Fagatele Bay National Marine Sanctuary

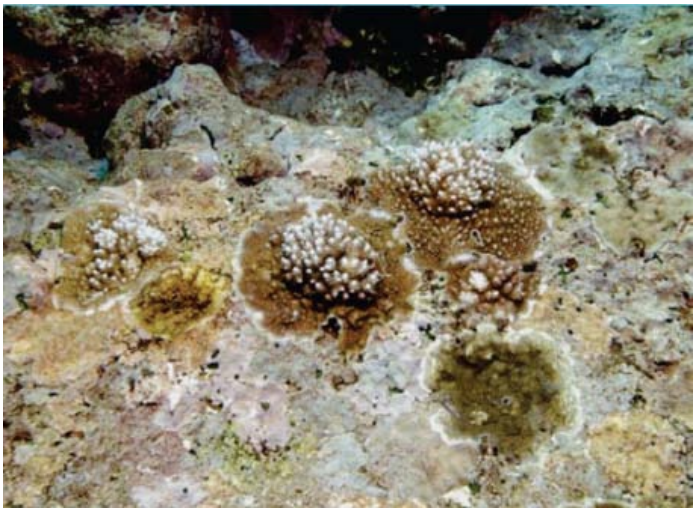
Climate Change: Ocean Acidification

Management Issue

Climate change and the associated phenomena of ocean acidification are predicted to affect physical oceanographic and biogeochemical processes within the Fagatele Bay National Marine Sanctuary (FBNMS or Sanctuary). Specifically, ocean acidification is likely to change aragonite and calcite concentrations in the Sanctuary and potentially impact wide array of calcareous organisms. Potential impacts and the likely responses and recovery of organisms in the Sanctuary need to be studied.

Description

The threat of ocean acidification is real. As CO_2 diffuses into the ocean, the pH will decrease and this will likely make it more difficult for calcifying organisms to calcify and may even lead to calcified carbonate dissolution. An entire gambit of organisms are composed of and produce calcium carbonate structures including stony corals, crustose coralline algae, mollusks, echinoderms and calcifying macroalgae. Stony corals, crustose coralline algae and giant clams are all major reef building organisms and calcifying macroalgae can contribute substantially to sand production. Ocean acidification not only threatens to reduce the growth of these organisms but it threatens to reduce the growth and dynamics of the entire coral reef ecosystem including dissolution of the physical substrate.



Coral recruits growing on coralline algae on a large dead table coral. Photo credit: Richard Murphy, Ocean Futures Society

The physical structure of the reefs of the sanctuary are almost entirely comprised of calcium carbonate substrate. It is suspected that the ecological features of coral reefs may experience the first impacts of ocean acidification, and therefore it is important to monitor for these effects. It is also suspected that the calcite form of calcium carbonate (that calcifying marine algae have) may be more sensitive to ocean acidification than the aragonite forms that corals use, and so it is necessary for calcifying algae to be carefully monitored as well.

Questions and Information Needs

1) How could ocean acidification affect the ecosystem as a whole?

2) What options are available to managers to address and potentially mitigate ocean acidification in the sanctuary?

3) Which calcifying organisms are most severely affected by acidification?

4) What characteristics of a specific geographic area confer variability in pH and thus confer resistance or susceptibility to ocean acidification?

5) How does ocean acidification affect giant clam shell formation, growth and dissolution?

6) What is the seasonal and diel pH variability in the sanctuary?

Scientific Approach and Actions

- Identify areas that are generally more sensitive to ocean acidification to ensure that they are monitored
- Identify species and habitats within marine ecosystems that are highly vulnerable to ocean acidification
- Complete a vulnerability assessment of village communities in American Samoa to identify vulnerable reef dependent human communities
- Make regular measurements of pH and diel respiration
- Monitor the ecological impacts of acidification including benthic habitat dynamics, trophic interactions, habitat loss and disease
- Identify, develop and test intervention measures to reduce synergistic stress ocean acidification
- Implement and monitor possible intervention measures which reduce the impact of ocean acidification on coral reef ecosystems
- Develop models that predict acidification for each coastal area of the sanctuary
- Facilitate and support the development of ecosystem models
- Monitor the socioeconomic correlation to loss of resources by acidification and its impact to the ecosystem.

Key Partners and Information Sources

Hawai'i Institute of Marine Biology; NOAA/NMFS/PIFSC/Coral Reef Ecosystems Division; NOAA/NMFS/PIFSC/CRED/Pacific Benthic Habitat Mapping Program; NOAA/NMFS/Pacific Islands Fisheries Center; NOAA/NOS/National Center for Coastal Ocean Science; NOAA/NMFS/PIRO, US Fish and Wildlife Service; US Geological Survey/Biological Resources Division; USGS/BRD/National Biological Information Infrastructure/Pacific Basin Information Node; Territorial Government of American Samoa, American Samoa Department of Marine and Wildlife Resources, The National Park Service of American Samoa

Management Support Products

- Report characterizing areas and species that are particularly sensitive to ocean acidification
- Data record on long term monitoring of coral pH and calcifying organism calcification rates
- Report of vulnerable reef dependent human communities in American Samoa
- An index of natural baseline pH variation related to biogeochemical cycling
- Ecosystem and pH prediction models
- Socioeconomic study of loss of resources by ocean acidification
- Toolkit of mitigation of contingency strategies
- Maps of particularly sensitive areas

Planned Use of Products and Actions

- Use data collected and analytical results from research to develop or enhance education and outreach products
- Utilize research results to inform management and implementation of the Marine Conservation Science
- Restrict activity in sensitive areas
- Mitigation options identified by scientific activities will be considered for action
- Create areas with elevated protection based on identifying "sensitive" areas (e.g. limiting permits)

Program References

FBNMS Management Plan

- Action Plan 4.1 Marine Conservation Science
  - Strategy MCS-5: Continue to enhance research and monitoring programs
- Action Plan 5.1 Climate Change
  - Strategy CC-2: Identify and implement strategies to maximize the resiliency of coastal and marine resources to potential climate change impacts at National Marine Sanctuary sites in American Samoa.
  - Strategy CC-3: Conduct and facilitate targeted research and monitoring efforts to respond to the effects of climate change impacts at National Marine Sanctuary sites in American Samoa.

FBNMS Condition Report

- These activities will support questions 1, 4, 5-9, 11-14