



Rocky Intertidal Monitoring Program at Cabrillo National Monument

2021 Annual Report

Natural Resource Data Series NPS/MEDN/NRDS—2022/1357



ON THE COVER

Phyllospadix at Cabrillo National Monument.
Photograph by: Michael Ready

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Abstract

The rocky intertidal zone at Cabrillo National Monument is a valued and rare natural resource in southern California. It has been monitored since 1990 and was incorporated into the “Vital Signs” monitoring program of the Mediterranean Coast Inventory and Monitoring Network in 2011. Target species are monitored using core MARINe protocols (Engle 2008), which consist of: (1) circular plots to monitor the size and abundance of *Lottia gigantea*, (2) permanently marked photo-plots to monitor percent cover of sessile invertebrates and rockweed (*Chthamalus/Balanus*, *Tetracrita*, *Mytilus*, *Pollicipes* and *Silvetia*), (3) line transects to assess percent cover of dominant algae and seagrass (red algal turf, *Egregia* and *Phyllospadix*), and (4) timed searches to record presence of rare species (*Pisaster* spp. and *Haliotis* spp.). These surveys are conducted across three Zones at Cabrillo National Monument, which encompass a gradient of human use; Zone I receives the highest visitation, and Zone III has been closed to visitation since 1997. Equal sampling effort is allotted to each Zone. Data collected are assessed annually. This report provides a brief summary of findings from 1990-2021 and reflects on the current status of target species. While *Lottia gigantea* density in circular plots is relatively stable, mean size of individuals has decreased over time. Assessment of photo-plot data reveal a recent decline in *Silvetia* and increase in *Tetracrita* cover in their respective plots. Furthermore, *Phyllospadix* cover has increased in 2020 and 2021 along line transects. During timed searches in Fall 2020, no *Pisaster* species were located, but two adult *Haliotis fulgens* were found in Zone III. Collectively, these results reveal no sudden departures from reported findings in 2020.

Acknowledgments

Funding and data management for this project were provided by the Mediterranean Coast Inventory and Monitoring Network (MEDN). This work was completed with the help of many community and scientist volunteers.

Introduction

Cabrillo National Monument (CABR) is a unit of the National Park System located at the tip of Point Loma in San Diego, CA. Despite its small size (0.65 terrestrial km²), CABR attracts nearly one million visitors each year, 380,000 of which visited the coastal area of the park in 2020 (estimated using infrared trail counters deployed 2011-2020). Since three sides of the park are surrounded by water, and the fourth abuts a Navy base, the park acts as an “urban island”, providing habitat for unique algal, plant, and animal species in an area of increasing development and urbanization. Further, the 1 km stretch of rocky intertidal zone is regarded as the best conserved rocky intertidal shoreline in mainland southern California. Due to its value as both a habitat refuge and public resource, it is critical to monitor changes in species composition in the rocky intertidal at CABR.

To understand flux in natural ecosystems, Gary Davis and Jack Engle began the Cabrillo Rocky Intertidal Monitoring Program (CRIMP) in 1990 with the goals of: (1) establishing limits of variation, (2) determining present health, and (3) diagnosing abnormal conditions in natural ecosystems to inform conservation and resources management decisions (Davis et al. 1994, Davis 1983). In the first five years of data collection (1990-1995), 7 of the 13 focal taxa declined or disappeared from the study area (Engle and Davis 2000). These findings spurred management decisions such as the closure of Zone III to visitors in 1996, creation of the Tidepool Protection, Education and Restoration volunteer docent Program (TPERP) in 1997, founding of the Multi-Agency Rocky Intertidal Network (MARINe), and establishment of the Cabrillo State Marine Reserve as part of the California Marine Life Protection Act (MLPA) in 1999. As a result of these and other successes, the National Park Service established a service-wide Inventory and Monitoring (I&M) Program to provide scientific information on ecosystem health. In 2011, the Cabrillo Rocky Intertidal Monitoring Program was formally incorporated as a “Vital Sign” in the Mediterranean Coast Network (MEDN) of the I&M Program.

Program Developments

The purpose of this annual report is to provide data summaries for the years 1990-2021, note deviations from sampling protocols, and highlight recent developments in the research program at Cabrillo National Monument. While the ongoing COVID-19 pandemic posed challenges to long-term monitoring efforts, all sampling activities were completed in 2021. New developments to the program include installation of TidbiT (Onset corp.) temperature loggers in all Zones (I in May 2020, II in November 2021, and III in February 2021).

Vessel Groundings and Oil Spill

There were two vessel groundings affecting Zones I and II in 2021. A significant 40 ft trawler grounding occurred between Zones I and II in May 2021. The grounding resulted in a multi-agency rescue mission, federal investigation, c.1-acre diesel fuel sheen spanning Zones I and II, major debris piles necessitating intensive cleanup and damage assessment operations by park staff and a project to remove a leaking engine block completed by the NPS National Maintenance Dive Team, which is part of the NPS Submerged Resources Center. A second grounding of a 30 ft sailboat occurred in Zone I in August 2021. As of December 2021, half of the vessel remains lodged in a small cove just

North of the tidepool entrance. Debris removal continues as waves break up the boat. Long-term monitoring plots were not in the major wreckage areas from either grounding, but Zones I and II were likely exposed to diesel fuel and light disturbance from wreckage. In addition to vessel groundings, the Pipeline Oil Spill started in Orange County (CA, USA) in October 2021, with impacts in San Diego County by mid-October. Tar balls were observed at Cabrillo National Monument, resulting in the deployment of a United States Coast Guard Hot Shot Team cleanup via Unified Command on October 19th, 2021. While tar was observed in all zones, the highest volume of tar was observed on the sandy shore between Zones I and II.

Methods

Study Area

The study area at Cabrillo National Monument (San Diego, CA, USA) consists of *c.* 1 km of shoreline comprised of gently sloping sandstone benches with metavolcanic boulders scattered at the base of sandstone cliffs. This area is subdivided into three management zones (I, II, and III; Figure 1), which represent a gradient in human visitation. The single public access point to the tidepool area is in the middle of Zone I. Since it is the most accessible, this area receives the most visitation. Access to zone II requires visitors to amble through a boulder field, so it receives fewer visitors. Zone III has been closed to visitors since November 1996.

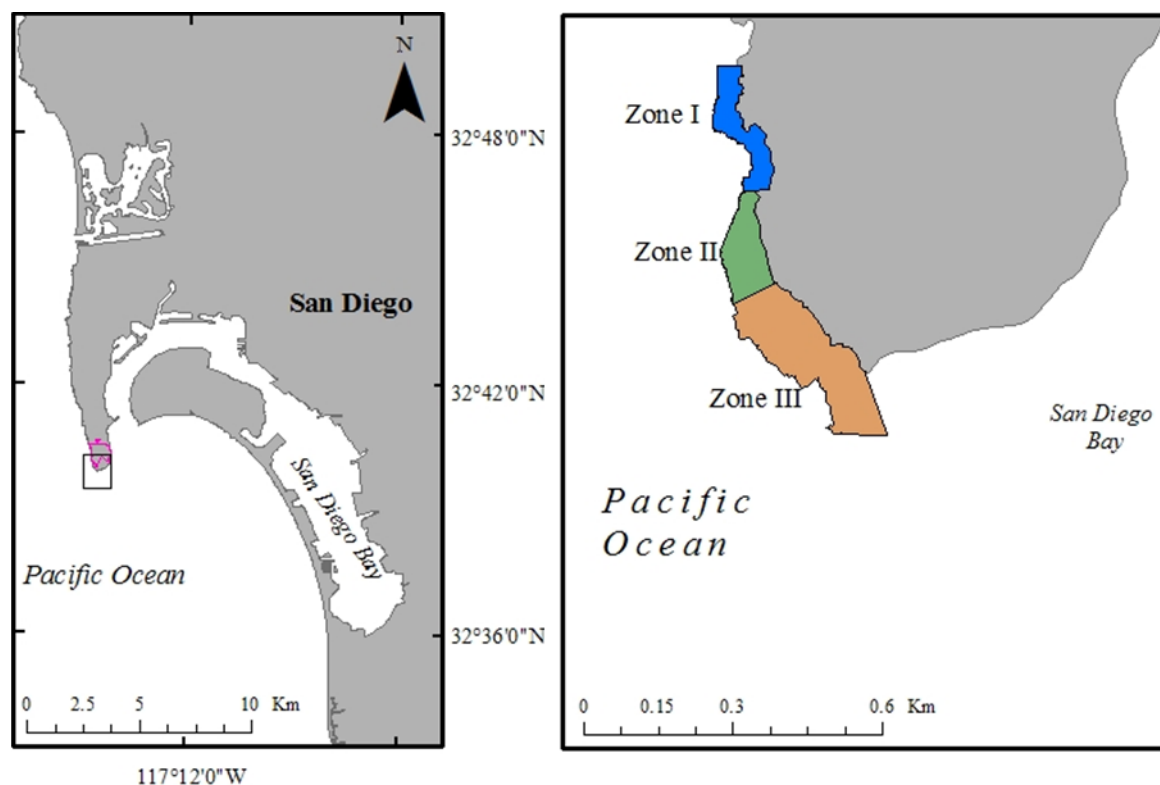


Figure 1. Map of the intertidal of Cabrillo National Monument, in San Diego, CA. The three management zones of the park represent different levels of human visitation: Zone I is high use, Zone II is intermediate use, Zone III has been closed to all visitors since 1996.

Approach and Sampling Design

The complete sampling protocol was conducted twice per year, in the spring and fall, of 1990-2016. In 2017, photoplot, transect, and timed search methods were reduced to annual surveys (Raimondi et al. 2018), while circular *Lottia* plots continued to be monitored twice annually. Spring *Lottia* surveys were completed March 25th-26th, 2021, and full fall surveys were completed November 3rd-December 3rd, 2021, with most activities completed between November 3rd-6th. While a summary of methodology is presented in this report, CRIMP adheres to the core MARINE protocol (Engle 2008). All computations and data visualization were done in RStudio (Firke 2021, Garnier 2018, R Core

Team 2021, Wickham et al. 2019, Wickham and Bryan 2019), and data are available upon request from MARiNe.

R code: https://github.com/llmpandori2/cabr_ri/blob/main/code/annual_report_2021.R

Request data: <https://marine.ucsc.edu/explore-the-data/contact/index.html>

Circular *Lottia* Plots

To collect data on the size-frequency, abundance and density of owl limpets (*Lottia gigantea*), pre-measured pieces of line were used to delineate circular plots of 1 m radius around fixed bolts ($N \geq 6$ per zone). All owl limpets in each plot greater than or equal to 15 mm in shell length were counted and measured. Smaller individuals were not counted or measured, as they are difficult to correctly identify.

Photoplots

Rectangular photo-plots were established to document percent cover of four target taxa: (1) California mussels (*Mytilus californianus*), (2) acorn/thatched barnacles (*Chthamalus* spp./*Balanus glandula* and *Tetraclita rubescens*), (3) goose barnacles (*Pollicipes polymerus*), and (4) rockweed (*Silvetia compressa*) ($N \geq 5$ per zone). Plots were photographed during sampling events. Additionally, plots were field scored using a 50 cm x 75 cm PVC quadrat strung to create a grid of 100 evenly spaced points, under which the type of cover was identified and recorded on paper to yield percent cover. When field scoring was not possible, digital photos were scored by overlaying a similar grid with image processing software. Prior to 1996, three line transects per zone targeting *Pollicipes polymerus* were monitored. In 1996, each line transect was converted into two photo-plots, yielding six photo-plots per zone.

Line Transects

Line transects (10 m) were established to yield percent cover of three target taxa: (1) red algal turf, (2) surfgrass (*Phyllospadix* spp.), and (3) boa kelp (*Egregia menziesii*). Two transects were established per target taxa in each zone, for a total of 18 transects (Table 1). The type of cover under each 10 cm “point” along the line was recorded, yielding 100 points for percent cover calculations.

Timed Searches

In each zone, a 30 person-minute timed search was conducted to look for abalone (*Haliotis cracherodii* and other species) and sea stars (*Pisaster ochraceus* and other species) in habitat that is commonly inhabited by those animals. All abalone or sea stars encountered were identified, measured, and recorded.

Results

Circular *Lottia* Plots

Mean *Lottia* size has declined, but density remains similar to overall mean (1990-2021) values. Size-frequency data indicate that the largest individuals are consistently found in Zone II, while a high density of mid-sized individuals are found in Zones I and III (Figure 2). This trend is also indicated by the lower average density in Zone II than Zones I and III (Figure 3). While Zone II has the lowest overall density of individuals, it has the highest overall mean size of individuals. Individuals in Zones I and III have lower overall mean sizes (Figure 4). Mean size across all zones decreased between 1990 and 2010 and has shown some recovery between 2010 and 2021, particularly in Zone II.

Photoplots

The percent cover of most target species are dynamic over time, and 2021 mean values were similar to overall mean values over the study period (1990-2021) (Figure 5). *Chthamalus/Balanus* barnacles were slightly lower than their grand mean values, but not lower than minima observed during the study period in Zones I and II. Zone III, *Chthamalus/Balanus* cover is close to its minima over the study period. *Mytilus* percent cover continues to be much lower than their abundances in the 1990s, however values from 2021 are similar to observations in the past decade. The abundance of *Silvetia* had slowly declined across all zones between 2005 and 2015 but appears to be rebounding in recent years. Finally, *Tetracita* has been steadily increasing since 2015, with decreases in Zones I and III observed in 2021.

Line Transects

Line transect data are highly variable in part due to low sample size ($N = 2$ transects per target species in each zone), but there was notably high cover of *Phyllospadix* in 2020 and 2021 (Figure 6).

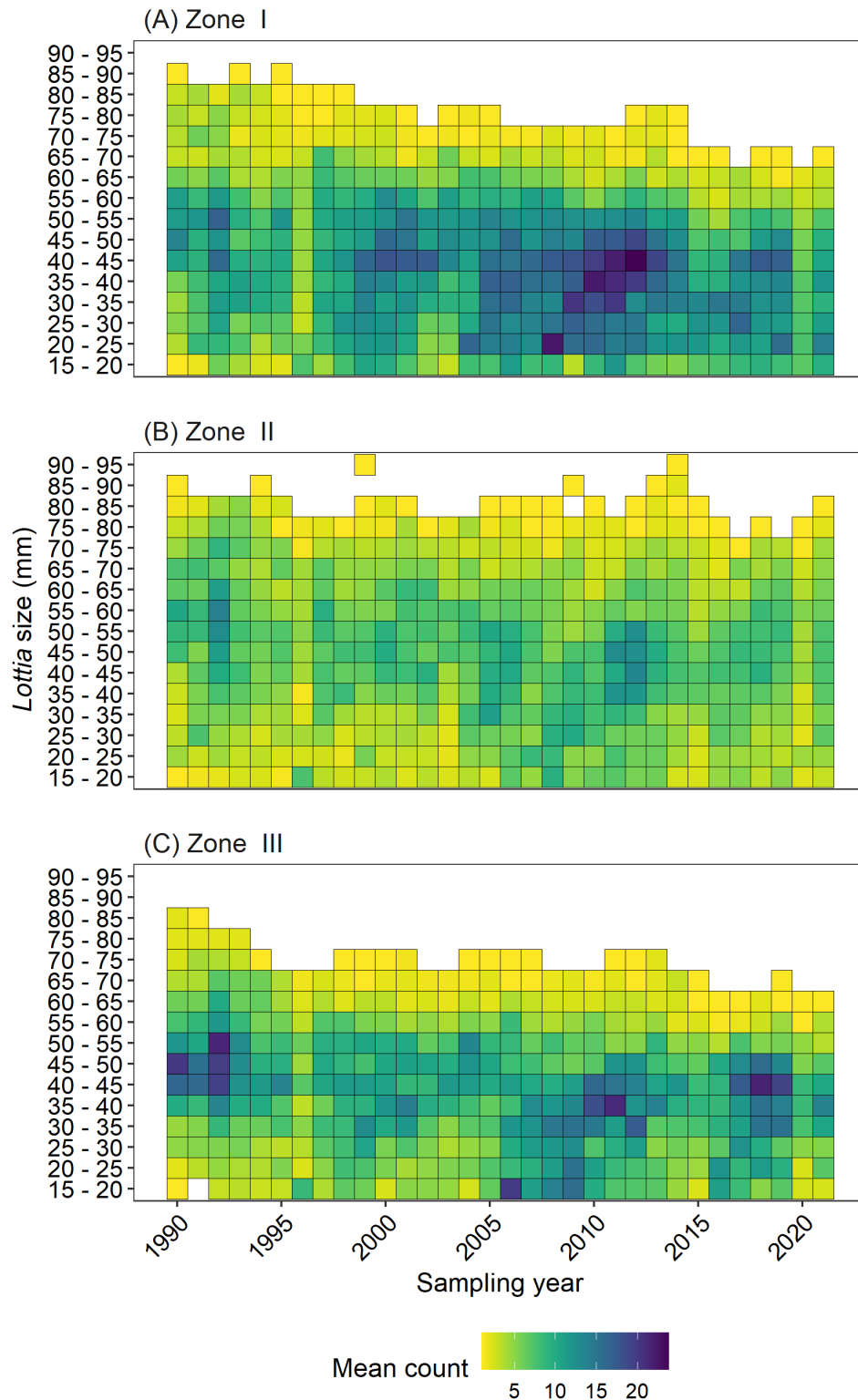


Figure 2. Heatmap of owl limpet (*Lottia gigantea*) size-frequency distribution at (A) Zone I, (B) Zone II, and (C) Zone III from 1990 – 2021. Counts are averages across seasons and plots. Zone II contained the largest individuals, while Zones I and III contained the highest densities of individuals.

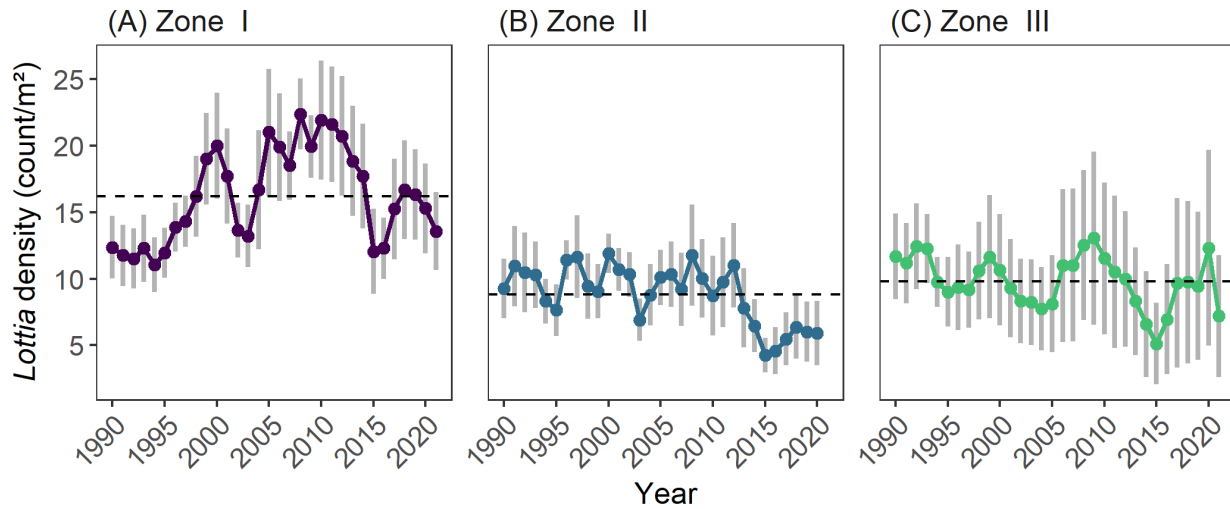


Figure 3. Time series of *Lottia gigantea* density at (A) Zone I, (B) Zone II, and (C) Zone III. Values presented are mean density (count/m²) $\pm$ SE, summarized across seasons and plots within each zone. Dashed lines represent grand mean density for each zone. In 2021, *Lottia* density was below the grand mean across all zones.

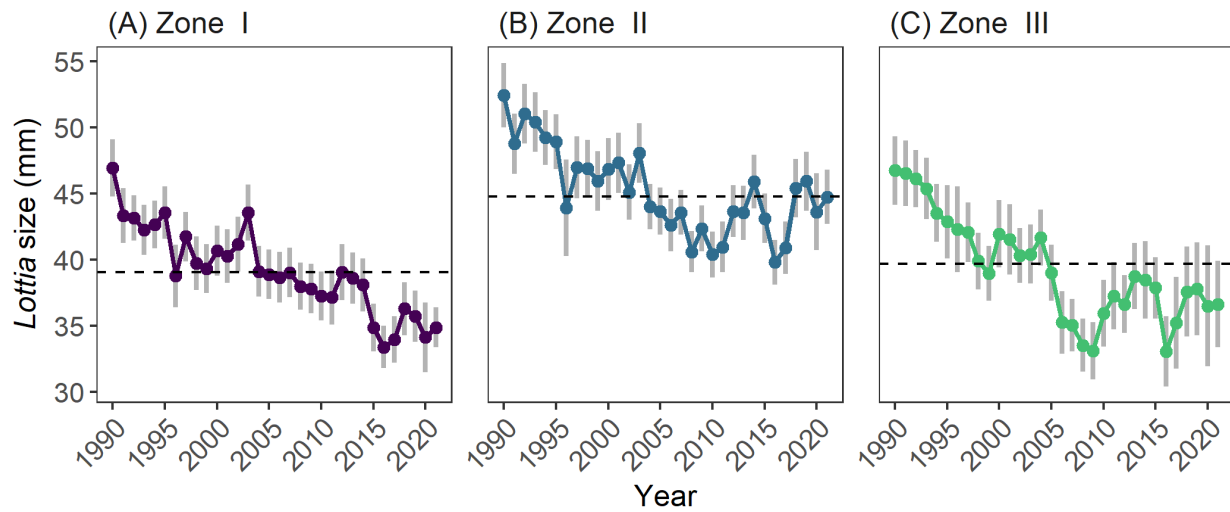


Figure 4. Time series of *Lottia gigantea* size at (A) Zone I, (B) Zone II, and (C) Zone III. Values presented are mean size (mm) $\pm$ SE, summarized across seasons and plots within each zone. Dashed lines represent grand mean density for each zone. Across all zones, mean size decreased from 1990 – 2010, and some brief recoveries have occurred between 2010 and 2021, particularly in Zones II and III.

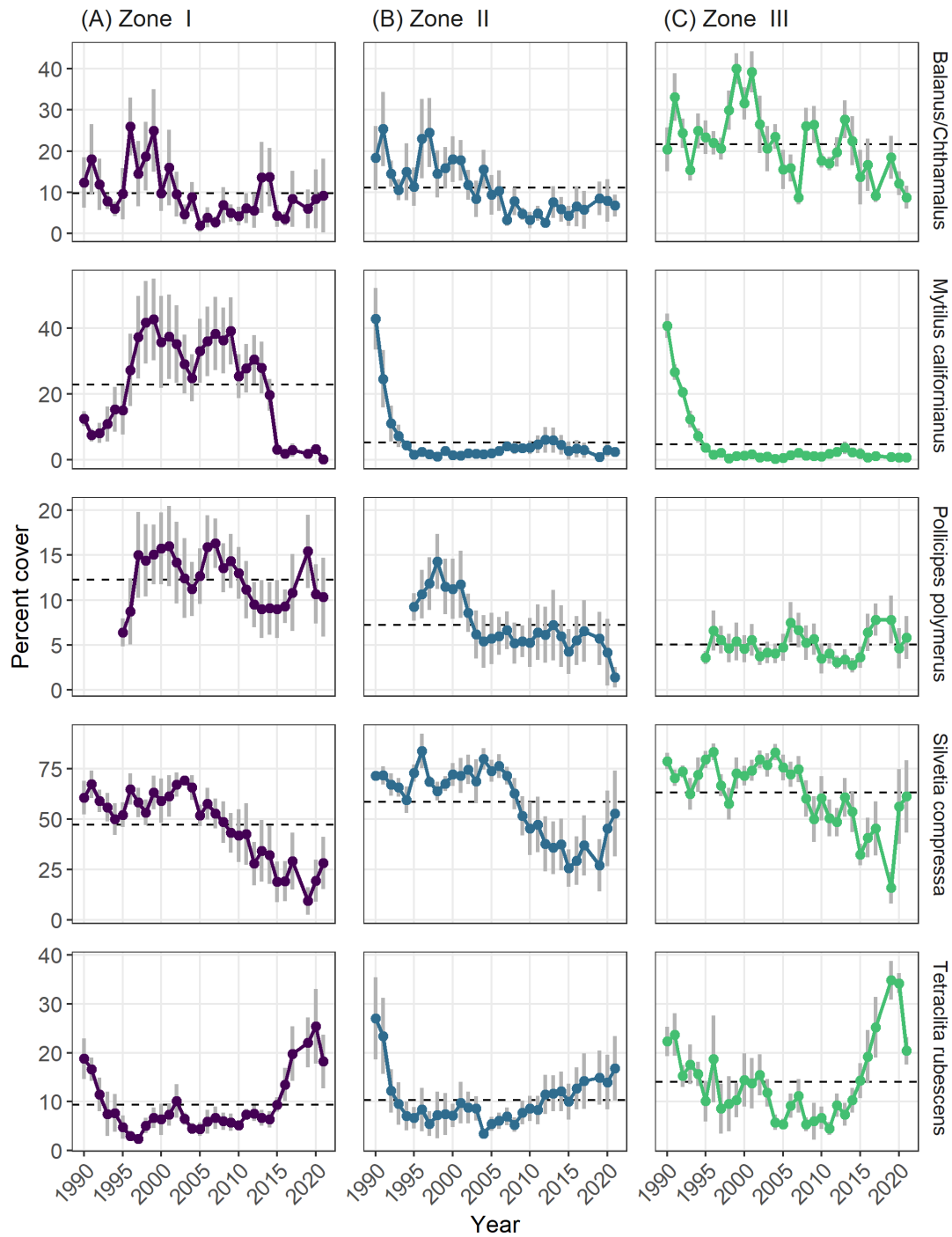


Figure 5. Time series of target species abundance in photo-plots across (A) Zone I, (B) Zone II, and (C) Zone III from 1990-2021. Values presented are mean percent cover $\pm$ SE, summarized across seasons and plots within each zone ($N \geq 5$ for each point). Dashed horizontal lines represent grand mean cover for each zone. Note that y-axis scales vary across plot rows. Present values for *Chthamalus/Balanus*, *Pollicipes* and *Silvetia* remain at or below grand mean values. Present values for *Mytilus* are far below values in the 1990s, while *Tetraclita* cover remains higher than the grand mean value.

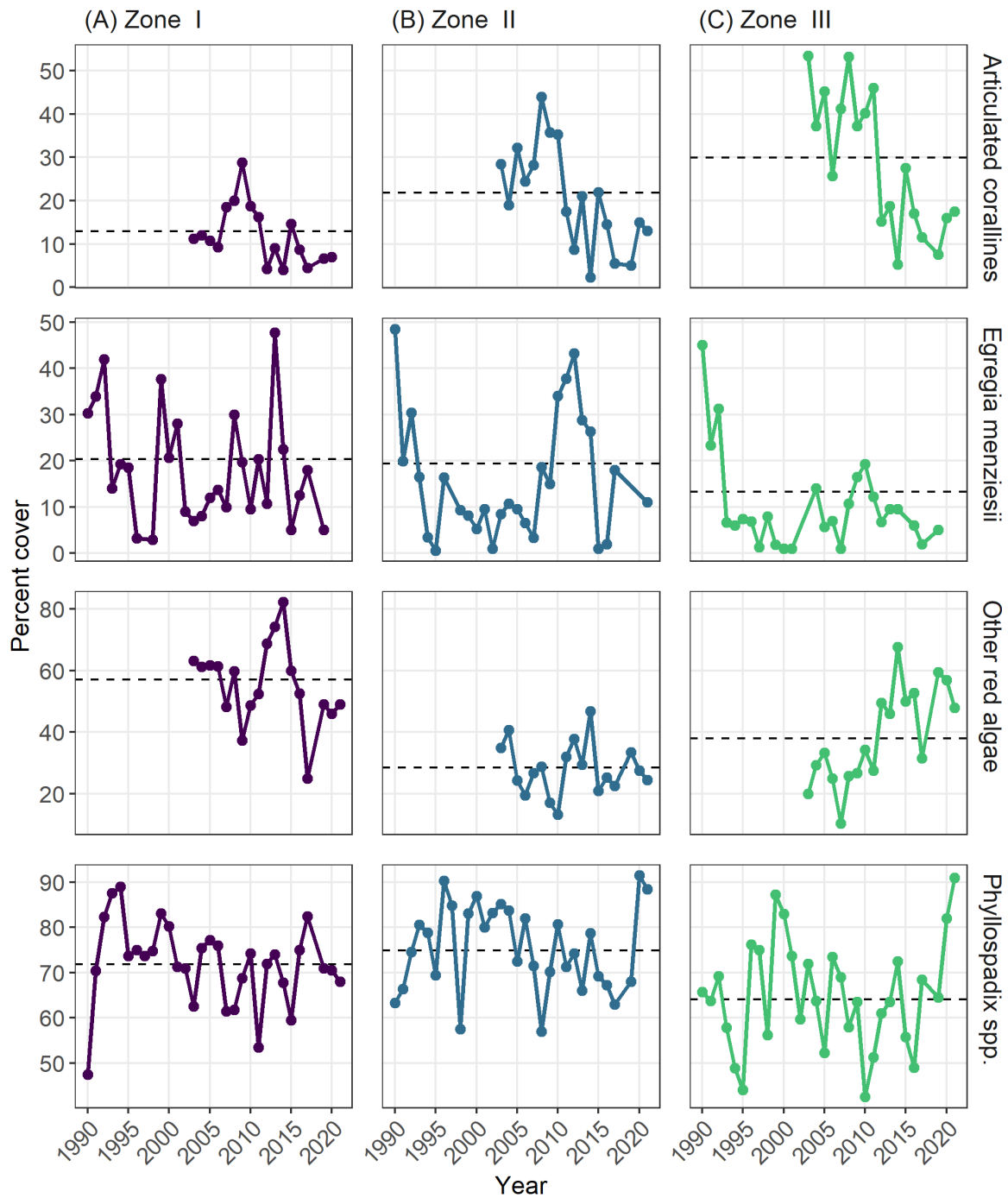


Figure 6. Time series of target species abundance in line transects across (A) Zone I, (B) Zone II, and (C) Zone III from 1990-2021. Values presented are mean percent cover summarized across seasons and plots within each zone ($N \geq 2$ per point). Dashed lines represent grand mean cover for each zone. Note that y-axis scales vary across plot rows. Due to low replication and a dynamic system, abundance is highly variable over time.

Timed Search

While no target species were found, it is notable that two adult *Haliotis fulgens* (green abalone) were found near the *Silvetia* plots in Zone III during Fall 2021 surveys at Cabrillo National Monument. Four individuals were found in the same area in 2020.

Table 1. Timed search data collected in Zone I-III in Fall 2021. All green abalone (*Haliotis fulgens*) were adults in Zone III.

Target and adjacent species	Abundance (FA 2021)
<i>Patiria miniata</i>	0
<i>Pisaster</i> spp.*	0
<i>Strongylocentrotus</i> spp.	0
<i>Haliotis corrugate</i>	0
<i>Haliotis cracherodii</i> *	0
<i>Haliotis fulgens</i>	2

* species targeted in timed searches.

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