Long-term Rocky Intertidal Monitoring Redwood National & State Parks

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INTRODUCTION

The National Park Service has made it a priority to establish long-term, monitoring programs to assess the status and trends of the natural resources within the boundaries of our National Parks. Therefore, in 2004 Redwood National and State Parks (RNSP), working in conjunction with researchers from the University of California at Santa Cruz, established a program at several coastal sites (Figure 1) to monitor changes in the intertidal community. This program utilizes sampling protocols developed by Multi-Agency Rocky Intertidal Network (MARINe) and Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO), two research programs that study nearshore ecological and oceanographic processes along the western coast of the US. In 2008, the NPS accredited this RNSP intertidal monitoring study into its long-term monitoring program.

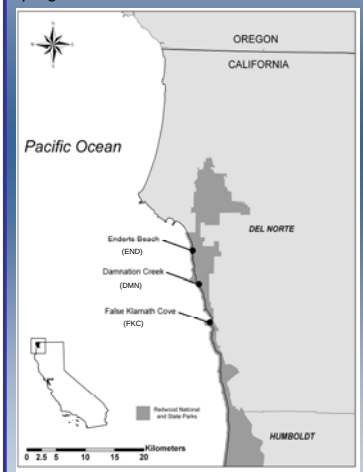


Figure 1. Map of monitoring sites in Redwood National and State Parks.

Photo 1. Researchers counting and measuring sea stars (right) and sampling surfgrass transects (left).

This monitoring program measures the composition of invertebrates and algae in the rocky intertidal community, how these communities change over time. These data provide important baseline information about temporal changes in populations and communities. Such information is essential to 1) assess the impact of either anthropogenic (e.g. trampling, oil spills) or natural (storms, El Niño) disturbances, 2) document species invasions and changes in species distribution, and 3) measure the temporal dynamics of populations and communities. These data are necessary for effective resource management.

MONITORING PROGRAM

The MARINe/PISCO monitoring program encompasses over 90 sites from southern California to northern Oregon. Three of these sites are in the Redwood National and State Parks in Northern California (Figure 1). These sites are sampled twice a year using a variety of methods to monitor the structure of the community.

At each site a set of permanent plots (each 50x75cm) has been established to measure the abundance of sessile (non-mobile) organisms like barnacles (*Chthamalus spp., Balanus glandula*), mussels (*Mytilus californianus*), turfweeds (*Endocladia*) and rockweeds (*Pelvetiopsis, Fucus*) (Photo 2). Digital photographs are taken of these plots (Photo 3), and the abundance (% cover) of all species is measured with the aid of imaging software. The size and abundance of small mobile invertebrates, like whelks (*Nucella* spp.), turban snails (*Tegula* spp.) and hermit crabs (*Pagurus* spp.), are also measured within these plots (Photo 4).

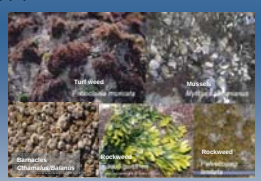


Photo 2. Species monitored in photo plots.

Photo 3. Taking pictures of a photoplot.

Photo 4. Sampling mobile species.

Other methods are used to monitor changes in other important species. For example, line transects are used to measure the abundance of surfgrass (*Phyllospadix* spp.) (Photo 1). Large, permanent plots (many square meters in size) have been established to measure the abundance and size of sea stars (*Pisaster ochraceus)* (Photo 1). Recruitment clearings are used to measure rates of larval input of sessile species. Panoramic pictures and field notes are used to describe general conditions at the site and to document both diversity and abundance of organisms.

TEMPORAL TRENDS

By repeatedly sampling the same plot, we can observe changes in the community over time. An example of the types of changes we have observed in the mussel (*Mytilus californianus*) and rockweed (*Pelvetiopsis limitata*) photoplots at Enderts is presented in Figure 2. In both plots dramatic decreases in abundance were observed in 2006. While the rockweed plot has yet to recover, the mussel plot soon returned to its original state.

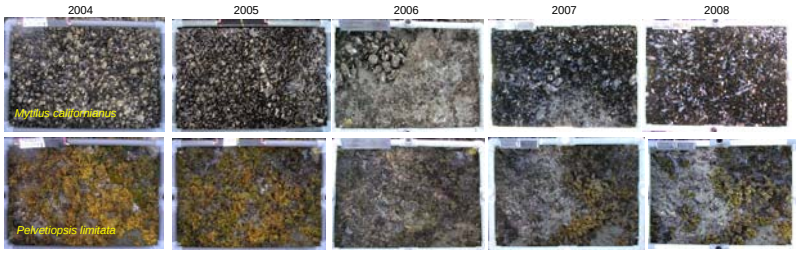


Figure 2. Temporal changes seen in a mussel (*Mytilus californianus*) and a rockweed (*Pelvetiopsis limitata*) plot at Enderts.

Recruitment of barnacles has been monitored at the sites since 2006 (Figure 3), While there was not much difference in recruitment among sites in 2007, recruitment was much greater at Enderts in 2008.

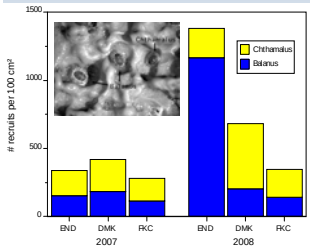


Figure 3. Recruitment of two species of barnacles (*Balanus glandula* and *Chthamalus* spp.) at RNSP intertidal sites for 2007- 08.

Size distributions of turban snails has varied among sites, and within sites over time (Figure 4). For example, large individuals (>20mm) have been rare at Enderts, while the population at False Klamath Creek tends to be dominated by small (<10mm) individuals.

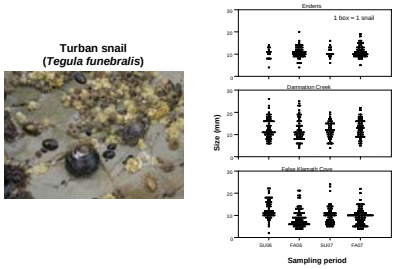
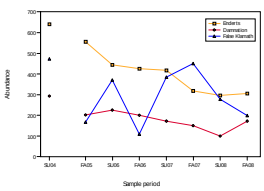


Figure 4. Size distributions of turban snails at RNSP intertidal sites. Width of bar represents relative abundance of each size class.

Since 2004, the abundance of ochre sea stars has declined at Enderts, and, to a much lesser extent, at Damnation Creek (Figure 5). Abundances have also changed at False Klamath Cove, but there is no apparent pattern.



Ochre sea star (*Pisaster ochraceus*)

Figure 5: Changes in Ochre sea star abundances at three intertidal sites. Data collected in Summer (SU) and Fall (FA) of each year.

Temperature probes deployed at the sites record daily changes in sea surface temperature (Figure 6). Such data allow us to link variations in oceanographic conditions to changes in community structure.

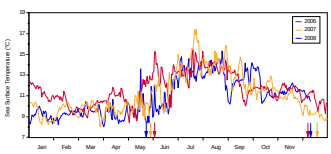


Figure 6: Sea surface temperature recorded at RNSP sites between 2006-2008. Arrows denote timing of intertidal sampling trips.

SUMMARY

Long-term monitoring studies provide important information not only about the current state of populations and communities, but also about whether and how much they change over time. With a comprehensive, field-tested protocol, two years of data collected during the protocol development phase (2004 and 2005), and three years of full project implementation (2006-2008), the rocky intertidal monitoring program at RNSP is off to a successful start. Our findings will be applied toward ocean conservation through public outreach, and influence of management and policy. Future Marine Protected Area development?

For more information on monitoring efforts see
http://piscoweb.org and
http://www.marine.gov

Acknowlegements

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