

Greater Farallones National Marine Sanctuary

Ocean Acidification: Rocky Intertidal Habitats

Management Issue

Global climate change has caused carbon dioxide (CO₂) levels and acidification of the ocean's waters to increase at an alarming rate, posing a serious threat to the health of ocean ecosystems. In order to develop adaptive management actions that will incorporate impacts from ocean acidification to the rocky intertidal habitats of Greater Farallones National Marine Sanctuary (GFNMS or Sanctuary) and the northern portion of Monterey Bay National Marine Sanctuary (MBNMS), data from existing long-term monitoring programs must be analyzed with respect to ocean acidification and current research gaps must be filled.

Description

The ocean plays a critical role in maintaining and balancing the amount of carbon dioxide that remains within Earth's atmosphere. Ocean acidification poses a serious threat to the health of the oceans habitats. As concentrations of CO₂ increase in the ocean, a decrease in the calcium carbonate saturation state occurs leading to less calcium carbonate production in some marine organisms. The consequences of a reduction in shell-forming animals and algae containing calcium carbonate can ultimately lead to shifts in ecosystem structure and dynamics, altering biological production and marine food webs. Locally, affected intertidal species include barnacles and mussels, and calcium carbonate-forming algae. A decline in these organisms will cause declines in seabirds, shorebirds, and marine mammals that forage on these species, as well as disrupt sport and commercial harvests. It is important for GFNMS management to understand the status of our rocky reefs on local and regional scales, in order to provide fully informed restoration and mitigation protection measures and designed restoration projects, keeping in mind the rise in sea level, the potential decrease in some invertebrate organisms, and increase in some marine algae organisms.



Intertidal monitoring tracks shifts in ranges. Monitoring will detect if the Anthopleura sola anemone range shifts northward. Photo credit: GFNMS

Questions and Information Needs

- 1) What are the predictions of impacts to temperate rocky reefs and rocky intertidal habitats from ocean acidification?
- 2) Are we currently seeing changes in distribution, abundance or diversity in rocky intertidal organisms?
- 3) Are rocky intertidal invertebrates weakened due to reduced ability to calcify? Are rocky intertidal invertebrates more vulnerable to predations from foraging shorebirds and seabirds? What are the past and current levels of predation from shorebirds, on rocky intertidal invertebrates? How have these rates changed over time?
- 4) How do the densities and percent coverage of calcifying (CaCO₃ containing) organisms at the Farallon Islands compare to other areas, e.g. nearby mainland, northern and southern island habitats?
- 5) How do changes in pH levels affect growth and reproduction in calcifying rocky intertidal species?
- 6) What are adaptive management actions that can be taken now in order to increase effectiveness of restoration and mitigation projects?
- 7) What are the socio-economic impacts of changes in extraction or disturbance regulations of calcifying rocky intertidal species?
- 8) What are additional monitoring parameters that specifically assess ocean acidification and that can be incorporated into existing long-term monitoring programs?
- 9) What impacts will ocean acidification have on sanctuary rocky intertidal ecosystems?
- 10) How do changes in pH levels affect growth and reproduction in calcifying organisms of rocky intertidal habitat?
- 11) How does density and percent cover of calcifying organisms at the Farallon Islands compare with other sites (e.g. nearby mainland sites)?

Updated: 5/1/2010

For More Information -- <http://www.sanctuaries.noaa.gov/science/assessment>

Scientific Approach and Actions

- Catalogue the rocky intertidal calcifying organisms and determine appropriate species for long-term study
- Review rocky intertidal species inventory and identify introduced species and calcifying species . Continue to collect monitoring data to identify linkages between introduced species and ocean acidification
- Develop and implement a monitoring program targeting influences from global climate change
- Compare GFNMS's 17-year rocky intertidal data with partner data sets from other rocky intertidal areas
- Integrate current web enabled databases for rocky intertidal habitats, e.g. PISCO and/or MARINE, to specifically analyze density and distribution changes of organisms potentially disrupted by ocean acidification

Key Partners and Information Sources

NOAA's Pacific Marine Environmental Laboratory, NCCOS, University of California, Bodega Marine Laboratory, National Park Service; Partnership for Interdisciplinary Studies of Coastal Ocean (PISCO); Multi-Agency Rocky Intertidal Network; United States Fish and Wildlife Service; PRBO Conservation Science; University of Washington, Humboldt State University; Stanford University, Hopkins Marine Station, West Coast Region LiMPETS, Tenera Inc; Sonoma State University; San Francisco State University; California Ocean Protection Council; and Ocean Science Trust Monitoring Enterprise

Management Support Products

- Interpretive, web enabled maps on Google Earth through the SIMoN MPA Monitoring map and CeNCOOS platforms, to better track species, abundance and distribution, and comparisons to historic data
- Provide habitat characterization with substrate and intertidal characteristics and quantification
- Web enabled biological database of species composition density and percent cover of calcifying organisms, Database will be used to track trends and distributional changes
- Database of monthly average sea surface temperature, salinity, pH, alkalinity, wind stress, and upwelling index, within defined areas relative to waters near MPA's sanctuary rocky intertidal areas
- Trend analysis of organisms potentially disrupted by ocean acidification
- Maps and web enabled biological database showing spatial change of affected intertidal organisms
- Document prescribing adaptive management actions, predicted results, and reviews the socio-economic impacts of changes in the extraction or disturbance regulations of calcifying rocky intertidal species
- Assessment of potential effectiveness of future restoration projects

Planned Use of Products and Actions

- Disseminate information on ocean acidification and develop recommendations for minimizing CO₂ inputs
- Inform stakeholder community how calcifying species are affected by ocean acidification
- Develop adaptive management actions to help alleviate the consequences of ocean acidification
- Compare the health of calcifying organisms found in mainland and Farallon Island rocky intertidal areas. Determine if additional protection for mainland sites is warranted
- Develop recommendations for restoration or mitigation projects as compensation from anthropogenic damages
- Develop adaptive management actions to adjust management zones, boundaries and regulations

Program References

GFNMS Management Plan

STRATEGY FA-1: Develop an ecosystem characterization of the sanctuary

STRATEGY CS-4: Develop and implement sanctuary ecosystem assessment and monitoring programs

STRATEGY CS-5: Complete characterization of sanctuary biological and physical features.

STRATEGY IS-3: Develop a monitoring program to detect and monitor introduced species

GFNMS Condition Report

The following Condition Report questions lack sufficient information to determine status or trend of resources:

- What are the levels of human activities that may influence water quality and how are they changing?
- What is the condition of biologically structured habitats and how is it changing?
- What is the status of key species and how is it changing?

ONMS Performance Measures

- Number of sites in which select living marine resources, are being maintained or improved.
- Number of sites in which select habitat, based on long term monitoring data, is being maintained or improved.
- Number of sites in which water quality, based on long term monitoring data, is being maintained or improved

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