occurred in moderate abundance within the *Silvetia* plots. *Caulacanthus* comprised 5% of plot 455. Last fall, the invasive occupied 1–2% of plots 455, 452, and 454. Mussel (*Mytilus californianus*) plots had 20.6% mussel cover. Mussels were measured at 23.6% last fall, and 8.2% in the fall 2016. The majority of cover in the five plots was occupied by *Mazzaella*, *Gelidium*, *Chondracanthus*, *Tetraclita*, *Chthamalus* and articulated corallines.

We accessed the site via the Shearwater. *Caulacanthus* appeared much more abundant relative to past surveys. *Mytilus* has become more abundant in recent years but is still relatively uncommon; most individuals were medium sized (30–50 mm) with very few recruits seen. No rockweeds were present.

Chondracanthus and *Mazzaella* dominated the site. *Tetraclita* and *Chthamalus* appeared to be two of the most dominant sessile invertebrates. Overall, this site appeared to be in a state of transition, since many of the longer lived species (rockweeds, *Mytilus*, *Balanus* etc.) declined or disappeared around 2006. Black abalone continued to decrease in abundance.

11/7/2018. Cat Rock

Low tide -0.5 ft at 1522 hrs. The conditions were good for sampling since the swell/surge was low. Wind was light (5–10 kt). We were able to conduct searches for black abalone and sea stars and score all plots. No shorebirds were observed. One adult harbor seal was recorded near the site. The site was monitored from 1130 to 1630.

Note that in fall 2015, 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 Raimondi et al. (2018), 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 three plots that were trampled once, three 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 Adri. All 20 photoplots were scored in the field by Whitaker.

A 30-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Langan and Bland. N = 19 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 11–50 cm apart. Sizes ranged 54–144 mm. The five fixed plots for black abalone were searched and zero abalone were located. For reference, last fall N = 15 black abalone were observed site-wide and most individuals were located 1–10 cm apart. Sizes ranged 54–148 mm.

A 30-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by Bland and Langan using a flashlight. N = 1 ochre star (140 mm) was observed site-wide (from *Lottia* plot #3 on the west end of the site to the abalone plots at the east end); the individual appeared to be healthy. For reference, last fall N = 2 ochre stars (140 and 180 mm) were observed site-wide (from *Lottia* plot #3 on the west end of the site to the abalone plots at the east end); both individuals appeared to be healthy.

The field log was completed by Whitaker.

Lottia gigantea were measured within the fixed plots by Whitaker. Abundances were N = 22, 34, and 7 in each consecutive plot. Sizes ranged 20–62 mm. For reference, last fall, abundances in plots 1–3 were N = 39, 39, and 7, respectively.

No plot repairs were necessary this visit.

Mussels were measured in the five *Mytilus* plots by Whitaker. Sizes of mussels ranged 20–40 mm and mussel bed depths ranged 2–4 cm; all plots were monolayers. For reference, last fall, Sizes of mussels ranged 10–40 mm and mussel bed depths ranged 15–68 mm.

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 62% mean barnacle cover, which was slightly higher than the 57% measured in fall 2017. The majority of point contacts in the five plots were *Chthamalus* spp. We measured 20.6% mean *Endocladia* cover in fall 2018. In fall 2017 mean *Endocladia* cover was 14.4% and plot 467 lacked *Endocladia* cover both years. The majority of space in the five plots was bare rock and *Endocladia*, 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 5.2% (2.6% measured in fall 2017) mean *Silvetia* cover and 24.6% (12.6% measured in fall 2017) *Pelvetiopsis* cover. Most of the space within the rockweed zone was bare rock. Mussel (*Mytilus californianus*) plots had 37.6% mean cover. The majority of cover in the five plots was occupied by *Mytilus*. For reference, last fall, mean mussel cover was 37.2%.

Shearwater was used to access the Cat Rock site. High diversity of algae was observed. *Silvetia* and *Pelvetiopsis* both appeared healthy and relatively abundant; recruits were seen for both species as well. No bleaching was observed for any algal species. *Mytilus* was common but few recruits were observed and nearly all were small (10–50 mm). *Endocladia* appeared lush. *Caulacanthus* was seen but in low abundance. Many of the black abalone were out in the open, totally exposed. Nearly all *Lottia gigantea* in plots were med-large (3–60 mm).

11/8/2018. South Frenchy's Cove

Low tide -0.47 ft at 1603 hrs. The conditions were excellent although we faced time limitations from the late low tide and the need to return before dark. There was low swell and wind. Two oystercatchers were observed and no pinnipeds were observed at the site at any time during the day. The site was monitored from 1300 to 1515.

Plots were photographed by Bland. Site panoramas were photographed by Bland. All the photoplots were scored in the field by Whitaker.

A 15-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Bland and Langan. 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 15-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by Bland and Langhan. 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 Whitaker.

Lottia gigantea were measured within the fixed plots by Whitaker. Abundances ranged N = 1–10 in the three plots. Sizes ranged 19–56 mm. For reference, last fall, abundances ranged N = 6–18 in the three plots. Sizes ranged 13–54 mm.

No repairs were necessary this year, but *Mytilus* plot #265 was recorded to be in need of a taller bolt. Temp logger #10999083 was replaced with logger # 10999079 in the low zone at 1511. Temp logger #10999085 was replaced with logger # 10443594 in the air zone at 1515.

This year, barnacle (*Chthamalus* spp./*Balanus* spp.) plots had 25.25% mean barnacle cover compared to 38.4% last fall (note that plot 257 was not photographed or scored last year—mean is calculated using four plots). The majority of point contacts in the four plots were bare rock. *Endocladia* plots had 46.4% mean *Endocladia* cover (in fall 2017, mean *Endocladia* cover was 31.25% across four plots, *not* including #257). The majority of point contacts in the five plots were *Endocladia* and bare rock. The rockweed plots had 64% mean *Silvetia* cover, slightly more than 62% last fall. Most of the cover within the rockweed zone was dominated by *Silvetia*. Mussel (*Mytilus californianus*) plots had 50.2% mean cover. The majority of cover in plots 264, 265, and 266 were occupied by *Mytilus*. Plot 202 held no mussels, while plot 201 had 5% *Mytilus* cover. For reference, last fall, mean mussel cover across all plots was 51.2%.

Mussels were measured in the five *Mytilus* plots by Langhan. Sizes of mussels ranged 10–50 mm and mussel bed depths ranged 1–5 cm; all plots were monolayers. Last fall, sizes of mussels ranged 10–50 mm and mussel bed depths ranged 1–6 cm; all plots were monolayers.

We observed three med-large zebra perch (80–120 mm) in the tidepool near the upper plots. *Jania crassa* was still dominant on the inshore reef. Filamentous red algae covered most of the site and it was observed growing on other species. Both rockweed species, particularly *Silvetia*, appeared to be healthy and robust with perhaps the highest level of recruitment Whitaker has observed here. *Endocladia* appeared lush, as did most other algae, excluding the dominant filamentous red alga seen epiphytically throughout. *Mytilus* was common only on the outer reef and nearly all individuals were small to medium (10–50 mm).

Santa Cruz Island, December 7–9 2018

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

- Kathryn Bland, UCSC Technician
- Michael Langhans, UCSC Technician
- Jade Blennau, SCA intern

Procedure and General Observations

Kayaks were used to access both sites A and B. Standard procedures were used for monitoring the rocky intertidal site. Plots and site overviews were photographed with an Olympus Tough TG-5 12 Megapixel digital camera. Photoplots were scored in the field at Sites A and B. Black abalone and sea stars were counted and measured during timed site-wide searches at Site A and Site B. There are no *Lottia gigantea* plots at Scorpion Rock. Motile invertebrates are no longer sampled in photoplots at all sites. Hobotemp Tidbit temperature loggers were installed at Site B. Mussel sizes and mussel bed depth were measured at Site A. Island Packers provided transportation to and from Santa Cruz Island.

12/7/2018. Scorpion Rock (Site A).

Low tide -0.72ft at 1553 hrs. The conditions were good; swell declined with the tide, which allowed us to safely work the entire site with no issues. Sky was clear and sunny all day. There were no shore birds or pinnipeds present. The site was monitored from 1300 to 1630.

Plots were photographed by Langhans. Site panoramas were photographed by Langhans. All photoplots were scored in the field by Whitaker.

A 30-minute search was conducted for black abalone (*Haliotis cracherodii*) presence at Site A by Bland. N = 9 black abalone were observed site-wide at Site A (sizes ranged 52–112 mm, most individuals were located 1–5 m apart). For reference, last fall, N = 14 black abalone were observed site-wide at Site A (sizes ranged 34–155 mm, most individuals were located 1–10 cm apart or were touching one another). In fall 2016, 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). In fall 2015, 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).

A 30-minute search was conducted for ochre star (*Pisaster ochraceus*) presence at Site A by Bland. N = 2 ochre stars (sizes ranged 100–140 mm) were observed site-wide; both appeared to be healthy. For reference, last fall, N = 4 ochre stars (sizes ranged 60–170 mm) were observed site-wide; all appeared to be healthy. In fall 2016, N = 5 ochre stars (sizes ranged 64–88 mm) were observed site-wide; all appeared to be healthy. In fall 2015, 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).

The field log was completed by Whitaker.

The OA sensors were switched with the assistance of the California Institute of Environmental Studies folks. This switch occurred at 1530 and a water sample was taken. No repairs on plots were necessary.

The barnacle (*Chthamalus* spp./*Balanus* spp.) plots had 26.8% mean barnacle cover (26.2% measured during the last visit in October 2016). The majority of point contacts in the five plots were bare rock. *Endocladia* plots had 23% (28.6% measured during the last visit in October 2016) mean *Endocladia* cover. The majority of point contacts in the five plots were *Endocladia*. Mussel (*Mytilus californianus*) plots had 88.2% (84.6% measured during the last visit in October 2016) mean mussel cover. The majority of cover in the five plots was occupied by *Mytilus*, bare rock (mean = 3.8%), and *Tetraclita* (mean = 3.8%). The *Tetraclita* plots had 19.6% (26.4% measured during the last visit in Jan 2017) mean *Tetraclita* cover with 39% bare rock (32.8% in Jan 2018). The *Pelvetiopsis* plots (Site B) had 32.6% (12.8% measured during the last visit in Jan 2018) mean *Pelvetiopsis* cover. Most of the point contacts within the *Pelvetiopsis* zone were bare rock (mean = 38%).

Mussels were measured in the five *Mytilus* plots by Bland and Langhans. Sizes of mussels ranged 10–110 mm and mussel bed depths ranged 60–130 mm. For reference, last year, sizes of mussels ranged 20–100 mm and mussel bed depths ranged 20–131 mm; all plots except plot 1 were monolayers. In fall 2016, sizes of mussels ranged 20–80 mm and mussel bed depths ranged 1–5 cm; all plots except plot 1 were monolayers. In fall 2015, mussels measured 10–50 mm and mussel bed depths ranged 1–5 cm; all plots were monolayers.

Extremely high (~hundreds) of *Strongylocentrotus purpuratus* present—no signs of disease. Several *S. strongylocentrotus franciscanus* observed. Several *Megathura*, *Lithopoma* also observed. *Mytilus* appears healthy but very few recruits seen. *Tetraclita* extremely abundant—most are large and <10% are dead. *Chthamalus* highly abundant—all appear healthy, except for individuals higher in the intertidal, which are mostly dead. *Endocladia* appears healthy but not necessarily lush, and potentially decreased in abundance relative to recent years. Several *Cypraea* seen. No signs of obvious damage observed for the site.

12/8/2018. Scorpion Rock (Sites B)

Kayaks were used to access the site. We monitored site B from 1345 to 1645. Low tide: -0.6 at 1630. Sampling conditions improved as the tide went down. An unidentified bird of prey was present (potentially an osprey) with white head and belly, perched on Scorpion Rock. Two western gulls, two oystercatchers and two ravens were also observed. Abalone shells were found, including 1 large freshly dead black abalone. *Silvetia* and *Pelvetiopsis* appeared to be healthy and in approximately similar abundances as past years. Recruits for both species were seen in low abundances.

No repairs were necessary for the *Pelvetiopsis* plots. Six temperature loggers were installed (three under *Silvetia* canopy, three approximately 20 cm outside *Silvetia* canopy) (Table B-1). Both loggers in each pair were arranged in similar orientation, angle, and aspect.

Table B-1. Temperature loggers installed at Scorpion Rock on Santa Cruz Island in 2018 in Channel Islands National Park.

Pair #	Inside Unit Number	Outside Unit Number
1	10999083	20186768
2	10999080	10999092
3	10999081	10999085

The black abalone (*Haliotis cracherodii*) search included the finger reef on the south end of the cove, inshore to the arch, and the boulder field over to Scorpion Rock. Langhans and Bland measured and Blennau recorded, then all three searched remainder of the site for black abalone abundance. Flashlights were used. Time searched: 1435–1640 (three observers). N = 1,002 black abalone were observed. Due to time limitations, only 100 individuals were measured for size frequency; sizes ranged 20–153 mm. For reference, last fall, N = 556 black abalone were observed. In October 2016, a 30-minute search was conducted by Kenan Chan for black abalone 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. 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 Barbara Island, January 30–31, 2019

Prepared by Jade Blennau

Personnel

Joshua Sprague, Marine Ecologist, Channel Islands National Park

Jade Blennau, SCA intern

Purpose

To monitor rocky intertidal sites at Anacapa Island.

Procedure and General Observations

Standard procedures were used to monitor the rocky intertidal sites. All plots except for the red turf algal and rockweed plots at Landing Cove were photographed. Site overviews and plots were photographed with an Olympus Tough TG-5 digital camera. Plots were not scored in the field. Photos were later scored by Stephen Whitaker in office. Counts were not made of motile invertebrates inside the photoplots. Searches were conducted to count sea stars and black abalone at both sites (not including western half of Landing Cove). The maximum number of shorebirds and pinnipeds observed at each site was recorded. The island was accessed via helicopter with David Mazurkiewicz (assessing brown pelican nesting activity). Three of us were the first personnel to return to the island since the 35 day government shutdown (Dec 22, 2018–Jan 25, 2019). Note that Stephen Whitaker was not on this trip since he was monitoring the San Miguel sites.

Note: Jim Howard (CIES) was able to obtain photographs of the *Silvetia* plots at Landing Cove on 2/19/2019. Stephen Whitaker scored the photographs in the office.

30 January 2019. Sea Lion Rookery

Low tide -0.08ft at 1252 hrs. 1–2 ft swell conditions with 10 kt winds. The conditions were conducive for sampling; the site was mostly dry the entire afternoon.

There were 3 black oystercatchers, 55 western gulls on the reef, in addition to approx. 117 sea lions that stayed in the water close to shore. We were on site from 1230 to 1530 hrs.

Josh and Jade photographed the plots. Most of the plots were located with relative ease since nearly all plots had three bolts marking the locations of corners. We experienced some issues with plot orientations using the hand drawn map.

Whitaker scored all plots via photos in the office.

A 30-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Sprague and Blennau. N = 1 black abalone (133 mm) was observed site-wide. All five black abalone plots were surveyed. For reference, in 2017 one abalone was found, of approximately the same size. In November 2016 and January 2015, there were no abalone seen at the site. In fall 2013, zero abalone were observed. In fall 2012, N = 0 black abalone were seen.

A 30-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by Sprague and Blennau. No ochre stars were observed site-wide. For reference, in November 2016 and January 2015, there were no sea stars (besides one *P. giganteus*) seen at the site. In fall 2013, N = 144 *P. ochraceus* were observed. In fall 2012, N = 143 *P. ochraceus* were counted.

Barnacle plots only averaged 6.6% (9% measured last year) *Balanus/Chthamalus* cover. The majority of point contacts in the five plots were bare rock and *Ulva* (mean = 39%). *Endocladia* plots had 11% (14.4% measured last year) mean *Endocladia* cover along with 14.2% *Ulva* and 30% *Mazzaella*, among other less common taxa. Rockweed plots averaged 32.2% (42.4% measured last year) *Silvetia compressa* and 10.2% *Mazzaella*, along with scarce amounts of several other taxa. Mussel (*Mytilus californianus*) plots had 3.8% (0.4% measured last year) mean cover. The majority of cover in the five plots was occupied by articulated corallines (mean = 42.4%), *Tetraclita* (mean = 12%) and *Egregia* (mean = 12.8%).

Mussels were measured in the five *Mytilus* plots by Sprague and recorded by Blennau. Sizes of mussels ranged 10–30 mm and mussel bed depths ranged 0.5–2.2 cm; all plots were monolayers.

Garbage on site consisted of boat line above the site at rock-dirt interface ~100 m. There was a plastic line wrapped around the mussel plot bolts. We were unable to remove the line from bolts. *Sargassum horneii* was reproductive and healthy. One small patch of surf grass was present. *Sargassum muticum* was moderately abundant in low lying areas and more abundant than *Sargassum horneri*.

31 January 2019. Landing Cove

Low tide -0.39 at 1334 hrs. We experienced high swell activity on the west side of site due to storm conditions in the morning. We were unable to access the western half of site (rockweed, red turf algal plots) due to unsafe slippery conditions at the access point. It rained 0.75" several hours before the site was sampled. A large plume of sediment was present in the water. Two gulls were observed at the site on the ledge upon our arrival.

Sprague and Blennau photographed the plots on the eastern side of the site. Plot orientation was difficult to discern with the hand drawn map. Numerous plots were missing corner markers; plot 326 was especially in need. Jim Howard mentioned that *Silvetia* plot 314 was missing a UL number bolt (the remaining hole was still visible). Also, *Silvetia* plot 313 was a bit challenging to orientate based on the locations of the existing bolts.

Whitaker scored plots via photos from within the office. The decision was made in 2015 during our second program review to stop monitoring the red algal turf plots.

Sprague and Blennau searched for sea stars throughout the reef located south of the pier. Zero *Pisaster ochraceus* were seen throughout the site. For reference, in 2017, zero *Pisaster ochraceus* were seen throughout the site. In November 2016, N = 0 *P. ochraceus* were observed, and in January 2015, N = 3 *P. ochraceus* were seen throughout the site. Sizes were estimated to be 100–120 mm. During the visit prior, in October 2013, Dan Richards counted N = 182 sea stars throughout the reef located south of the pier.

A 30-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Sprague and Blennau. Zero black abalone were seen. For reference, in November 2017 and 2016, zero black abalone were seen; in January 2015, one black abalone (126 mm) 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.

After photographing the eastern side of the site, Sprague and Blennau did not cross chasm to rockweed plots due to slippery and unsafe conditions.

Barnacle plots were again nearly depleted of *Balanus/Chthamalus* cover (mean = 3.2%) (5.6% measured last year) and appear to be transitioning to a community more representative of the mid to lower intertidal zone. In the barnacle plots, *Tetraclita* mean cover was 9%, non-coralline crust was 13.4%, and *Mytilus* mean cover was 10.2% among other less abundant taxa. Note that the plots were scored in the office from photos and the relatively diverse assemblage of algae was challenging to identify. A large proportion (33%) of plot 316 was composed of a red turf alga that appeared to be *Mazzaella leptorhynchus*. *Silvetia* plots were devoid of *Silvetia* except for plot 310 (cover = 4%) and 311 (2%) (only 1–2% measured in two plots last year, all other plots = 0%). The *Silvetia* plots were instead dominated by *Mazzaella* (mean = 10%) and *Chondracanthus* (mean = 34.6%). Mussel cover in *Mytilus* plots averaged 100% (73% measured last year). 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 Sprague and Blennau. Sizes of mussels ranged 10–70 mm and mussel bed depths ranged 2–6.8 cm; plots were not monolayers. For reference, last year, sizes of mussels ranged 10–70 mm and mussel bed depths ranged 2–5 cm; all plots were monolayers.

San Miguel Island, January 30–February 2, 2019

(Database event #2017-18-D)

Prepared by Jade Blennau

Purpose

To monitor rocky intertidal sites at San Miguel Island.

Personnel

Stephen Whitaker, Marine Ecologist, Channel Islands National Park

Katy Bland, Technician, UCSC

Michael Langhans, 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 Tough TG-5 12 Megapixel 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 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. Mussel sizes and mussel bed depth were measured at all four sampling sites.

1/30/2019. Crook Point

Low tide -0.09 ft at 1322 hrs. The conditions were very good with light swell and occasional sets wetting front half of outer reef. We had no trouble completing all protocols, including searching inside all the black abalone plots. There were 5 elephant seals present, 30 cormorants, 3 gulls, 5 black oystercatchers, 2 unidentified songbirds (potentially song sparrows). The site was monitored from 1300 to 1715.

Plots and panoramas were photographed by Langhans and Bland. All photoplots were scored in the field by Whitaker. The field log was completed by Whitaker.

No plot repairs were necessary during this visit.

The temperature logger located above site was removed at 1700 and was not replaced.

A 30-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Bland and Langhans. N = 58 black abalone (sizes ranged 39–183 mm) were observed site-wide. Nine were found in plot 393 and none in plot 394. Last year, N = 57 black abalone (sizes ranged 30–137 mm) were observed site-wide from the east end excluding the offshore reef to the west end in line with plot 388. Abalone were counted first and then a subset was measured afterwards. All other fixed black abalone plots were not sampled. In February 2017, 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. In February 2016, 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 Bland and Langhans. N = 7 ochre stars were observed site-wide (from plot 388 to end, excluding reefs), sizes ranged 90–160 mm, mode = 110 mm and 140 mm). All sea stars appeared to be healthy with no visible lesions. Last year, N = 5 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 90–130 mm, mode = 130 mm). In February 2017, 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).

Mussel measurements were taken by Bland and Langhans. Mussel lengths ranged 10–60 mm and bed depths ranged 20–40 mm in *Mytilus* plots 1–5. All plots appeared to be comprised of monolayers of *Mytilus*. Last year, Mussel lengths ranged 20–60 mm and bed depths ranged 20–80 mm in *Mytilus* plots 1–5. In February 2016, 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*.

Barnacle (*Chthamalus* spp./*Balanus* spp.) plots had 27.2% (28.8% measured last February) mean barnacle cover. The majority of the point contacts in the five plots were bare rock. *Endocladia* plots had 18% (17.2% measured last February) mean *Endocladia* cover. The majority of the point contacts in the five plots were bare rock except plot 388, where the majority was *Endocladia*. *Endocladia* plot 389 had 43% mussels present (previously 54%). The rockweed plots had 0% (0% measured last February) *Pelvetiopsis* and *Silvetia* cover (the same was documented in February 2017). Most of the cover within the rockweed zone was dominated by mussels (mean = 21.2%). Mussel (*Mytilus californianus*) plots had 83.6% (76% measured last February) mean cover. The majority of cover in the five plots was occupied by mussels.

Mazzaella affinis appears reproductive, resembling *Mastocarpus*. Approximately 214 *Pelvetiopsis hybrida* thalli on outer reef (around plots 388 and 399), all were tiny (max length 3") and most were reproducing. Several hundred more thalli were observed around the upper perimeter of the CBS grid. Upper intertidal heavily dominated by *Ulva*, *Endarachne*, *Porphyra* and *Cladophora*. *Strongylocentrotus purpuratus* dominant (thousands) and appear healthy. *Mytilus* is abundant but most are small (~30–60mm). *Anthopleura xanthogrammica* appears more abundant than *A. sola*. Several small patches of *Phyllospadix torreyi* (1sq ft) on outer reef. The surge channel was dominated by *Ulva* and *Gracilaria* and devoid of sand. N = 4 *Pisaster* were sampled for tube feet for Raimondi.

1/31/2019. Otter Harbor

Low tide -0.4 ft at 1404 hrs. The conditions were decent for sampling. Moderate sized swell made for wet conditions doing the *Lottia* plots. Otherwise, we were not affected by conditions and completed all monitoring protocols. Partly cloudy. There were four gulls and four oystercatchers at the site at various times throughout the day. Upon arrival, there were 82 California sea lions (majority small/young) and 8 harbor seals (large) on the reef. One elephant seal was seen swimming in water. The site was monitored from 1245 to 1715.

Plots were photographed by Langhans and Bland. Site panoramas were photographed by Langhans. All photoplots were scored in the field by Whitaker except plot #374. The field log was completed by Whitaker.

Temp logger# 100999087 replaced at 1600 by logger# 10770466 in the mid zone east side.

Temp logger#10999077 replaced at 1552; logger was not replaced on the west side.

No plot repairs were conducted during this visit since nearly all plots now have three bolts indicating the locations of the corners. Plot #376 is missing upper right bolt and needs to be installed next visit. All plots were easily located.

A 35-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Bland and Langhans. The search encompassed the area from R1 to R2. Abalone were counted first, then a subset was measured afterwards. N = 401 black abalone were observed site-wide (N = 68 measured, sizes ranged 35–139 mm, most individuals were either touching or were located 1–10 cm apart from one another). Abalone fixed plot #368 and #369 were sampled; plot #369 held three abalone while none were found in plot #368. Other fixed abalone plots were not searched. For reference, in the past all abalone plots were searched. In December of 2017, N = 301 black abalone were observed site-wide (N = 95 measured, sizes ranged 30–178 mm, most individuals were either touching or were located 1–10 cm apart from one another). All five abalone fixed plots were sampled; plots 1–5 had N = 0, 2, 0, 0, 2 black abalone, respectively. In February 2017, 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. In February 2016, 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 30-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by Bland and Langhans. N = 0 ochre stars were observed site-wide from R2 to the east end near the surge channel. For reference, none were found in December of 2017 and N = 1 ochre stars were observed site-wide in Feb 2017 (size = 200 mm). In February 2016, 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 the entire crew. Plots 1–5 had N = 69, 51, 38, 37 and 82 owl limpets, respectively. Sizes of *L. gigantea* lumped across the five plots ranged 9–71.5 mm. For reference, last year, Plots 1–5 had N = 105, 71, 100, 32 and 49 owl limpets, respectively. Sizes of *L. gigantea* lumped across the five plots ranged 11–60 mm. February 2017 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. In February 2016, 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 measurements were taken by Bland and Langhans. Mussel lengths ranged 20–60 mm and bed depths ranged 10–44 mm in *Mytilus* plots 1–5. All plots appeared to be comprised of monolayers of *Mytilus*. For reference, last year, mussel lengths ranged 10–80 mm and bed depths ranged 25–65 mm in *Mytilus* plots 1–5. In February 2017 mussel lengths ranged 10–90 mm and bed depths ranged 1–70 mm in *Mytilus* plots 1–5. All plots appeared to be comprised of monolayers of *Mytilus*.

The barnacle (*Chthamalus* spp./*Balanus* spp.) plots had 8.8% (8.2% in December 2017 and 8.4% in February 2017) 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. *Endocladia* plots had 34.8% (30.2% in December 2017 and 47% measured in November 2016) mean *Endocladia* cover. The majority of point contacts in the five plots were bare rock except plot #362. The rockweed plots had 0.0% (0.2% measured in December 2017 and November 2016) mean *Silvetia* cover and 0% mean *Pelvetiopsis hybrida* cover. Most of the point contacts within the rockweed zone were bare rock or *Endocladia* (mean = 17.2%). Mussel (*Mytilus californianus*) plots had 39.6% (46% in December 2017 and 54.4% measured November 2016) mean cover. The majority of cover in the five plots was occupied by mussels.

Rockweeds were nearly absent: only one *Silvetia* thalli was seen, but there were approximately 20 *Pelvetiopsis hybrida* adults, and numerous juvenile recruits. *Poryphyra* and *Ulva* occurred in low abundances in the upper intertidal. *Mazzaella affinis* was reproductive and in low abundance. *Endocladia* appeared robust and abundant. *Mytilus* was abundant but recruitment was not observed. Substantial amount of *Phyllospadix* occurred on the lower reef. *Chlorostoma* was highly abundant in the tide pools. As usual, at this site it was very difficult deciphering between non-coralline crust and mineral deposits. Both *Chthamalus* and *Balanus* were uncommon. Black abalones were potentially more abundant than any other year post mid-1990s. No *Pisaster* were seen, but N = 1 *Leptasterias* was observed.

2/1/2019. Harris Point

Low tide -0.45 ft at 1543 hrs. The conditions were a little wet due to inconsistent but large waves washing through the *Lottia* plots. Otherwise we were unaffected by the conditions. It began raining on the return hike to housing and it was projected to rain the entire following day, 2/2/19.

Approximately 160 juvenile California sea lions, a single adult male elephant seal, and 8 adult harbor seals were at the site upon arrival. The site was monitored from 1245 to 1630.

Plots were photographed by Bland and Langhans. Site panoramas were photographed by Langhans. All 25 photoplots at the site were scored in the field by Whitaker. The field log was completed by Whitaker.

No repairs were made during this visit, but several plots require reparations—see photolog from December 2017 and February 2017 visit for details. However, all plots were easy to locate.

The Hobotemp Tidbit air temperature logger was not replaced and no mid zone logger was installed.

A 30-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Bland and Langhans. The search was impeded by large swell. N = 135 black abalone were observed site-wide (sizes ranged 32–132 mm, most individuals were located 1–10 cm more apart from one another). For reference, in December 2017, N = 103 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 20–160 mm, most individuals were located 1–10 cm more apart from one another). The five fixed plots were not sampled. For reference, last February, A 45-minute search 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 apart from one another). All five fixed plots were sampled; all had N = 0, except plot 443 with N = 3 black abalone. In February 2016, 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 30-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by Bland and Langhans. N = 0 ochre stars were observed site-wide. Five *Patiria* were observed. For reference, in December 2017, three *Patiria* and zero ochre stars were found. February 2017 and February 2016, zero sea stars were observed.

Owl limpets (*Lottia gigantea*) were counted and measured in the fixed plots by Whitaker. Plots 1–5 had N = 6, 12, 68, 84 and 15 owl limpets, respectively. Sizes of *L. gigantea* lumped across the five plots ranged 16–66 mm. For reference, last year, plots 1–5 had N = 13, 33, 76, 82 and 15 owl limpets, respectively. Sizes of *L. gigantea* lumped across the five plots ranged 8–70 mm. In February 2016, 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. In February 2016, 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 measurements were taken by Bland and Langhans. Mussel lengths ranged 10–80 mm and bed depths ranged 16–64 mm in *Mytilus* plots 1–5. All plots appeared to be comprised of monolayers of *Mytilus*. For reference, in December 2017, mussel lengths ranged 10–90 mm and bed depths ranged 15–90 mm in *Mytilus* plots 1–5. In February 2017, 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*.

The barnacle (*Chthamalus* spp./*Balanus* spp.) plots had 18.2% (13.4% measured in December 2017) mean barnacle cover. The majority of point contacts in the five plots were bare rock. *Endocladia* plots had 27.2% (16.2% measured in December 2017) mean *Endocladia* cover. The majority of point contacts in the five plots were bare rock. No *Endocladia* in plot #433. The rockweed plots had 0% (0.2% measured in December 2017) mean *Pelvetiopsis hybrida* cover and 0% *Pelvetiopsis* and

Silvetia cover. Note that the only rockweed present at this site appears to be *Pelvetiopsis hybrida* – and all previous *Hesperophycus* cover data have been converted to *P. hybrida*. Most of the point contacts within the rockweed zone were bare rock. Mussel (*Mytilus californianus*) plots had 28% (28.8% measured in December 2017) mean cover. The majority of point contacts in five plots were bare rock, non-coralline crust, or mussels. The *Tetraclita* zone had 9.8% (14% measured in December 2017) mean *Tetraclita* cover. The majority of point contacts in the five plots were bare rock or non-coralline crust.

Mytilus was common but patchy in low density. This made it challenging to walk around without smashing them. No *Mytilus* recruitment was observed. Rockweed (*Pelvetiopsis hybrida*) appeared to be even less abundant than it has been in recent years. The only remaining thalli are around plot 442. *Endocladia* appeared to be lush and approximately similar in abundance to that of recent years. *Mazzaella* was mostly reproductive. Barnacle spp. (*Chthamalus/Balanus/Tetraclita*) appear to be approximately equal in abundance, with few open tests observed. Overall, there is a lot of bare rock at this site, with high cover of non-coralline crust.

2/2/2019. Cuyler Harbor

Low tide -0.68 ft at 1512 hrs. We noted the presence of sand in some plots with higher cover than usual. Conditions were good overall; swell was large but the site is oriented such that the swell did not impact our ability to conduct all protocols. No shorebirds or mammals were observed on the site. Several hundred elephant seals were seen on Cuyler Beach; nearly all were females. The site was monitored from 1315 to 1645.

Plots were photographed by Bland and Langhans. Site panoramas were photographed by Langhans. All photoplots were scored in the field by Whitaker. The field log was completed by Whitaker.

No bolts were installed but several # patches were installed with epoxy.

A temperature air logger was removed and not replaced. There are no other permanent temperature loggers at this site. Six temporary loggers were installed to measure the differences between the canopy formed by *Silvetia* and the absence of canopy. The three pairs of loggers were installed in the small patch of *Silvetia* located on the northeast side of the site (Table B-2).

Table B-2. Temperature loggers installed at Cuyler Harbor on San Miguel Island in 2019 in Channel Islands National Park.

Pair #	Inside Unit Number	Outside Unit Number
1	10770475	10770492
2	10770551	10770506
3	10770495	10770510

A 15-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by both Bland and Langhans. N = 17 black abalone (sizes ranged 49–129 mm) were observed site-wide. This is the fourth consecutive year that black abalone have been observed at this site in perhaps 20 or more

years. For reference, in December 2017, N = 19 black abalone (sizes ranged 50–85 mm) were observed site-wide. In February 2017, 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. In February 2016, N = 1 black abalone (86 mm) was observed site-wide.

A 15-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by both Bland and Langhans. N = 1 healthy ochre star was found (radius = 100 mm). One *Pisaster giganteus* was found (approx. 180 mm). In December 2017, N = 3 ochre stars were observed site-wide (sizes ranged 100–120 mm); all individuals appeared healthy. In February 2017, 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. In February 2016, N = 6 *P. ochraceus* (sizes ranged 30–150 mm) were observed site-wide; all appeared to be healthy.

Mussel measurements were taken by Langhans. Mussel lengths ranged 30–150 mm and bed depths ranged 39–87 mm in *Mytilus* plots 1–5. All plots appeared to be comprised of monolayers of *Mytilus*. For reference, in December 2017, mussel lengths ranged 20–130 mm and bed depths ranged 35–110 mm in *Mytilus* plots 1–5. In February 2017, mussel lengths ranged 10–120 mm and bed depths ranged 20–90 mm in *Mytilus* plots 1–5.

The barnacle (*Chthamalus* spp./*Balanus* spp.) plots had 38.2% (30.4% measured in December 2017) mean barnacle cover. The majority of the point contacts in the five plots were bare rock. *Endocladia* plots had 23% (17.6% measured in February 2017) mean *Endocladia* cover. Plots were relatively diverse with substantial cover of *Mytilus* (mean = 7.2%) and *Balanus/Chthamalus* (mean = 9.4%). In December 2017, the majority of the point contacts in the five plots were bare rock, but all five plots were relatively diverse with substantial cover of *Mytilus* (mean = 11.2%) and *Balanus/Chthamalus* (mean = 11.4%). Rockweed plots had 0% *Pelvetiopsis* and *Silvetia* cover (the same was documented February 2017). Most of the point contacts within the rockweed plots were bare rock, but like the *Endocladia* plots, the rockweed plots were fairly diverse, with substantial amounts of *Mytilus* (mean = 12.6%), *Balanus/Chthamalus* (mean = 8%) and non-coralline crust (mean = 10.4%). Mussel (*Mytilus californianus*) plots had 52.4% (74.2% in December 2017) mean mussel cover. Majority of plots were covered by mussels.

Approximately 24 *Pelvetiopsis* thalli were observed with low recruitment (approx. five thalli). *Silvetia* appeared healthy but only a low level of recruitment was observed—both rockweed species appeared to be reproductive. *Mytilus* was abundant with mostly extra-large individuals. *Endocladia* was lush and moderately abundant. *Balanus* was far more abundant than *Chthamalus*; few open tests were observed for either species. *Pollicipes* and *Tetraclita* occurred in low abundance. *Mazzaella* was reproductive. At least two *Cancer* spp. were seen. N = 17 black abalone were seen; two were in shallow cracks around plot #401, two were around #410, and the rest were under large rock (R1). One *P. ochraceus* and 1 *P. giganteus* were seen. Note: we searched the beach for snowy plovers but did not observe any.

Santa Cruz Island, March 17–21, 2019

(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

Katy Bland, Technician, UCSC

Michael Langhans, Technician, UCSC

Procedure and General Observations

Island Packers transportation was utilized to access the island. Note that the site at Orizaba Cove was not sampled during this visit. Standard procedures were used for monitoring rocky intertidal sites. Plots and site overviews were photographed with an Olympus Tough TG-5 12 Megapixel 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 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 loggers were downloaded at each of the sites to record air and sea surface temperature. Mussel sizes and mussel bed depth were measured at all sites. IPCO provided transportation off the island on 3/21.

3/17/2019. Prisoners Harbor

Low tide -1.01 ft at 1419 hrs. The conditions were fantastic given the extremely low tide and minimal swell/wind. The only gripe was that it was incredibly warm and sunny. No measurable precipitation was detected recently. One harbor seal was seen in the water immediately offshore towards the end of the day. No shorebirds were observed. The site was monitored from 1245 to 1700.

Jennifer Burnaford and her graduate student joined us for the day to voucher common algae and invertebrates as part of a coordinated effort through MARINe to document the target species for each of the affiliated sampling teams.

Plots were photographed by Bland and Langhans. Site panoramas were photographed by Langhans. All photoplots were scored in the field by Whitaker. The field log was completed by Whitaker.

No repairs were necessary since nearly all plots have three bolts marking the locations of three corners and all plots are easy to locate, but some epoxy was placed around bolts that appeared to be loose. The plot(s) that do not have three bolts have two bolts plus epoxy that clearly indicate the location of the plots.

Two temperature loggers were installed at the site in 2017: one above the site to record air temperature and another in the mid intertidal for sea surface temperature. The logger in the mid intertidal was installed between plots 850 and 845. The other logger was installed in a nook within the staging rock that is located in the area of the reef above the *Endocladia* and *Pelvetiopsis* plots. The logger in the mid intertidal was exchanged with a new one; the one within the staging rock was

collected and not replaced since it has been determined that the location does not provide accurate air temperature readings.

Three pairs of temperature loggers were installed to document temperature under *Silvetia* canopy and outside the canopy nearby (Table B-3). The three pairs were installed in a patch of *Silvetia* near the *Chthamalus* plots. Refer to the picture below for more information on their locations (Figure B-1).

Table B-3. Temperature loggers installed at Prisoner's Harbor on Santa Cruz Island in 2019 in Channel Islands National Park.

Pair #	Inside Unit Number	Outside Unit Number
1	10770497	10770558
2	10770477	10770557
3	10770505	10770474



Figure B-1. Location of temperature loggers installed in 2019 at Prisoner's Harbor on Santa Cruz Island, Channel Islands National Park.

A 30-minute site-wide search was conducted for black abalone (*Haliotis cracherodii*) presence by Bland. No abalone were seen. Last year, N = 1 black abalone was observed site-wide (129 mm). In fall 2016, N = 1 black abalone was observed site-wide (103 mm—individual was out in the open and foot appeared to be shrunken but the abalone held tightly to the substratum when tested; periostracum was nearly entirely removed). 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 site-wide search was conducted for ochre star (*Pisaster ochraceus*) presence by Langhans. N = 1 *P. ochraceus* (healthy appearance, 170 mm) was located throughout the entire site. Last year, N = 1 *P. ochraceus* (healthy appearance, 90 mm) was located throughout the entire site. For reference, in November 2016, zero *P. ochraceus* were located throughout the entire site. In fall 2015, 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).

The barnacle (*Chthamalus* spp./*Balanus* spp.) plots had 3% (6.6% mean barnacle cover measured last year) mean barnacle cover. Similar to last year, the majority of point contacts in the five plots were *Septifer* (mean = 40.6%) followed by bare rock (mean = 22.6%). *Endocladia* plots had 26.2% (29.8% measured last fall) mean *Endocladia* cover. The majority of point contacts in the five plots were *Chthamalus* spp./*Balanus* spp. (mean = 32.4%) and bare rock (mean = 29.4%). The *Silvetia* plots had 0.0% (0.0% measured last year and the preceding year as well) mean *Silvetia* cover. Within the *Silvetia* zone, there was a relatively diverse mix of species occupying space, including the following most abundant species: *Mazzaella*, non-coralline crust, *Tetracrita*, and *Septifer*. The *Pelvetiopsis* plots had 11% (5.8% measured last year) mean *Pelvetiopsis* cover. Most of the point contacts within the *Pelvetiopsis* zone were *Chthamalus* spp./*Balanus* spp. (mean = 31%), but bare rock (mean = 30.6%) and *Endocladia* (mean = 17.4%) were quite common. Mussel (*Mytilus californianus*) plots only had 4.8% (2.8% measured last year) mean cover. Mussel cover was only documented in *Mytilus* plots 1–3. The majority of cover in the five plots was occupied by *Chondracanthus canaliculatus* (mean = 53.2%) and articulated corallines (mean = 14.8%).

Mussels were measured in the five original *Mytilus* plots by Langhans and Bland. Sizes of mussels ranged 30–60 mm and mussel bed depths ranged 2–5 cm; all plots were monolayers. *Mytilus* plot 4 had zero mussels observed in the plot, just like it did last year.

Septifer was highly abundant particularly on the west reef. *Scytosiphon* was nearly 100% of the cover in the upper intertidal on the west reef. *Endarachne* was also highly abundant below the zone formed by *Scytosiphon*. There was a marked level of silt observed in the lower reaches of the site—the temperature logger housing was entirely filled with sediment. *Chthamalus* recruitment appeared extremely high—potentially the highest Whitaker has observed at this site in several years. *Balanus* was relatively rare. *Mytilus* was common on the west reef, but most individuals were small and recruits were rare. *Silvetia* was healthy in appearance but very few recruits were seen. The same held true for *Pelvetiopsis*. *Tetracrita* was common, with approx. <10% open tests. A high proportion of algae appeared to be bleached.

3/18/2019. Fraser Cove

Low tide -1.24 ft at 1459 hrs. The conditions were excellent; swell was a bit larger than anticipated but the extreme low tide was more than adequate to safely conduct all protocols throughout the entire site. The wind was light. No shorebirds or pinnipeds were seen at Fraser. At Forney's, one very thin juvenile elephant seal was seen hauled out on the beach and a harbor seal was in the water. The site was monitored from 1230 to 1800. All plots at Fraser and Forney were scored during the same day.

Plots were photographed by Bland and Langhans. Site panoramas were photographed by Bland. All 35 photoplots were scored in the field by Whitaker.

No plot repairs were necessary. Last year, a temperature logger was installed above the staging area; unit was epoxied to the surface of the rock. Another temperature logger was installed in the mid intertidal west (approx. 1 m) of *Pollicipes* plot 2. Neither of the temperature loggers were downloaded or replaced this visit.

A 30-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Bland. N = 17 black abalone (sizes ranged 55–157mm) were observed site-wide from plot 891 to plot 905. For reference, last year N = 10 black abalone (sizes ranged 66–140 mm) were observed site-wide from plot 891 to plot 905. All were 1–10 cm apart from one another. In November 2016, N = 4 black abalone (sizes ranged 67–106 mm) were observed site-wide from plot 891 to plot 905. All were 1–10 cm apart from one another. In fall 2015, N = 7 black abalone (sizes ranged 66–139 mm) were observed site-wide from plot 891 to plot 905.

A 30-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by Langhans. Zero *P. ochraceus* were observed site-wide from plot 891 to plot 905. For reference, last year one *P. ochraceus* (80 mm) was observed site-wide from plot 891 to plot 905. The individual appeared to be healthy. In November 2016, one *P. ochraceus* (60 mm) was observed site-wide from plot 891 to plot 905. The individual appeared to be healthy. In fall 2015, N = 2 ochre stars were observed site-wide.

Surfgrass transects were sampled by Whitaker. Transects 1–3 had *Phyllospadix* cover = 50, 32, and 65%, respectively. Most of the surfgrass appeared to be in moderate condition with a moderate level of bleaching and light fouling from *Melobesia*. Note that cover of surfgrass on all three transects decreased markedly from previous measurements. For reference, last year Transects 1–3 had *Phyllospadix* cover = 82, 82, and 92%, respectively. Most of the surfgrass appeared to be in good shape overall with very minimal bleaching and a moderate level of fouling from *Melobesia*. In fall 2016, 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 of fouling from *Melobesia*. In fall 2015, transects 1–3 had *Phyllospadix* cover = 79, 77, and 87%, respectively.

The fixed owl limpet plots were sampled by Whitaker (plots 1–3) and Langhans and Bland (plots 4–5). Note that Whitaker used digital calipers to record limpet sizes in plots 1–3. Plots 1–5 had N = 11, 8, 8, 12, and 8 *Lottia gigantea*, respectively. Throughout the five plots, sizes ranged 20–63 mm. For reference, last year plots 1–5 had N = 12, 2, 13, 15, and 5 *Lottia gigantea*, respectively. Throughout the five plots, sizes ranged 10–65 mm. For reference, in November 2016, plots 1–5 had N = 20, 8,

12, 21, and 6 *Lottia gigantea*, respectively. Throughout the five plots, sizes ranged 12–65 mm. In fall 2015, plots 1–5 had N = 13, 6, 11, 14, and 10 *Lottia gigantea*, respectively. Throughout the five plots, sizes ranged <15–65 mm.

The barnacle (*Chthamalus* spp./*Balanus* spp.) plots had 31.2% (25% measured last year) mean barnacle cover. The majority of point contacts in the five plots were bare rock. *Endocladia* plots had 55.8% (20.4% measured last year) mean *Endocladia* cover. The majority of point contacts in the five plots were *Endocladia*. The *Silvetia* plots had 21.8% (19.6% 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 and *Endocladia* was relatively abundant (mean = 21.8%). The *Pelvetiopsis* plots had 18.8% (8% measured last fall) mean *Pelvetiopsis* cover. Most of the point contacts within the *Pelvetiopsis* zone were bare rock; *Endocladia* cover was relatively high (mean = 35.4%). Mussel (*Mytilus californianus*) plots had 60.2% (67% measured last fall) mean mussel cover. The majority of cover in the five plots was occupied by *Mytilus californianus*. *Pollicipes* plots had 14.4% (15.6% measured last fall) mean *Pollicipes* cover. The majority of cover in the five plots was occupied by *Mytilus californianus* (mean = 39.4%). Tar plots had 43.6% (49% measured last fall) mean tar cover. Overall, in comparison to data collected for all the photoplots at this site during the past two years, all target taxa appear to have remained relatively unchanged.

Mussels were measured in the five *Mytilus* plots by Langhans and Bland. Sizes of mussels ranged 10–100 mm and mussel bed depths ranged 20–100 mm; all plots were essentially monolayers. For reference, in February 2016, sizes of mussels ranged 10–100 mm and mussel bed depths ranged 25–70 mm; all plots were essentially monolayers.

High cover of filamentous red algae (similar to *Ceramium* and *Polysiphonia*) was observed growing epiphytically throughout the mid/lower intertidal. High percentage of algae were bleached at Forney's but a very small percentage of algae were bleached at Fraser. *Mytilus* seemed to be exceptionally brittle, since an unusually high number of shells were crushed under foot by all three team members. *Endocladia* appeared to be lush and highly abundant. *Chthamalus* recruits were seen, but they occurred in lower abundance than at the Prisoner's site. *Phyllospadix* was markedly less common compared to abundances from recent years and a fair amount of bleaching and fouling from *Smithora* were observed. At Forney's, *Silvetia* and *Hesperophycus* appeared to be abundant, healthy and reproductive.

3/19/2019. Trailer

Low tide -1.25 ft at 1536 hrs. The conditions were quite good despite the impending storm. The tide was exceptionally low and the swell and wind were light. Light rain fell overnight. No shorebirds were observed nearby the site the entire day. One harbor seal was seen in the water. The site was monitored from 1245 to 1700.

Plots were photographed by Langhans and Bland. Site panoramas were photographed by Langhans. All photoplots were scored in the field by Whitaker. The field log was completed by Whitaker.

No plot repairs were necessary. Last year, one temperature logger was installed in the mid intertidal near the center of the site between the *Mytilus* and *Chthamalus* plots. Another temperature logger intended to document air temperature was installed near the top of the rock located at the staging area. This visit, we exchanged the logger in the mid intertidal and removed the logger near the staging area.

Three pairs of temperature loggers were installed to document temperature under *Silvetia* canopy and outside the canopy nearby (Table B-4). The three pairs were installed in a patch of *Silvetia* near the *Chthamalus* plots. Pair 1 was installed next to SIL4; Pair 2 next to SIL1; Pair 3 next to SIL3. Refer to pictures for more information on their locations (Figures B-2 to B-4).

Table B-4. Temperature loggers installed at Trailer on Santa Cruz Island in 2019 in Channel Islands National Park.

Pair #	Inside Unit Number	Outside Unit Number
1	10770490	10770479
2	10770493	10770484
3	10770473	10770549



Figure B-2. Location of the Pair 1 temperature loggers installed in 2019 at the Trailer site on Santa Cruz Island in Channel Islands National Park.



Figure B-3. Location of Pair 2 temperature loggers installed in 2019 at the Trailer site on Santa Cruz Island in Channel Islands National Park.



Figure B-4. Location of Pair 3 temperature loggers installed in 2019 at the Trailer site on Santa Cruz Island in Channel Islands National Park.

A 40-minute search (2 observers each 20 mins) was conducted for black abalone (*Haliotis cracherodii*) presence by Bland and Langhans. N = 360 black abalone (sizes ranged 39–147 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 past surfgrass transect-3 to the *Lottia* plots at the west end. For reference, last year, N = 330 black abalone (sizes ranged 27–165 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 past surfgrass transect-3 to the *Lottia* plots at the west end. For reference, in November 2016, 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 past surfgrass transect-3 to the *Lottia* plots at the west end. In fall 2015, 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 2014, N = 61 black abalone were observed (sizes ranged 27–141 mm, most individuals were located 1–10 cm apart from one another).

A 40-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by Langhans and Bland. N = 0 *P. ochraceus* were seen at the site. For reference, last year, N = 1 *P. ochraceus*

(presumably healthy) (100 mm) was seen at the site. In November 2016, N = 5 *P. ochraceus* (presumably healthy) (sizes ranged 60–130 mm) were seen at the site. In fall 2015, N = 4 *P. ochraceus* (appeared healthy) (sizes ranged 50–70 mm) were seen.

Surfgrass transects were sampled by Whitaker. Transects 1–3 had *Phyllospadix* cover = 93, 75, and 26%, respectively. *Phyllospadix* was moderately fouled by *Smithora*, and a low percentage of the beds appeared bleached and/or abraded. For reference, last year, transects 1–3 had *Phyllospadix* cover = 97, 86, and 35%, respectively. *Phyllospadix* was lightly fouled by *Melobeisa* and *Smithora*, and a low percentage of the beds appeared bleached and/or abraded. In November 2016, 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. In fall 2015, transects 1–3 had *Phyllospadix* cover = 95, 73 and 31%, respectively.

The fixed owl limpet plots were sampled by Whitaker. Plots 1–5 had N = 26, 36, 24, 27, and 14 *Lottia gigantea*, respectively. Throughout the five plots, sizes ranged 15.5–91.5 mm. For reference, last year, plots 1–5 had N = 31, 37, 18, 19, and 11 *Lottia gigantea*, respectively. Throughout the five plots, sizes ranged 12–91 mm. In November 2016, plots 1–5 had N = 31, 33, 29, 22, and 16 *Lottia gigantea*, respectively. Throughout the five plots, sizes ranged 5–92 mm. In fall 2015, plots 1–5 had N = 18, 20, 6, 9, and 1 *Lottia gigantea*, respectively.

The barnacle (*Chthamalus* spp./*Balanus* spp.) plots had 54% (39.4% measured last fall) mean barnacle cover. The majority of point contacts in the five plots were *Chthamalus* spp./*Balanus* spp. The *Silvetia* plots had 49.8% (51% measured last fall) mean *Silvetia* cover. Most of the cover within the *Silvetia* zone was dominated by *Silvetia*. The *Hesperophycus* plots had 5.8% (2.4% measured last fall) mean *Hesperophycus* cover. Most of the point contacts within the *Hesperophycus* zone were *Silvetia* (mean = 38%). Mussel (*Mytilus californianus*) plots had 59.2% (57.6% measured last fall) mean cover. The majority of cover in the five plots was dominated by *Mytilus*.

Mussels were measured in the five original *Mytilus* plots by Bland and Langhans. Sizes of mussels ranged 10–90 mm and mussel bed depths ranged 10–60 mm; all plots appeared to be comprised largely of a monolayer of mussels. For reference, last year, sizes of mussels ranged 10–100 mm and mussel bed depths ranged 20–75 mm; all plots appeared to be comprised largely of a monolayer of mussels. In November 2016, 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.

Silvetia and *Hesperophycus* appeared to be in good shape (lush and abundant) with a high level of recruitment observed for both species. *Silvetia* receptacles appeared orange for approx. 50% of the thali. *Mytilus* was abundant and now noticeably more abundant than *Phragmatopoma*. Far fewer mussels were crushed under foot compared to that of the Fraser Cove population yesterday. *Chthamalus* recruitment was observed in lower abundance than seen at Prisoner's or Fraser. Black abalone abundance appeared to be even higher than observed in recent years. N = 360 black abalone were observed during the site search. However there were numerous others seen in the lowest reaches of the site which were not included in the count to remain consistent with counts from past years. *Endocladia* appeared lush and rich in color with very little bleaching.

3/20/2019. Willows Anchorage

Low tide -1.05 ft at 1612 hrs. The conditions were not optimal for sampling given the high swell originating out of the southwest. The mussel plots and owl limpet plots were impacted by the swell all day long. We were still able to sample all the plots between sets, but it was highly challenging and required a lot of running and waiting. Fortunately, the tide was extremely low, which provided a small buffer against the high swell that routinely washed across the *Endocladia* plots. No shorebirds were seen around the site throughout the day, but one harbor seal was hanging around the site in the water most of the day. The site was monitored from 1300 to 1815.

Plots were photographed by Bland and Langhans. Site panoramas were photographed by Bland. All of the photoplots were scored in the field by Whitaker. The field log was completed by Whitaker. The temperature logger #20186762 in the mid intertidal was replaced at 1515 by logger #10770555. The logger # 20186766 that was installed above the staging area was removed and not replaced. Six temperature loggers were installed to measure conditions nearby and under the canopy formed by *Silvetia* (Table B-5).

Table B-5. Temperature loggers installed at Willows Anchorage on Santa Cruz Island in 2019 in Channel Islands National Park.

Pair #	Inside Unit Number	Outside Unit Number
1	10770494	10770467
2	10770480	10770464
3	10770469	10770496

A 30-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Bland and Langhans. N = 149 black abalone were observed in the area of the site between the beach and the *Mytilus* plots (sizes ranged 22–156 mm, most individuals were touching one another). For reference, last year, N = 125 black abalone were observed in the area of the site between the first *Hesperophycus* plot and the *Mytilus* plots (sizes ranged 25–145 mm, most individuals were either touching or located 1–10 cm apart from one another). In November 2016, 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). In January 2016, 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 Langhans. N = 11 *P. ochraceus* were seen across the entire site from H1 to L5 (sizes ranged 40–140 mm, mode = 50 mm). All individuals appeared healthy with no lesions observed. For reference, last year, N = 28 *P. ochraceus* were seen across the entire site from H1 to L5 (sizes ranged 90–150 mm, mode = 80–90 mm). All individuals appeared healthy with no lesions observed. In November 2016, 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. In January 2016, 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.

The fixed owl limpet plots were sampled by Whitaker. Plots 1–5 had N = 64, 50, 57, 31, and 14 *Lottia gigantea*, respectively. Throughout the five plots, sizes ranged 13.5–64 mm. For reference, last year, plots 1–5 had N = 60, 28, 53, 34, and 13 *Lottia gigantea*, respectively. Throughout the five plots, sizes ranged 11–53 mm. In November 2016, plots 1–5 had N = 97, 63, 91, 39, and 11 *Lottia gigantea*, respectively. Throughout the five plots, sizes ranged 9–57 mm. In January 2016, 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 54.4% (50% measured last year) mean *Endocladia* cover. The majority of cover in the five plots was occupied by *Endocladia*. The *Silvetia* plots only had 16.6% (15% measured last year) mean *Silvetia* cover (only plot 949 had significant cover of *Silvetia* present [75%]). Most point contacts within the *Silvetia* zone were *Endocladia* (mean = 34.2%) and crustose corallines (mean = 24%). The *Hesperophycus* plots had 0.2% (0.2% measured last year) mean *Hesperophycus* cover (only plot 940 had *Silvetia* present [1%]). Most point contacts within the *Hesperophycus* zone were *Endocladia* (mean = 42.8%). Mussel (*Mytilus californianus*) plots had 28.6% (50.4% measured last year and 82.6% measured the year before) mean cover. Note the dramatic decline in *Mytilus* cover. The majority of cover in the five plots was occupied by articulated corallines (mean = 31.4%).

Mussels were measured in the five original *Mytilus* plots by Langhans and Bland. Sizes of mussels ranged 10–80 mm and mussel bed depths ranged 2–8 cm; all plots were primarily composed of monolayers. For reference, last year, sizes of mussels ranged 10–80 mm and mussel bed depths ranged 1–5 cm; all plots were primarily composed of monolayers. In November 2016, sizes of mussels ranged 10–80 mm and mussel bed depths ranged 4–11 cm; all plots were primarily composed of monolayers.

A high amount of bleaching was seen for *Chondracanthus canaliculatus* and *Mazzaella affinis* and to a lesser degree, *Endocladia*. *Silvetia* recruitment appeared to be high relative to past year levels. The condition of *Silvetia* appeared to be moderate overall with some tattered individuals and some

thalli exhibiting orange tips (approx. half the population). Several *Aplysia* were observed. Approximately 40 *Lithopoma* were seen. Markedly fewer black abalone were seen between *Pelvetiopsis* plot 1 and *Endocladia* plot 5 compared to recent years. In contrast, there was an inordinate amount (>100 individuals) of abalone between the beach and *Hes* plot 1. Many of the abalone near the beach were partially covered by sand. One freshly dead black abalone was found and collected; it appeared to be withered.

Santa Rosa Island, April 15–19, 2019

Prepared by Stephen Whitaker

Purpose

To monitor rocky intertidal sites at Santa Rosa Island.

Personnel

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Procedure and General Observations

Island Packers was utilized to access the island. Standard procedures were used for monitoring the rocky intertidal sites. Plots and site overviews were photographed with an Olympus Tough TG-5 12 Megapixel digital camera. Photoplots were scored in the field at all sites. 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 (surfgrass cover was estimated instead). *Lottia gigantea* were sampled 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. Mussel sizes and mussel bed depths were measured at all monitoring sites.

4/15/2019. East Point

Low tide -0.63 ft at 1355 hrs. The conditions were excellent although the tide was not low enough to safely and accurately monitor the surfgrass transects. We walked to the site from Southeast Anchorage. The swell and wind were light at the site. However, beyond the site, on the way back to north side of the island, the wind was blowing (>35 kt). There were approx. 50 cormorants and approx. 300 brown pelicans, along with 3 juvenile elephant seals, at the site upon arrival. The site was monitored from 1145 to 1700.

Temperature logger #20186752 was replaced by logger #10999078 at 1700 in the mid intertidal near *Mytilus* plot 2. The logger above the staging area was removed from the site and not replaced.

Three pairs of temperature loggers were installed to document temperature under *Silvetia* canopy and outside the canopy nearby (Table B-6). The three pairs were installed near plots 573 and 587.

Table B-6. Temperature loggers installed at East Point on Santa Rosa Island in 2019 in Channel Islands National Park.

Pair #	Inside Unit Number	Outside Unit Number	Location
1	10770488	10770559	South 573 ~1m
2	10770550	10770554	South 587 ~1m
3	10770471	10770483	North 587 ~1m

Plots were photographed by Bland. Site panoramas were photographed by Bland. All 25 photoplots were scored in the field by Whitaker.

A 30-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Bland. N = 117 black abalone were observed site-wide from the sand channel on the north side of the site to plot 594 on the south end (sizes ranged approx. 44–169 mm, most individuals were spaced 1–10 cm apart from one another). The fixed abalone transect was not sampled. Note that a flashlight was used during the abalone search. For reference, last year, N = 110 black abalone were observed site-wide from the sand channel on the north side of the site to plot 594 on the south end (sizes ranged approx. 58–172 mm, most individuals were spaced 1–10 cm apart from one another). The fixed abalone transect was not sampled. Note that a flashlight was used during the abalone search. In April 2017, 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. In 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 30-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by Bland. N = 5 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 30–140 mm and all individuals appeared to be free of lesions. For reference, last year, N = 14 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 90–180 mm and nearly all individuals appeared to be free of lesions (one appeared to be diseased and was identified as a stage 4). In April 2017, 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. In 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 with a transect tape due to the constant surge of water. However, Whitaker was able to estimate cover of *Phyllospadix* in each of the three transects since cover was high (near 100%). Transects 1–3 had 100%, 79%, and 100% cover of *Phyllospadix*, respectively.

The field log was completed by Whitaker.

No repairs were necessary.

The barnacle (*Chthamalus* spp./*Balanus* spp.) plots had 43.8% (45% measured last year) mean barnacle cover. The majority of point contacts in the five plots were *Chthamalus* spp./*Balanus* spp. *Endocladia* plots had 68.6% (32.8% measured last year) mean *Endocladia* cover. The majority of point contacts in the five plots were *Endocladia*. The *Silvetia* plots had 33.2% (35.8% measured last year) mean *Silvetia* cover. Most of the point contacts within the *Silvetia* zone were *Silvetia*. The *Hesperophycus* plots had 30% (5.2% measured last year and 8% the year before) mean *Hesperophycus* cover; in November 2015, there was 36.2% mean *Hesperophycus* cover. Most of the point contacts within the *Hesperophycus* zone were *Hesperophycus*. A major decline in *Hesperophycus* cover occurred sometime after November 2015, but now it appears that the population has recovered. Mussel (*Mytilus californianus*) plots had 66.6% (65.6% measured last year) mean cover; in November 2015, there was 44.6% mean *Mytilus* cover. Unlike several years ago when only two plots (593 and 594) had mussels present, mussels have been present in all five plots during the last few years. The majority of cover in the five plots was occupied by *Mytilus*.

Mussels were measured in the five original *Mytilus* plots by Bland. Sizes of mussels ranged 10–90 mm and mussel bed depths ranged 4–7 cm; all plots were monolayers. Last year, mussels ranged 10–90 mm and mussel bed depths ranged 4–9 cm; all plots were monolayers.

High *Silvetia* recruitment was observed in the *Endocladia* zone plots. *Chthamalus* recruitment appeared to be exceptionally high. *Mytilus* recruits were rare but mussel cover has persisted and *Phragmatopoma* cover continues to decrease. *Hesperophycus* and *Silvetia* appeared healthy and more widespread compared with recent years. *Silvetia* in particular was highly abundant on the reefs north of the site. *Endocladia* was lush and abundant, with very minimal bleaching. Empty tests were rare for both *Chthamalus* and *Balanus*. High cover of *Ulva* was seen throughout the mid intertidal; other ephemeral species were not observed. Approximately a dozen *Aplysia californica* were seen.

4/16/2019. Ford Point

Low tide -0.6 ft at 1635 hrs. The conditions were okay but the moderate-sized swell hampered the searches for sea stars and black abalone and the tide was not exceptionally low. Wind was high, but we were somewhat protected at the site. There were two black oystercatchers and two gulls at the site at various times throughout the day. One harbor seal and two elephant seals were seen in the water. The site was monitored from 1200 to 1700.

Plots were photographed by Bland. Site panoramas were photographed by Bland. All 15 photoplots were scored in the field by Whitaker.

Temperature logger #20186757 was replaced in the mid intertidal at 1700 by #2018672. It is located below plot 525 in a tidepool. Another temperature logger #20186756 was removed at 1700 from the site and not replaced.

A 30-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Bland. N = 127 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 ranged 70–193 mm, most individuals were located 1–10 cm

apart). The fixed plots were not sampled. Also, note that conditions were not optimal for surveying for black abalone given the high frequency of moderately sized waves impacting the site. For reference, last year, N = 139 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 ranged 24–178 mm, most individuals were located 1–10 cm apart). In spring 2017, 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. In 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 30-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by Bland. N = 7 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 ranged 100–170 mm; all appeared healthy). For reference, last year, N = 17 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 ranged 50–150 mm; all appeared healthy except one that had one lesion). In spring 2017, 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. In 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 Whitaker.

No repairs were necessary.

The barnacle (*Chthamalus* spp./*Balanus* spp.) plots had 10.6% (15% measured last year) mean barnacle cover. The majority of point contacts in the five plots were bare rock. *Endocladia* plots had 32.2% (17.8% measured last year) mean *Endocladia* cover. The majority of point contacts in the five plots were bare rock, although the plots were quite diverse with several species occupying substantial space, including *Mytilus* (mean = 10.2%) and crustose corallines (mean = 7.2%). Mussel (*Mytilus californianus*) plots had 64% (66.6% measured last year) mean cover. The majority of cover in the five plots was occupied by *Mytilus*. All the splash plots were devoid of biota aside from littorine snails (abundances in plots 1–5 = 1, 17, 10, 1, 0, respectively), *Chthamalus* (abundances in plots 1–5 = 0, 140, 9, 50, 150, respectively), and cyanobacteria.

Mussels were measured in the five original *Mytilus* plots by Whitaker. Sizes of mussels ranged 20–90 mm and mussel bed depths ranged 3–8 cm; all plots were monolayers. This information was noted on the field form. For reference, last year, sizes of mussels ranged 10–80 mm and mussel bed depths ranged 3–9 cm; all plots were monolayers.

Owl limpets (*Lottia gigantea*) were measured in the fixed plots by Whitaker and Bland using the digital calipers. Plots 600 (new)–604 had N = 11, 2, 12, 14, and 22 owl limpets, respectively. Sizes

throughout all five plots ranged 9–72 mm. Note that plot 600 (old) was not sampled because it was not located. For reference, last year, plots 600 (new)–604 had N = 18, 2, 8, 39, and 17 owl limpets, respectively. Sizes throughout all five plots ranged 9–72 mm. Note that plot 600 (old) was not sampled because it was not located. In spring 2017, plots 600 (new)–604 had N = 18, 1, 5, 7, and 18 owl limpets, respectively. Sizes throughout all five plots ranged <15–72 mm. 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 unchanged compared with conditions documented during recent past years. *Mytilus* was by far the most dominant species but very few mussel recruits were observed. *Chthamalus* and *Balanus* occurred in patches and were not ubiquitous overall. *Endocladia* was common but not particularly lush; no bleaching was seen. No rockweeds were present at the site, but last summer Whitaker observed a small patch (1–2 sq ft) of *Silvetia* growing at the edge of Ford Beach. *Tetraclita* and *Pollicipes* were relatively rare considering how abundant *Mytilus* was. Overall, diversity appeared low compared to most other sites. *Phragmatopoma* cover seemed to be decreasing compared to that of recent years. *Ulva* covered a low percentage of the mussel zone; no other ephemeral species were observed.

4/17/2019. Northwest-Talcott

Low tide -0.5 ft at 1511 hrs. The conditions were good overall since the tide was sufficiently low and swell was not very large. The access point had eroded significantly at the base of the cliff; a rope was definitely required for both ascending and descending. There were two gulls, and four black oystercatchers at the site upon arrival. No pinnipeds were observed. The site was monitored from 1230 to 1745.

The temperature logger # 20186755 was replaced by logger # 20186756 at 1700. Logger # 20186759 was retrieved from the bluff directly above the site and not replaced.

Three pairs of temperature loggers were installed to document temperature under *Silvetia* canopy and outside the canopy nearby (Table B-7). The three pairs were installed near plots 561 and 566.

Table B-7. Temperature loggers installed at Northwest-Talcott on Santa Rosa Island in 2019 in Channel Islands National Park.

Pair #	Inside Unit Number	Outside Unit Number	Location
1	10770507	10770511	~20 cm south 566 and west of 561
2	10770472	10770478	~1 m north 566
3	10770461	1077053	~2 m NW 566

Plots were photographed by Bland and Langhans. Site panoramas were photographed by Bland. All photoplots except the splash plots were scored in the field by Whitaker.

A thirty-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Bland and Langhans. N = 52 black abalone were seen throughout the site; sizes ranged 24–200 mm, most individuals were spaced 1–10 cm apart from one another). The fixed abalone plots were not sampled, but plot 573 appeared to have at least two black abalone present. For reference, last year, N = 38 black abalone were seen throughout the site; sizes ranged 39–186 mm, most individuals were spaced 11–50 cm apart from one another. The fixed abalone plots were sampled; plots 1–5 = 0. In April 2017, 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 apart). The fixed abalone plots were not sampled. In November 2015, N = 8 black abalone were observed site-wide (sizes ranged approx. 59–188 mm, most individuals were 1–10 cm apart). 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 30-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by Langhans. Zero sea stars were observed. Likewise, last year and in April 2017 and 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 Whitaker. Transects 1–3 had *Phyllospadix* cover = 89, 97, and 75%, respectively. *Phyllospadix* on the transects was highly fouled with epiphytic algae (*Ulva* spp.) and lightly bleached/browned. Flowers were not observed. For reference, last year, transects 1–3 had *Phyllospadix* cover = 100, 100, and 82%, respectively. *Phyllospadix* on the transects was lightly fouled with epiphytic algae and moderately bleached/browned. Flowers were observed on a small proportion of *Phyllospadix* on transect #2. In April 2017, 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. In November 2015, transects 1–3 had 100, 100, and 90% cover, respectively.

The *Lottia gigantea* plots were sampled by Whitaker using the digital calipers. Plots 1–5 had N = 35, 44, 41, 17, and 26 *L. gigantea*, respectively. Sizes of owl limpets in all the plots combined ranged <15–94 mm. For reference, last year, plots 1–5 had N = 51, 48, 66, 14, and 22 *L. gigantea*, respectively. Sizes of owl limpets in all the plots combined ranged <15–94 mm. In April 2017, 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. 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 Whitaker.

Few 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. Bolts were installed in splash plots 4 and 5. Special attention should be placed on installing new bolts in the abalone plots.

The barnacle (*Chthamalus* spp./*Balanus* spp.) plots had 16.6% (11% measured last year) mean barnacle cover. The majority of point contacts in the five plots were bare rock, but *Silvetia compressa* occupied 22.6% cover. *Endocladia* plots had 10.2% (14% measured last year) mean *Endocladia* cover. The majority of point contacts in the five plots were bare rock. Additionally, the invasive red alga, *Caulacanthus*, comprised 60, 31, and 27% of plots 1–3, respectively. The rockweed plots had 63.4% (67% measured last year) mean *Silvetia* cover. Most of the cover within the rockweed zone was dominated by *Silvetia*. Mussel (*Mytilus californianus*) plots had 62.6% (58% measured last spring) mean cover. The majority of cover in the five plots was occupied by *Mytilus*. The splash plots 1–5 were devoid of biota, and most had low percentages of tar present. Motile invertebrates are usually counted in the splash plots, but they were not counted this visit due to insufficient time. For reference, in April 2017, 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, and 2 *Chthamalus*, respectively. Splash plot #5 was not located.

Mussels were measured in the five *Mytilus* plots by Bland and Langhans. Sizes of mussels ranged 10–80 mm and mussel bed depths ranged 2–7 cm; all plots were monolayers. Last year, sizes of mussels ranged 20–90 mm and mussel bed depths ranged 3–7 cm; all plots were monolayers. In April 2017, 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, Associate Professor, California State Polytechnic University, Pomona, personal communication with S. Whitaker). *Caulacanthus* has been seen each year since and was present again during this visit. The invasive appears to have increased markedly in abundance since we first observed it in 2013. It has spread to nearly all areas of the site and is particularly abundant on vertical surfaces. We have also seen it at Fossil Reef beginning in around 2016.

Caulacanthus undoubtedly increased in cover compared to our observations here last year. The invasive alga was also highly abundant on reefs nearby the site. *Silvetia* is still one of the most ubiquitous species here and it appeared to be healthy but recruitment was low. *Endocladia* also was robust and common but not extremely abundant. *Phyllospadix* was heavily fouled by *Ulva*, with low epiphytic cover of other species (e.g., *Smithora* and *Melobesia*). *Veleva* were seen on the beach. *Mytilus* appeared similar in abundance to that of recent years, with low levels of recruitment observed. The black abalone count increased markedly again this year to N = 62.

4/18/2019. Fossil Reef

Low tide -0.15 ft at 1547 hrs. The conditions were good overall even though the swell increased in size throughout the day; we were able to successfully complete all protocols including the site searches. Wind was light all day. There were two black turnstones and one black oystercatcher at the

site upon arrival. Five elephant seals were observed in the water near the site. No other pinnipeds were seen at the site at any time during the day. The site was monitored from 1200 to 1745.

Logger #20186754 was replaced by #10999087 at 1700. Temp logger #20186753 installed above the site (on the bluff above staging area) last year was not relocated.

Plots were photographed by Bland and Langhans. Site panoramas were photographed by Langhans. All 20 photoplots were scored in the field by Whitaker.

A 30-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Langhans. N = 148 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 26–153 mm, most individuals were 1–10 cm apart). A flashlight was used during the abalone search. The fixed abalone plots were sampled; plots 1–5 had N = 0, 0, 0, 21, and 2 black abalone, respectively. The relatively high number of abalone found in plot 4 were located under a small boulder. For reference, last year, N = 42 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 25–146 mm, most individuals were 1–10 cm apart). A flashlight was used during the abalone search. The fixed abalone plots were sampled; plots 1–5 had N = 0 black abalone. In April 2017, 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 1–10 cm apart). A flashlight was not used during the abalone search. The fixed abalone plots were not sampled. In November 2015, N = 43 black abalone (sizes ranged 26–146 mm, most individuals were observed touching one another) were observed site-wide.

A 30-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by Bland. N = 0 ochre stars 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. One *Patiria miniata* was observed. For reference, last year, zero sea stars were observed at this site. In April 2017, N = 1 ochre star (120 mm, 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. In February 2015, N = 2 ochre stars (80 mm and 100 mm, 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 Whitaker using the digital calipers. Plots 1–5 had N = 1, 5, 103, 97, and 161 *L. gigantea*, respectively. Sizes of owl limpets in all the plots combined ranged 16–58 mm. Last year, plots 1–5 had N = 1, 13, 93, 116, and 291 *L. gigantea*, respectively. Sizes of owl limpets in all the plots combined ranged 8–70 mm. In April 2017, 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 Whitaker. No repairs were necessary; all plots now have three bolts indicating the locations of the corners.

The barnacle (*Chthamalus* spp./*Balanus* spp.) plots had 21.2% (24.4% measured last year) mean barnacle cover. The majority of point contacts in the five plots were bare rock. *Endocladia* plots had 26.8% (23% measured last year) mean *Endocladia* cover. The majority of point contacts in the five plots were bare rock, but *Silvetia* (mean = 28%) was also relatively abundant. The rockweed plots had 46% (60.6% measured last year) mean *Silvetia* cover. Most of the cover within the rockweed zone was dominated by *Silvetia*. Mussel (*Mytilus californianus*) plots had 42.2% (41% measured last year) mean cover. The majority of cover in the five plots was occupied by *Mytilus* followed by *Phragmatopoma* (mean = 21.6%).

Mussels were measured in the five *Mytilus* plots by Bland. Sizes of mussels ranged 10–70 mm and mussel bed depths ranged 3–7 cm; all plots were monolayers. Last year, sizes of mussels ranged 10–70 mm and mussel bed depths ranged 3–8 cm; all plots were monolayers. In April 2017, sizes of mussels ranged 20–70 mm and mussel bed depths ranged 4–7 cm; all plots were monolayers. In November 2015, sizes of mussels ranged 20–60 mm and mussel bed depths ranged 2–6 cm; all plots were monolayers.

Like last year, *Silvetia* recruitment appeared to be the highest (hundreds of recruits) ever observed; most recruits were observed in the *Endocladia* zone. Overall abundance of *Silvetia* also appeared to reach record highs this year. Most *Silvetia* appeared to be healthy and reproductive. Low cover of *Caulacanthus* was observed around plot 610 and several other locations, but overall there appeared to be lower cover of the invasive alga than observed in recent years. *Endocladia* appeared to be lush and abundant. *Chthamalus* was common but not overly abundant, with approx. <10% empty tests; *Balanus* was comparatively less abundant. *Mytilus* abundance was similar to that of recent years with very few recruits seen. A large land slide occurred slightly southwest of the *Lottia* plots but it did not affect them.

4/19/2019. Johnson's Lee

Low tide 0.3 ft at 1621 hrs. The conditions were not optimal due to the large and frequent sets of waves and the positive low tide. The challenging conditions compromised the searches for black abalone and sea stars as well as our ability to safely and accurately sample the *Lottia* plots. Sand cover was low on the beach and in the surge channel in the center of the site. There were four black oystercatchers observed at the site, and one California sea lion and one harbor seal were observed in the water immediately offshore of the site. The site was monitored from 1245 to 1800.

Temperature logger #20186758 located in the mid intertidal was NOT replaced since it was not found—perhaps due to the large swell.

Plots were photographed by Langhans and Bland. Site panoramas were photographed by Bland. All photoplots were scored in the field by Whitaker.

A 30-minute search was conducted for black abalone (*Haliotis cracherodii*) presence by Langhans. N = 48 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 28–111 mm, most individuals were spaced 1–10 cm apart from one another). The black abalone plots were not searched, but plot 519 appeared to have at least two black abalone in it. For reference, last year, N = 23 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 21–99 mm, most individuals were spaced 1–10 cm apart from one another). The black abalone plots were not searched. In spring 2017, 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. In 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 30-minute search was conducted for ochre star (*Pisaster ochraceus*) presence by Bland. N = 7 ochre stars were observed site-wide (see area searched during black abalone search) (sizes ranged 90–190 mm). All individuals appeared to be healthy. For reference, last year, N = 13 ochre stars were observed site-wide (see area searched during black abalone search) (sizes ranged 60–130 mm). All but two individuals appeared to be healthy; two were stage 1 since they each had a lesion. In spring 2017, N = 22 ochre stars were observed site-wide (see area searched during black abalone search) (N = 11 individuals measured, sizes ranged 60–110 mm). In 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 measured in the fixed plots by Whitaker using the digital calipers. Plots 1–5 had N = 9, 6, 15, 57, and 63 owl limpets, respectively. Sizes throughout all five plots ranged 10–91 mm. For reference, last year, plots 1–5 had N = 14, 6, 20, 33, and 66 owl limpets, respectively. Sizes throughout all five plots ranged 10–91 mm. In spring 2017, plots 1–5 had N = 9, 4, 5, 29, and 39 owl limpets, respectively. Sizes throughout all five plots ranged 12–73 mm. In 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.

No repairs were made. All abalone plots still require new bolts.

The barnacle (*Chthamalus* spp./*Balanus* spp.) had 31% (28.8% measured last year) mean barnacle cover. The majority of point contacts in the five plots were bare rock. *Endocladia* plots had 25.6% (8.8% measured last year) mean *Endocladia* cover. The majority of point contacts in the five plots were bare rock. Mussel (*Mytilus californianus*) plots had 60.8% (51.7% measured last year) mean cover overall including the four new plots. Without the additional plots, the original five plots had 58.6% (35.4% measured last spring) mean mussel cover. 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 = 3, 1, 0, 73, and 0 littorine snails, respectively. Splash plots 1–5 also had 0, 0, 4, 11, and 1 *Chthamalus*, respectively. For reference, in spring 2017, 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 Bland. Sizes of mussels ranged 20–120 mm and mussel bed depths ranged 3–14 cm; all plots were monolayers. For reference, last year, sizes of mussels ranged 20–80 mm and mussel bed depths ranged 3–10 cm; all plots were monolayers. In spring 2017, 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.

This site, like Ford Point, is mostly comprised of *Mytilus* and *Phragmatopoma* with lower abundances of *Endocladia* and barnacles (*Balanus* and *Chthamalus*). The site appeared unchanged from past visits, with the exception of potentially decreased cover of *Phragmatopoma*. Recruitment was not obvious for *Mytilus* or either of the aforementioned barnacle species. *Endocladia* was low in profile and not particularly dense, but no bleaching was observed. *Lottia gigantea* ranged widely in size. Most of the surge channel was covered in *Porphyra* and *Ulva*. Sand was mostly absent from the beach between the reefs. Beaches between the site and the building were loaded with elephant seals and sea lions.

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NPS 159/190032, August 2023

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