



## **Coral Adaptations at National Park of American Samoa**

Project Title: Unique Coral Adaptations to Environmental Stressors at National Park of American Samoa

Brief Summary (Abstract):

Ofu Lagoon, part of the National Park of American Samoa (NPSA), contains a healthy coral reef habitat that supports a diversity of species. The park is working with university partners to understand the unique adaptations of the coral in Ofu Lagoon to multiple environmental stressors associated with climate change.

Project Location: National Park of American Samoa

Partners: Territorial government agencies.

Background:

The coral reefs in and around NPSA support over 975 fish species, more than 250 coral species, and a high diversity of invertebrates. Disturbances such as cyclones are expected to increase with climate change, but the principal threat to coral reefs is global warming, which increases nearshore water temperatures and, in turn, increases coral disease and coral bleaching events. Coral reefs within NPSA and worldwide are expected to experience substantial mortality, up to 90% loss by the end of the century. Ocean acidification, which is caused by increased levels of carbon dioxide in the atmosphere, also weakens coral.

The corals in Ofu Lagoon are healthy despite experiencing multiple environmental stressors including high daily temperatures (regularly exceeding 31°C [88°F]) and large fluctuations in temperature (range of 4.4°C [8°F]), pH (varying by more than 0.5 units of pH), and dissolved oxygen (from 50% to 200%). In 2002 and 2003, increased water temperatures caused extensive coral bleaching, an event in which the heat-stressed coral polyps expel their tan-colored symbiotic zooxanthellae, causing coral to look white or “bleached.” Surprisingly, the corals in Ofu Lagoon experienced less bleaching than other nearby reefs. Interestingly, although the Ofu Lagoon corals are better adapted to the lagoon environment than corals transplanted from other reefs in American Samoa, they do not fare as well when they are transplanted to areas outside the lagoon.

This unique tolerance to high temperatures and other stressors provides an opportunity to better understand coral resilience and the implications for the health of corals worldwide; to identify areas of reefs in Samoa that would benefit most from protection and conservation; and perhaps to use these corals to reseed areas where corals have been lost to climate change impacts.

Project Goals:

Strategy Goals Implemented:



This project is ongoing and is an example of the following adaptation strategies:

- Incorporating climate change into policies, plans, and regulations
- Reducing non-climate stressors (e.g. destructive fishing practices)
- Coordinating planning and management across institutional boundaries
- Increasing/improving public awareness, education, and outreach efforts
- Conducting/gathering additional research, data, or products

#### Climate Impacts Addressed:

The park works closely with territorial government agencies and advisory groups to develop solutions to concerns related to coral reef health and expected impacts of climate change. This is not only an effective collaboration but it is also necessary, because the park leases rather than owns the lands and waters within its boundaries, and so must negotiate management plans and actions with traditional landowners and village councils in addition to American Samoa government agencies.

To study and support research on this unique coral reef system, the park operates a laboratory facility on the island of Ofu. This facility supports park and university researchers, and includes an experimental coral tank system that the park designed and built to study the effect of temperature shifts on living coral. Local Samoan interns provide field assistance and monitor experiments while researchers are away.

Results from recent research indicate that heat tolerance derives from both the coral polyps and also from their symbiotic photosynthesizing zooxanthellae. The gene expression of heat-sensitive corals can change in response to heat stress, but the most resilient corals in the Ofu lagoons already have those thermal tolerance genes 'turned on'. Additionally, the zooxanthellae in Ofu corals are of four different genotypes, or clades; the corals with clade D were found to be more resilient to heat stress but less tolerant of cooler waters in comparison to coral with other clades. Over time, selection for the thermal tolerance gene expression and the clade D zooxanthellae may allow coral reefs to adapt to higher temperatures and fluctuations. This appears to already have occurred in Pool 300 in the NPSA section of the Ofu reef lagoon, making these corals some of the most heat tolerant known.

Related studies conducted near NPSA found that discharging cooler water onto heat-stressed reefs could speed and sustain recovery from coral bleaching events. Furthermore, UV-protection from shade cloth improved coral health. The park is conducting baseline studies of corals within park waters; data will allow comparison with future coral cover. The NPS Pacific Islands Network Inventory and Monitoring Program also provides water quality data and natural resources inventories for NPSA.

Results of these studies help the park in planning long-term management efforts, such as identifying new candidates for marine protected areas. It would be most effective to target areas that are expected

to have higher resiliency to climate change provided that other locally-controlled stressors (such as destructive fishing practices) are reduced; examples include shaded areas at the base of cliffs, and reef edges that experience cold-water upwelling events. Although actions such as shading and cool-water discharge would not allow coral to adapt to changing conditions nor would it slow climate change, these strategies could be implemented for short-term solutions, such as briefly protecting small areas of reef, while longer-term management decisions are resolved.

In addition to working with agencies and community groups on broad efforts to protect island reefs and other natural and cultural resources, the park has also developed educational outreach programs focusing on how to minimize individual contributions to climate change.

Status of Project Implementation (Timeline, Milestones, Next Steps):

Project Outcomes:

Funding Sources: NPS

Photos/Attachments:



T  
re  
lifts a crate of coral samples from Ofu lagoon. Bottom:  
Local NPS interns Sui Fautua and Vano Alosio take water  
samples while assisting visiting researchers. Image credit:  
NPS.