



Monitoring Alcatraz Island's Rocky Intertidal Zone

Importance: *Monitoring the rocky intertidal zone on Alcatraz can help alert scientists when something is awry above or below the waterline in the San Francisco Bay.*

In the center of the San Francisco Bay, Alcatraz Island is bordered by a rocky shoreline that hosts a wide variety of specially adapted intertidal plants and animals. Changing tides where the land and sea meet expose the inhabitants of Alcatraz's rugged coast to powerful terrestrial and marine forces. As a result, the Island's rocky intertidal ecosystem is uniquely vulnerable to changes in both marine and terrestrial environmental conditions. Long-term monitoring of the Alcatraz rocky intertidal zone was initiated in 1989 to help the National Park Service (NPS) understand the natural variability and composition of the intertidal community. Monitoring also serves to document when and how the intertidal community is affected by events like sudden oil spills or steady climate change.



Mason Cummings, NPS

Figure 1. With the city of San Francisco as a backdrop, an NPS researcher counts snails and limpets in a long-term intertidal monitoring plot on Alcatraz Island.

Monitoring Program: *Each year, the NPS San Francisco Bay Area Inventory and Monitoring Program (SFAN) records the status of intertidal organisms in a series of permanent plots.*

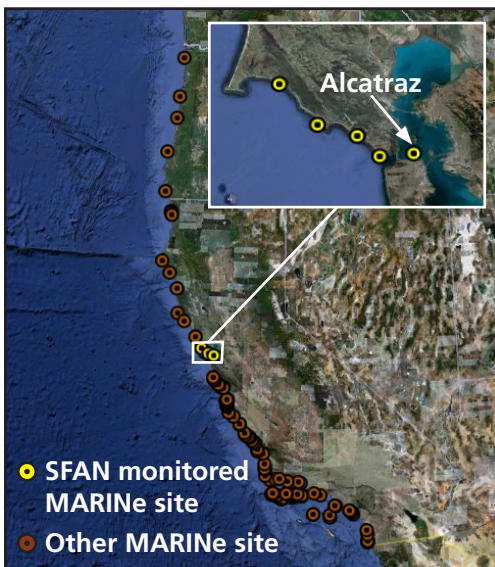


Figure 2. Rocky intertidal sites monitored with the MARINE protocol. Alcatraz is one of five MARINE sites monitored by SFAN.

The NPS set up a series of 15 rectangular (0.5m x 0.75m) photo plots and two linear seastar transects in the Alcatraz intertidal zone in 1989. These plots and transects are still being monitored today. Although monitoring regimes have changed somewhat over the years, monitoring is now done once a year in the fall to avoid disturbing the seabirds that nest on Alcatraz from late winter to late summer. On days with sufficiently low tides, biologists find and photograph each of the plots. Key species in the plot are identified and recorded, and in smaller subsections of each plot, the motile (or mobile) invertebrates such as snails, limpets, and crabs are counted and measured (Figure 1). To monitor seastars, researchers count, measure, and identify all seastars within one meter of the two established linear transects.

Back in the office, the photographs are examined to determine how much of each plot is covered by various species of algae or sessile (immobile) invertebrates like mussels and barnacles.

The specific monitoring protocol currently in use on Alcatraz was adopted in 2006 from the Multi-Agency Rocky Intertidal Network (MARINE - www.marine.gov). Using the MARINE protocol allows data collected on Alcatraz to be compared to more than 115 other monitoring sites along the West Coast (Figure 2).

Status and Trends: Rapid changes in Alcatraz's rocky intertidal zone were especially evident in the aftermath of the COSCO Busan oil spill.

On November 7, 2007, a container ship called the COSCO Busan struck a tower of the Bay Bridge spilling more than 50,000 gallons of oil into the San Francisco Bay. Alcatraz's tidepools and their inhabitants were heavily oiled (Figure 3). Since researchers were already monitoring the Alcatraz's coast prior to the spill, they were able to quantify the oil's effects on the intertidal community.

NPS monitoring prior to the spill revealed that rockweed (*Fucus gardneri*, a brown alga) was a dominant species in the Alcatraz intertidal zone (Figures 4a & 5). A MARINE biodiversity survey one year after the oil spill revealed a decrease in long-lived species like California mussels (*Mytilus californianus*) and rockweed. At the same time, NPS biologists recorded an increase in bare rock and opportunistic, ephemeral colonizers like barnacles and sea lettuce (*Ulva spp.*, a green alga) (Figures 4b & 5). These changes were greater than the natural variation between monitoring years established by years of NPS data collection on Alcatraz.



Figure 3. A lined shore crab (*Pachygrapsus crassipes*) on Alcatraz is covered in oil from the 2007 COSCO Busan oil spill.



Figure 4a. East-facing panorama of the Alcatraz rocky intertidal community in 2005, pre-spill. In the years before the COSCO Busan oil spill, rockweed (inset) was the dominant species of algae on Alcatraz.

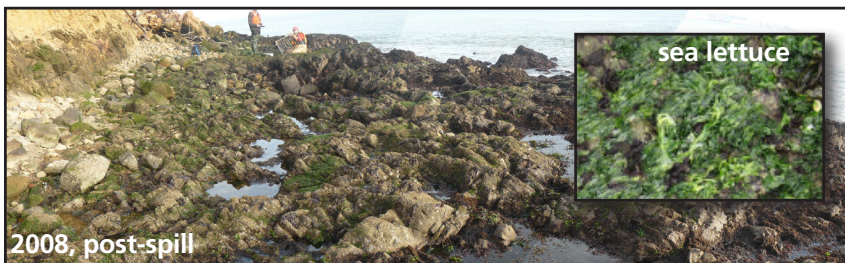
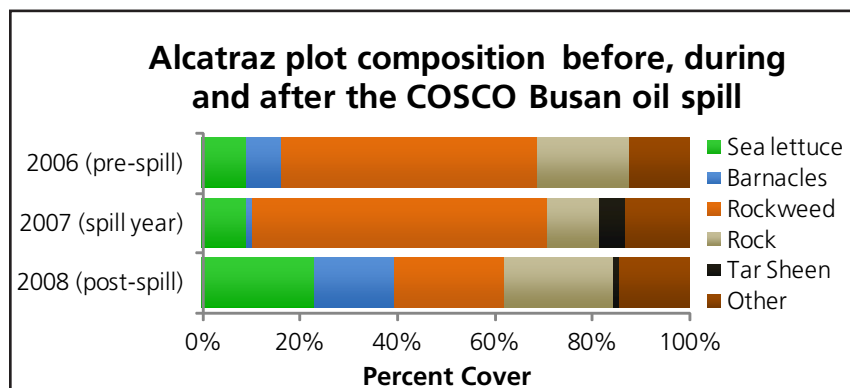


Figure 4b. East-facing panorama of the Alcatraz rocky intertidal community in 2008, post-spill. Notice the abundance of sea lettuce (inset), an opportunistic species that colonizes disturbed areas, often serving as an indicator of high pollution levels.



To be sure the oil spill was the culprit and not an unknown regional event, scientists also compared the changes that took place in the Alcatraz rocky intertidal community between 2006 (pre-spill) and 2008 (post-spill) with changes that took place at other MARINE monitoring sites in the region that were not oiled. No other site exhibited such differences between years.

Long term data sets such as those at Alcatraz provide an invaluable resource for NPS resource managers who must understand the mechanisms of community change (both natural and man-made) to make appropriate management decisions.

For More Information:

For more information on Rocky Intertidal monitoring in Bay Area National Parks, contact Aquatic Ecologist Darren Fong at darren_fong@nps.gov.

For more information on the Bay Area National Parks' intertidal ecosystems, visit www.sfnps.org/intertidal.

Summary written by Jessica Weinberg.

Figure 5. The percent cover of species or substrates making up Alcatraz's permanent monitoring plots before, during and after the oil spill. Post-spill there was an increase in bare rock and ephemeral species, and a decrease in long-lived rockweed.