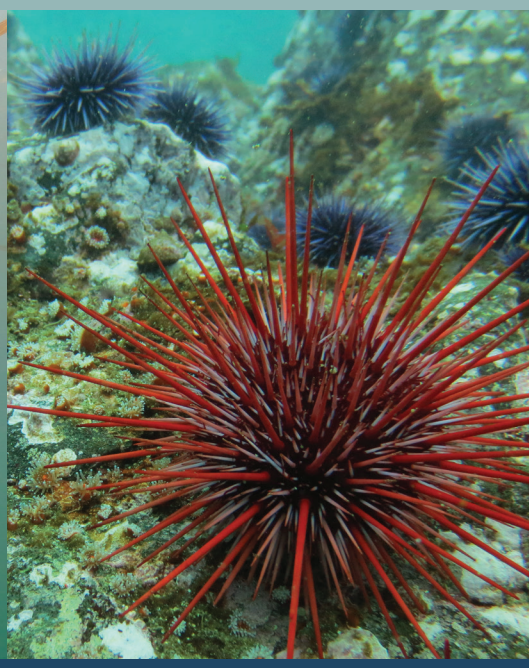
SNAPSHOT REPORT VOLUME 2

BASELINE HIGHLIGHTS FROM
NORTH COAST KELP & ROCKY REEF MONITORING

# A Changing Undersea Forest



**ABOUT THIS SNAPSHOT REPORT** This report highlights some key scientific findings from the Kelp and Rocky Reef Monitoring Projects, two of eleven baseline projects in California's North Coast region.[1] These projects characterized the kelp and rocky reef ecosystems (0-30m depth) around the time of marine protected area (MPA) implementation. Facts and figures are derived from the projects' peer-reviewed technical reports and associated references,[2,3] which can be found, along with the related data, at **OceanSpaces.org.**

## Life in an Undersea Forest

The nearshore rocky reefs and kelp forests of the North Coast are complex, diverse, and productive ecosystems. They are distinct from the central and southern regions of the state. Large, dense canopy forming kelp beds of giant kelp *(Macrocystis pyrifera)* are generally absent from the region, and a canopy of blades of bull kelp *(Nereocystis luetkeana)* dots the nearshore coastline. Rocky reefs are extensive throughout the region, characterized by patches of bull kelp and an understory of smaller kelps and algae. These reefs support a diverse assemblage of fishes, invertebrates, marine mammals, and seabirds, and these ecological communities are important to the regional economy as they sustain important commercial and recreational fisheries and tourism.

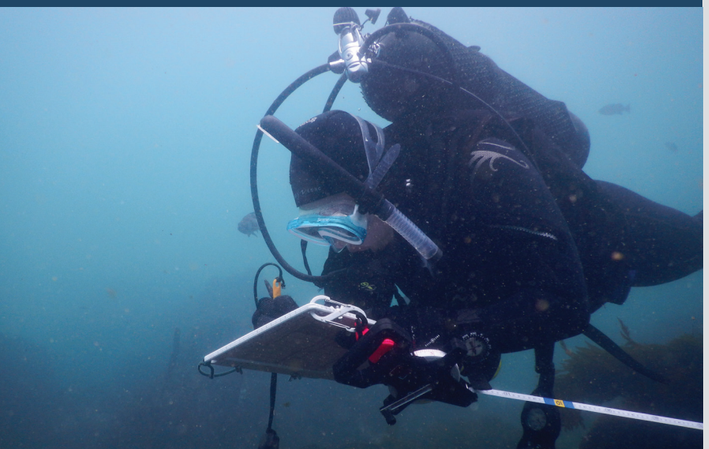
A typical North Coast rocky reef and kelp forest are home to several species of fish that are targeted by fishermen and play important ecological roles, including rockfish, greenling, lingcod, and cabezon. Abundant invertebrate species typically include purple and red sea urchins, red abalone, and several sea star species. Together, these and other organisms support a rich food web, interacting with each other in a variety of ways, including predation and competition for resources such as food and habitat space. For example, urchins and abalone are herbivores that 'graze,' or eat, kelp and understory algae. Large sea stars and fish, such as lingcod and cabezon, are carnivorous predators that prey upon other fish species, urchins, and abalone. These interactions help functioning kelp forests support a dense canopy and understory, with diverse fish and invertebrate communities, that are sensitive to environmental changes.

## KELP AND ROCKY REEF STUDY SITES

*Study sites used by Humboldt State University (purple) and Reef Check California (teal).*


## Monitoring North Coast Kelp Forests

Two monitoring projects enhanced our understanding of kelp and rocky reef habitats by characterizing these ecosystems at or near the time of implementation of the MPAs in the North Coast region. Both projects used SCUBA: One led by scientific divers and researchers at Humboldt State University (HSU)[4] and the other by highly trained citizen science divers through Reef Check California (RCCA)[5]. Both programs employed a sampling design and protocols that are directly comparable to data collected during the baseline characterizations of rocky reef and kelp forest ecosystems throughout the state.



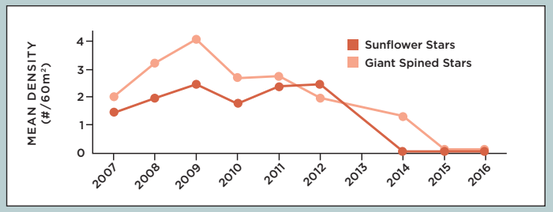
# Understanding Changes With 10 Years of Data

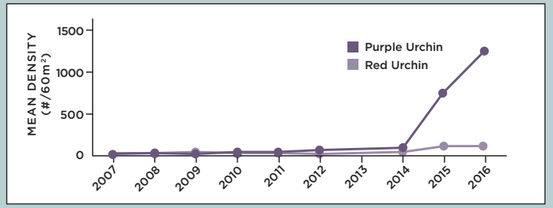
## TRACKING CHANGES: 2007-2012

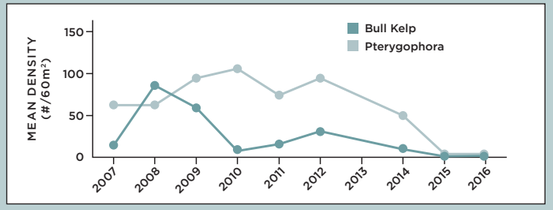
Three sites that RCCA has surveyed since 2007, Mendocino Headlands, Portuguese Beach, and Van Damme, have provided critical insight into large ecosystem changes that coincided with MPA implementation and when data were collected for the baseline monitoring period (2014 – 2016). Long-term RCCA data from 2007 – 2012 suggest relatively healthy kelp forests in the southern region of the North Coast, south of Cape Mendocino at nearshore sites. Study sites had bull kelp canopies and stable sub-canopy kelps with abundant predatory sea stars, and relatively low densities of urchins. Bat stars and red abalone were commonly observed across RCCA sites during this period.

## TRACKING CHANGES IN KEY SPECIES OVER TIME

*Densities of selected species of sea stars, urchins, and kelp at three long-term study sites from 2007 - 2016. Adapted from RCCA technical report.*

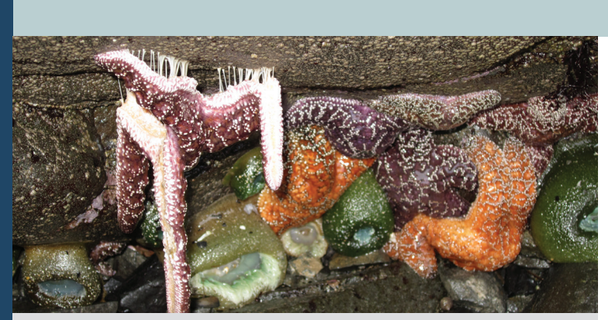



## TRACKING CHANGES: 2014-2016

RCCA data collected during the baseline monitoring period revealed a vastly different ecosystem than had previously existed. Two predatory sea stars, sunflower stars and giant spined sea stars, were almost entirely absent from study sites, while urchin densities increased through time from just a few individuals per survey to hundreds of individuals per survey. Urchins were particularly abundant in the southern part of the region. Bull kelp and other kelp species were found in much lower abundance, and were absent entirely from most study sites. Understory red and brown algae also showed declines through time, while encrusting coralline algae became more abundant. Red abalone numbers also decreased. However, fish abundances were not greatly affected by the drastic changes observed in invertebrates and algae. Robust tracking of ecological changes is only possible with long-term monitoring.



## Stressful Conditions

Beginning in 2013, the North Coast experienced warmer-than-usual ocean temperatures due to a persistent “North Pacific Marine Heatwave” (an unusually warm water mass present in the northeast Pacific) and an El Niño that began in 2015. These unusual ocean conditions also changed the nearshore waters in which kelp forests and rocky reefs are found. Northern California usually experiences strong seasonal upwelling, which brings cool, nutrient-rich water to the surface. However, weak upwelling from 2013 - 2015 due to the unprecedented conditions resulted in warmer, nutrient-poor waters. Additionally, a resulting West Coast wide outbreak of sea star wasting disease in 2013 caused the dramatic die-off of several sea star species.

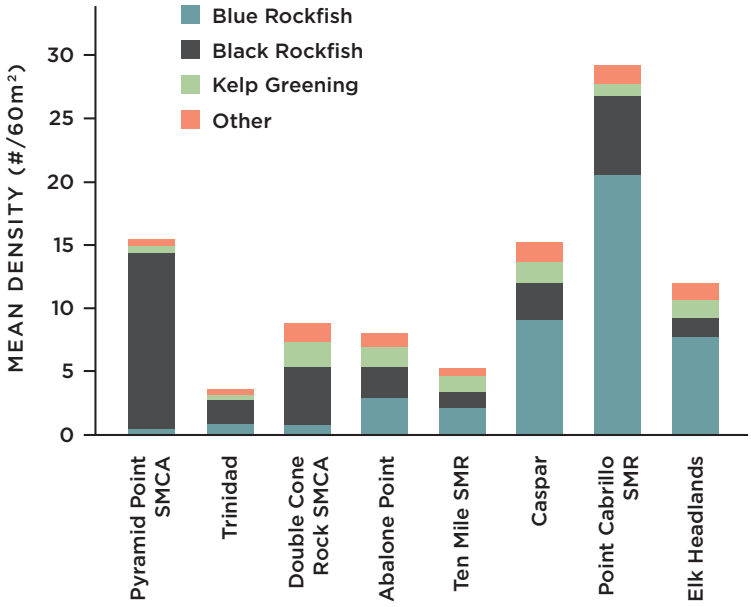
## Evidence of a Recent Trophic Cascade?

The unusual environmental conditions and changes in rocky reef and kelp forest communities documented prior to and during the baseline period suggest a series of events resulting in a trophic cascade. A trophic cascade occurs when changes in the abundance of predators or resources triggers shifts in the abundance or behavior of other species, which can lead to dramatic changes in ecosystems.


On the North Coast, predatory sea stars were decimated by sea star wasting disease, which possibly led to a population explosion of their prey, herbivorous sea urchins. These sea urchins then proceeded to graze kelp and understory brown and red algae, the primary producers in the kelp forest, causing “urchin barrens” with very little kelp cover. Simultaneously, there was a decrease in red abalone abundance, likely due to competition with the urchins for limited food. It is possible that invertebrates and fish that rely on kelp forests for food and shelter may continue to be affected on a longer timescale.

## Regional Patterns

Regional patterns emerged from data collected during the baseline study period. HSU data showed distinct differences in fish and invertebrate communities between sites north of Cape Mendocino, sites immediately south of Cape Mendocino, and the region around Fort Bragg. In locations south of Cape Mendocino, RCCA data also illuminated differences in communities within this part of the region. HSU data revealed increases in invertebrate abundance from north to south while RCCA data showed the same trend in diversity of invertebrate species. Both projects found black and blue rockfish were the most abundant fish species across the region. Research suggests that patterns in abundance, diversity, and community composition are driven, at least in part, by latitude and how exposed a site is to swell. Together these monitoring projects paint a fuller picture of the kelp forests in the region.




### TRENDS IN HISTORIC MPAS

*Both research projects surveyed Point Cabrillo SMR, which has been an established MPA since 1975. Surveys at this site may provide a glimpse into potential future changes associated with MPAs in the North Coast, particularly in the southern end of the region. Researchers found differences in species abundances, with high rockfish and urchin densities at this site relative to others in the region. RCCA also found larger fish sizes at this site. Adapted from HSU Technical Report.*

## The Importance of Long-term Monitoring

The data collected by both kelp and rocky reef monitoring projects and others like them help to strengthen our understanding of how both natural and human-caused changes to the environment are affecting this ecosystem, and can inform future management decisions. Fortunately, organizations including RCCA, which is powered by highly trained volunteers, and HSU continue to collect data in the region. While scientists, managers, and stakeholders can hypothesize about how these North Coast ecosystems will fare in the future, continued monitoring is required to increase our understanding moving forward.

### ABOUT NORTH COAST MPA BASELINE MONITORING

California Ocean Science Trust, California Department of Fish and Wildlife (CDFW), California Ocean Protection Council (OPC), and California Sea Grant coordinated and collaborated in the implementation of baseline monitoring, which was funded by OPC. Results from this work will inform CDFW management recommendations to the California Fish and Game Commission from the first five years of MPA implementation in the region, anticipated in 2018. MPA monitoring results can also inform the management of fisheries, water quality, and climate change.

### FOOTNOTES

1. To learn more about the kelp and rocky reef baseline monitoring projects, visit OceanSpaces.org: https://goo.gl/PfSvm2 and https://goo.gl/3koiaB
2. J Freiwald and A Neumann. 2017. Reef Check California: Citizen Scientist monitoring of rocky reefs and kelp forests: Creating a baseline for California's North Coast MPAs. California Sea Grant. San Diego, CA. 165 pp. https://goo.gl/tRMCrg
3. R Jenkinson and S Craig. 2017. Baseline monitoring of rocky reef and kelp forest habitats of the North Coast study region. California Sea Grant. San Diego, CA. 43 pp. https://goo.gl/sm3nYP
4. Humboldt State University: https://goo.gl/BaBa9C
5. Reef Check: https://goo.gl/qqSsNU



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