

# Papahānaumokuākea Marine National Monument

## Climate Change – Ocean Acidification

### Management Issue

Global climate change is linked to increasing amounts of carbon dioxide in the atmosphere. This affects the chemical makeup of seawater resulting in ocean acidification, which can cause detrimental effects on calcifying marine organisms such as corals and coralline algae, thereby threatening the extensive reef habitats of the Papahānaumokuākea Marine National Monument (PMNM or Monument).

### Description

Atmospheric carbon dioxide is rising at an unprecedented rate. The ocean absorbs approximately one-third of all carbon dioxide from the atmosphere, resulting in changes to the chemical composition of the ocean. Marine organisms that incorporate calcium carbonate into their make-up are being adversely affected by these changes in ocean chemistry. Impacts include slower growth rates, weaker skeletons, increased susceptibility to erosion, malformations, and in the most severe scenarios, dissolution of their skeletons. Ocean acidification over the next century is projected to affect calcifying organisms in both shallow and deep waters, including corals, plankton, and coralline algae. Managers need to understand the processes and impacts of ocean acidification to better plan for the future of reef systems in the Monument.



*Hard corals and coralline algae, the major reef building components in the NWHI, are negatively affected by variations in pH and are at risk of decreased growth rates with changes in ocean chemistry. Photo credit: James Watt*

### Questions and Information Needs

- 1) How does a carbonate reef affect the surrounding sea water?
- 2) What are the fluctuations of sea water inside the atoll lagoons?
- 3) What measures are available to managers to address or mitigate CO<sub>2</sub> emissions?
- 4) How are calcifying organisms affected by acidification?
- 5) Which calcifying organisms are most severely affected by ocean acidification?

### Scientific Approach and Actions

- Develop a baseline of the carbonate chemistry of the waters surrounding the atolls
- Examine the bathymetry of the atolls to understand how bathymetry influences carbonate chemistry
- Conduct literature reviews for new methods of researching carbonate chemistry and ocean acidification
- Examine the three carbon system parameters (dissolved inorganic carbon, pH, and total alkalinity) in the Monument
- Facilitate and support the development of ecosystem models

*Updated: September 2014*

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

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### Potential Key Partners and Information Sources

Hawai'i Pacific University; NOAA/Pacific Marine Environmental Lab; NOAA/NMFS/Coral Reef Ecosystems Division; NOAA/NMFS/Pacific Islands Fisheries Center, Coral Reef Ecosystem Division; Native Hawaiian Cultural Practitioners; US Fish and Wildlife Service; State of Hawai'i

### Management Support Products

- Develop carbonate chemistry footprint for each atoll including currents, eddies and prevailing winds
- Establish how far into the open ocean the effects of a carbonate bank can be measured
- Draft scientific papers and reports
- Present at scientific meetings, workshops, symposia and conferences
- Develop education and outreach products to inform the general public about ocean acidification issues
- Identify sensitive areas (e.g. slow growing corals, decreased water movement, etc.)

### Planned Use of Products and Actions

- Create areas with elevated protection based on identifying “sensitive” areas (e.g. limiting permits)
- Coordinate meetings for updates with researchers, both locally, within the sanctuary system and abroad
- Use materials and information gathered during research expeditions to PMNM to develop education and outreach products that raise awareness about ocean acidification

### Program References

#### PMNM Management Plan

- Action Plan 3.2.3 Habitat Management and Conservation
  - o Strategy HMC-1: Within 15 years, develop and implement a strategy for restoring the health and biological diversity of the shallow reefs and shoals where anthropogenic disturbances are known to have changed the ecosystem.
- Action Plan 3.1.1 Marine Conservation Science
  - o Strategy MCS-1: Continue and expand research, characterization and monitoring of marine ecosystems for the life of the plan.
- *Links to other Action Plans:*
  - o 3.5.1 - Agency Coordination
  - o 3.6.2 - Information Management
  - o 3.6.3 - Coordinated Field Operations

#### PMNM Condition Report

- Ocean acidification may be a factor in response to Question 1.

#### Other Documents

- Links to Monument Goals 1, 2, and 5

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